

**UNITED STATES
SECURITIES AND EXCHANGE COMMISSION**

WASHINGTON, DC 20549

**Amendment No. 1
to**

FORM S-1

**REGISTRATION STATEMENT
UNDER THE
SECURITIES ACT OF 1933**

YIELD10 BIOSCIENCE, INC.

(Exact Name of Registrant as Specified in Its Charter)

Delaware

(State or other jurisdiction of incorporation or organization)

2870

(Primary Standard Industrial Classification Code Number)

04-3158289

(I.R.S. Employer Identification Number)

**19 Presidential Way
Woburn, Massachusetts 01801
(617) 583-1700**

(Address, including zip code, and telephone number, including area code, of registrant's principal executive offices)

**Dr. Oliver P. Peoples
President & Chief Executive Officer
Yield10 Bioscience, Inc.
19 Presidential Way
Woburn, Massachusetts 01801
(617) 583-1700**

(Name, address, including zip code, and telephone number, including area code, of agent for service)

Copies to:

Megan N. Gates, Esq. Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C.
One Financial Center Boston, Massachusetts 02111 (617) 542-6000

Michael F. Nertney, Esq. Ellenoff Grossman & Schole LLP 1345 Avenue of
the Americas New York, New York 10105 (212) 370-1300

Approximate date of commencement of proposed sale to the public: As soon as practicable after this registration statement becomes effective.

If any of the securities being registered on this Form are to be offered on a delayed or continuous basis pursuant to Rule 415 under the Securities Act of 1933 check the following box.

If this Form is filed to register additional securities for an offering pursuant to Rule 462(b) under the Securities Act, please check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering.

If this Form is a post-effective amendment filed pursuant to Rule 462(c) under the Securities Act, check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering.

If this Form is a post-effective amendment filed pursuant to Rule 462(d) under the Securities Act, check the following box and list the Securities Act registration statement number of the earlier effective registration statement for the same offering.

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	<input type="checkbox"/>	Accelerated filer	<input type="checkbox"/>
Non-accelerated filer	<input checked="" type="checkbox"/>	Smaller reporting company	<input checked="" type="checkbox"/>
		Emerging growth company	<input type="checkbox"/>

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 7(a)(2)(B) of the Securities Act.

CALCULATION OF REGISTRATION FEE

Title of each class of securities to be registered (1)	Proposed maximum aggregate offering price (1)(2)	Amount of registration fee ⁴
Class A Units consisting of:	\$ 5,200,000.00	\$ 674.96
(i) Shares of common stock, par value \$0.01 per share		
(ii) Warrants to purchase common stock		
Class B Units consisting of:	\$ 4,000,000.00	\$ 519.20
(i) Shares of Series A Preferred Stock, par value \$0.01 per share		
(ii) Shares of common stock issuable on conversion of Series A Preferred Stock (3)		
(iii) Warrants to purchase common stock		
Common stock issuable upon exercise of Warrants	\$ 10,580,000.00	\$ 1,373.28
Total	\$ 19,780,000.00	\$ 2,567.44

- (1) Estimated solely for the purpose of computing the amount of the registration fee pursuant to Rule 457(o) under the Securities Act of 1933, as amended (the "Securities Act").
- (2) Includes the price of additional shares of common stock and warrants to purchase shares of common stock that the underwriters have the option to purchase to cover over-allotments, if any.
- (3) No separate fee is required pursuant to Rule 457(i) under the Securities Act.
- (4) \$727.20 has been previously paid.

The Registrant hereby amends this registration statement on such date or dates as may be necessary to delay its effective date until the Registrant shall file a further amendment which specifically states that this registration statement shall thereafter become effective in accordance with Section 8(a) of the Securities Act of 1933, as amended, or until the registration statement shall become effective on such date as the Securities and Exchange Commission, acting pursuant to said Section 8(a), may determine.

THE INFORMATION IN THIS PROSPECTUS IS NOT COMPLETE AND MAY BE CHANGED. THE COMPANY MAY NOT SELL THESE SECURITIES UNTIL THE REGISTRATION STATEMENT FILED WITH THE SECURITIES AND EXCHANGE COMMISSION IS EFFECTIVE.

SUBJECT TO COMPLETION, DATED OCTOBER 11, 2019

PRELIMINARY PROSPECTUS



YIELD10 BIOSCIENCE, INC.

6,557,377 Class A Units consisting of one share of common stock and one warrant and
4,000 Class B Units consisting of one share of Series A Preferred Stock and warrants (and 19,672,131 shares of common stock underlying shares of Series A Preferred Stock and warrants)

We are offering Class A Units, with each Class A Unit consisting of one share of common stock, par value \$0.01 per share (the "common stock"), and a warrant to purchase one share of our common stock (together with the shares of common stock underlying such warrants, the "Class A Units") at an assumed public offering price of \$0.61 per Class A Unit. Each warrant included in the Class A Units entitles its holder to purchase one share of common stock at an exercise price per share of \$[●].

We are also offering to those purchasers whose purchase of our Class A Units in this offering would result in the purchaser, together with its affiliates and certain related parties, beneficially owning more than 4.99% (or, at the election of the purchaser, 9.99%) of our outstanding common stock following the consummation of this offering, the opportunity to purchase, if they so choose, in lieu of the number of Class A Units that would result in ownership in excess of 4.99% (or, at the election of the purchaser, 9.99%), Class B Units. Each Class B Unit will consist of one share of our Series A Preferred Stock, par value \$0.01 per share (the "Series A Preferred Stock"), convertible into 1,639 shares of common stock and warrants to purchase 1,639 shares of our common stock (together with the shares of common stock underlying such shares of Series A Preferred Stock and such warrants, the "Class B Units" and, together with the Class A Units, the "Units") at a public offering price of \$1,000.00 per Class B Unit. The warrants included in each Class B Unit entitles the holder to purchase a number of shares equal to 100% of the common stock underlying each share of Series A Preferred Stock at an exercise price per share of \$[●].

The Class A Units and Class B Units have no stand-alone rights and will not be certificated or issued as stand-alone securities. The shares of common stock, Series A Preferred Stock and warrants comprising such units are immediately separable and will be issued separately in this offering. The underwriters have the option to purchase additional shares of common stock and/or warrants to purchase shares of common stock to cover over-allotments, if any, at the price to the public less the underwriting discounts and commissions. The over-allotment option may be used to purchase shares of common stock, or warrants, or any combination thereof, as determined by the underwriters, but such purchases cannot exceed an aggregate of 15% of the number of shares of common stock (including the number of shares of common stock issuable upon conversion of shares of Series A Preferred Stock) and warrants sold in the offering. The over-allotment option is exercisable for 45 days from the date of this prospectus.

We do not currently have a sufficient number of authorized shares of common stock to cover shares issuable upon exercise of the warrants being offered by this prospectus. As a result, before any warrants can become exercisable, we will seek stockholder approval of an amendment to our certificate of incorporation to implement an increase in the number of authorized shares of our common stock (the "Charter Amendment") at a special meeting of stockholders to be called for this purpose. While our board of directors will unanimously recommend that stockholders approve the Charter Amendment, we cannot assure you that we will be able to obtain the requisite stockholder approval of the Charter Amendment. The warrants will be exercisable on any day on or after the date on

which we publicly announce, through filing of a Current Report on Form 8-K, that we have sufficient authorized shares of common stock as a result of the Charter Amendment, and will expire five and one-half years after issuance.

Our common stock is listed on The Nasdaq Capital Market under the symbol "YTEN." On October 8, 2019, the last reported sale price for our common stock was \$0.6199 per share. All share and warrant numbers of the securities being offered included in this prospectus are based on an assumed public offering price per share of \$0.61 and an assumed conversion price of \$0.61 per share. The recent market price used throughout this prospectus may not be indicative of the final offering price. The final public offering price will be determined through negotiation between us and the underwriter based upon a number of factors, including our history and our prospects, the industry in which we operate, our past and a present operating results, the previous experience of our executive officers and the general condition of the securities markets at the time of this offering. We do not intend to apply for listing of the warrants offered hereby or the shares of Series A Preferred Stock on any securities exchange or trading system.

	Per Class A Unit	Per Class B Unit	Total
Public offering price ⁽¹⁾	\$ [●]	\$ [●]	\$ [●]
Underwriting discounts and commissions ⁽²⁾⁽³⁾⁽⁴⁾	\$ [●]	\$ [●]	\$ [●]
Proceeds, before expenses, to us	\$ [●]	\$ [●]	\$ [●]

- (1) The public offering price and underwriting discount corresponds to (x) in respect of the Class A Units (i) a public offering price per share of common stock of \$[●] and (ii) a public offering price per whole warrant of \$0.01 and (y) in respect of the Class B Units (i) a public offering price per share of Series A Preferred Stock of \$1,000.00 and (ii) a public offering price per whole warrant of \$0.01.
- (2) We have also agreed to reimburse the representative for certain expenses. See "Underwriting."
- (3) We have granted the representative an option, which is exercisable not later than 45 days after the date of this prospectus, to purchase a number of additional shares of common stock in an amount that is up to 15% of the number of shares of common stock sold in the primary offering (which number includes the number of shares of common stock issuable upon conversion of shares of the Series A Preferred Stock, but excludes any shares of common stock underlying the warrants issued in this offering, and any shares of common stock issued upon any exercise of the over-allotment option). These shares would be sold to the representative at the public offering price per share of common stock sold in the primary offering, less the underwriting discounts and commissions. Further, the option we have granted to the representative is also exercisable not later than 45 days after the date of this prospectus to purchase a number of additional warrants in an amount that is up to 15% of the warrants sold in the primary offering at the public offering price per warrant set forth on the cover page hereto (which is \$0.01 per warrant), less the underwriting discounts and commissions. The representative may exercise the option to cover over-allotments, if any, made in connection with this offering. If any additional shares of common stock and/or warrants are purchased from us under this over-allotment option, the representative will offer these shares of common stock and/or warrants on the same terms as those on which the other securities are being offered.
- (4) Underwriting discounts and commissions per Unit with respect to the sale of Units to the public will be 8% and underwriting discounts and commissions per Unit with respect to the sale of Units to certain Company investors and insiders will be 3%.

Delivery of the securities offered hereby is expected to be made on or about [●]

AN INVESTMENT IN OUR SECURITIES INVOLVES RISKS. SEE THE SECTION ENTITLED "RISK FACTORS" BEGINNING ON PAGE 9

Neither the Securities and Exchange Commission nor any state securities commission has approved or disapproved of these securities or determined if this prospectus is truthful or complete. Any representation to the contrary is a criminal offense.

Ladenburg Thalmann

The date of this prospectus is [●], 2019

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You should read this prospectus before making an investment in the securities of Yield10 Bioscience, Inc. See “Where You Can Find More Information” for more information. You should rely only on the information contained in this prospectus. The Company has not authorized anyone to provide you with different information. This document may be used only in jurisdictions where offers and sales of these securities are permitted. You should assume that information contained in this prospectus is accurate only as of any date on the front cover of the applicable document. Our business, financial condition, results of operations and prospects may have changed since that date. Unless otherwise noted in this prospectus, “Yield10 Bioscience,” “Yield10,” “the Company,” “we,” “us,” “our” and similar terms refer to Yield10 Bioscience, Inc.

Smaller Reporting Company – Scaled Disclosure

Pursuant to Item 10(f) of Regulation S-K promulgated under the Securities Act of 1933, as amended (the “Securities Act”), as indicated herein, we have elected to comply with the scaled disclosure requirements applicable to “smaller reporting companies,” including providing two years of audited financial statements.

PROSPECTUS SUMMARY

This summary highlights some information from this prospectus. It may not contain all the information important to making an investment decision. You should read the following summary together with the more detailed information regarding our Company and the securities being sold in this offering, including "Risk Factors" and other information incorporated by reference herein.

Business Overview

Yield10 Bioscience, Inc. is an agricultural bioscience company which uses its "Trait Factory" to develop high value seed traits for the agriculture and food industries. Specifically, Yield10 plans to efficiently develop superior gene traits for the major grain crops, including corn, soybean, canola, wheat and rice that will enable step-change increases in crop yield of at least 10-20 percent. While maintaining our focus on the development of novel yield traits for grain crops based on a licensing model, we have recently begun to execute the second part of our strategy which is to develop independent business opportunities for Yield10 in the specialty oils and niche crop space using the oilseed Camelina. The target of this effort is sustainable business solutions to support agriculture, global food production and other specialty applications. Yield10 brings a unique history, skill set and tools, captured in our **Gene Ranking Artificial Intelligence Network ("GRAIN")** platform for developing advanced crop traits and increasing the concentration of specific biochemicals of commercial interest in crops. Our plan is to develop a source of revenue from funded research and development collaborations for traits, products and crops not being directly pursued internally. The Company is currently engaged in a range of discussions with third parties with respect to different crops, traits and products in the feed, food and pharmaceutical sectors. Yield10 Bioscience is headquartered in Woburn, Massachusetts and has an oilseed development Center of Excellence in Saskatoon, Saskatchewan, Canada.

We are currently progressing several novel yield gene traits in our pipeline in the major North American row crops canola, soybean and corn, and the niche crop Camelina, among others. Camelina is an oilseed crop similar to canola, with significant upside potential as a source of edible oils and polyhydroxyalkanoate ("PHA") biomaterials. Our approach is to focus internal resources on progressing our traits through development and field trials in Camelina and canola while leveraging third party resources to progress our traits in soybean and corn while retaining control of our intellectual property. Over the last three years, we have evaluated certain of our traits in greenhouse studies and field tests conducted in the United States and Canada. We currently have non-exclusive research license agreements in place with the Crop Science division of Bayer AG, for the evaluation of our C3003 and C3004 traits in soybean and with Forage Genetics International, LLC, a division of Land O'Lakes, Inc. for the evaluation of five yield traits in forage sorghum. Our business strategy is to progress our traits into field tests to generate validating yield data. We have progressed our evaluation of C3003 in field tests with Camelina and canola and we are planning to expand our field tests with more C3003 canola events as well as additional traits in Camelina, canola and corn in 2019 and 2020. We plan to leverage data that we generate to support the performance of our traits in key crops to establish collaborations or to sign licenses to the traits with major agricultural companies in order to generate revenue.

According to a United Nations report, crop production must be increased by over 70 percent in the next 35 years to feed the growing global population, which is expected to increase from 7 billion to more than 9.6 billion by 2050. During that time period, there will be a reduction in available arable land as a result of infrastructure growth and increased pressure on scarce water resources. Consumption of meat, fish, and dairy products is also expected to increase based on dietary changes associated with increasing wealth and living standards. Harvestable food production per acre and per growing season must be increased to meet this demand. At the same time, with the increasing focus on health and wellness, food safety and sustainability in developed countries, we anticipate a rise in demand for new varieties of food and food ingredients with improved nutritional properties. With crop intensification (less land available and more production needed), we expect that improved crop genetics based on new gene traits will be a key driver of increased productivity, potentially resulting in the best performing yield traits commanding disproportionate value and disrupting the seed sector. We expect farmers and growers to be the major beneficiaries of these drivers, which represent potential opportunities for increased revenue and crop diversification. Today the global food market has an estimated value of \$5 trillion.

Exciting new genetic engineering technologies like the CRISPR technology and other approaches to genome editing hold promise to accelerate the deployment of novel traits into commercial crops. This method of making insertions or deletions of DNA into plants without the use of foreign DNA has been described as “precision breeding.” We signed a research license, with rights to convert to a commercial license, to CRISPR/Cas-9 technology in 2018 to support our genome editing program. We have taken two genome edited traits designed to boost oil content in oilseed crops through the U.S. Department of Agriculture (“USDA”)—Animal and Plant Health Inspection Service (“APHIS”) “Am I Regulated?” petitioning process and confirmed that the agency does not consider two of our lines to be regulated pursuant to 7 CFR part 340, clearing the way to conduct field tests in the United States. Genome editing technology as well as the streamlined regulatory process supported by USDA-APHIS for certain types of plant traits may enable agricultural innovators such as Yield10 to deploy and field test new traits more quickly, potentially resulting in a shorter path to market and reduced costs as compared to the more highly regulated path required for traditional biotechnology-derived traits.

Founded in 1992 as Metabolix, Inc., the Company was previously focused on redirecting carbon flow in living systems to produce bioplastics and biobased chemicals. In 1997, Metabolix started a crop science research program with the intent to produce polyhydroxybutyrate (“PHB”), a natural biomaterial produced in crops such as Camelina. The PHB biomaterial, which is chemically the simplest member of the PHA family, is potentially useful as a natural water treatment product and as a replacement for petroleum-based plastics. As we made progress on our crop program, we learned that the rate of carbon supply from photosynthesis was a bottleneck to the effective utilization of carbon, and we initiated a series of exploratory programs to develop new technologies to fundamentally increase the plants’ ability to fix and capture more carbon. These early research programs resulted in the establishment of our crop yield trait gene discovery platforms and the identification of a series of promising proprietary yield trait genes, even as the PHB biomaterial produced in Camelina remained interesting.

Based on challenges in the industrial biotechnology space and encouraging early results from these gene discovery programs, we refocused our crop science efforts to yield improvement in major food and feed crops in 2015 and rebranded the effort as Yield10 Bioscience (Yield10: increasing soybean and canola yields by 10 bushels per acre in North America could generate around \$10 billion in added value). In 2016, we sold our fermentation based biopolymers assets. In January 2017, we completed this transition and changed the name of the company to Yield10 Bioscience, Inc. Today, we are developing proprietary, breakthrough plant biotechnologies to improve crop productivity and seed yield in commercial crops for licensing to the major agricultural companies as well as new business opportunities focused on niche crop products based on our GRAIN proprietary discovery platform. The GRAIN platform is not only an important part of Yield10's discovery and development capabilities but has the potential to be leveraged as a source of near-term revenue.

Yield10 has a pipeline of more than 10 novel yield traits in research and development and we expect to generate several proof points for our traits in various crops over the next two years. We are developing our lead yield trait C3003 in canola and recently completed the second year of field tests of C3003 in Canada. Field tests are continuing in 2019 as we advance the trait towards commercial development by developing additional commercial canola lines (events) with the trait and expanding field testing. We are conducting our first field testing of C3004 in our Camelina platform in 2019 and are currently working to deploy and test this promising trait in canola and soybean, as well as in corn in the future. We have proven capabilities with genome editing using the CRISPR/Cas9 system and have been granted “non-regulated” status from USDA-APHIS for single and multiple genome edited lines of Camelina designed to increase oil content. In 2019, we are field testing these plant lines and plan to use the data to optimize the deployment of these traits to boost oil content in canola and potentially soybean. We recently successfully edited C3007, a novel target gene for increasing oil content, in canola and these plants are now progressing through our development pipeline. We are progressing initial development and testing of multiple traits in wheat and rice as a means to attract funded partnerships for these crops. Our approach is to engineer rice and wheat plants with our gene regulator traits to increase photosynthesis and grain yield and use those plants as a source of data to generate new gene targets for genome editing. Yield10 has no plans to field test or develop wheat or rice using traditional genetic engineering technologies. We anticipate that data generated on our traits will enable us to establish revenue generating collaborations in the future for the development and commercialization of our novel yield traits in commercial crops.

We are building a portfolio of intellectual property around our crop technologies and traits. As of June 30, 2019, we owned or held exclusive rights to 20 pending patent applications worldwide related to advanced technologies for increasing yield in crops and for increasing the oil content in oilseed crops. In June 2019, we filed a new patent on what we believe to be a breakthrough technology for sustainable low-cost production of PHB biomaterials in engineered oilseeds such as Camelina. Our portfolio of patent applications includes plant science technologies we have in-licensed globally and exclusively from the University of Massachusetts and North Carolina State University related to the yield trait gene C3003 and other advanced technologies based on advanced metabolic engineering methods to improve carbon capture and selectively control carbon partitioning in plants. Our portfolio of patent applications also includes advanced technologies for increasing oil content in oilseed crops such as Camelina and canola that we in-licensed globally and exclusively from the University of Missouri in 2018 and 2019 related to the yield trait genes C3007, C3010 and C3012.

One of the critical unmet needs in the agricultural sector is to increase the fundamental yield potential of crops to address global food security. This challenge is well suited to Yield10's unique background and expertise in metabolic modeling, genetic engineering, genome editing and next generation microbial gene systems which collectively form the foundation of Yield10's trait development process. We refer to this trait development process as the "Trait Factory." The Trait Factory encompasses discovery gene targets using our GRAIN platform, genetic engineering of crops using traditional approaches or genome editing to modify those targets, and generation of field data with the engineered crops. Performance and molecular data from the engineered crops are then fed back into the GRAIN system to enable refinement of specific gene targets and the identification of new trait gene targets. Modified crops with improved performance enter the development pipeline and progress on the regulated or non-regulated path to market depending on how the plants are genetically engineered. GRAIN is a powerful new tool developed primarily to focus on Yield10 trait targets including performance traits for major row crops including, corn, soybean, and canola as well as our niche product opportunities based on our Camelina platform. We believe we may also be able to generate additional revenue streams by providing access to our GRAIN platform for third parties interested in other trait targets and/or crops Yield10 is not pursuing.

Business Strategy

Our goal is to build a successful agricultural biotechnology company centered on demonstrating and capturing the value of our traits and technologies based on three potential revenue streams in major food and feed crops for licensing to established agricultural companies and building other revenue generating business from our new niche crop opportunities we have begun developing based on our patent protected technologies. These potential revenue streams consist of:

- Licensing of our yield and performance traits for use in major row crops;
- Product sales revenue from niche products produced in our Camelina platform and other oilseeds; and
- R&D revenue for access to our GRAIN trait gene discovery platform.

We have identified and are evaluating novel yield trait genes in our Trait Factory to help address the growing global yield gap in food and feed crops. As the primary driver of financial returns each season, crop yield is the key decision variable for farmers in making seed buying decisions, and as a result is critical to the seed industry. Improvements in yield to the levels targeted by Yield10, for example 10-20 percent increases, would be expected to generate significant value to the seed and crop industry. For example, Yield10 is targeting an approximately 10-20 percent increase in canola and soybean yields, which, if successfully deployed across North American acreage, could result in annual incremental crop value of up to \$10 billion. By ultimately increasing the output of major food and feed crops and potentially reducing strains on scarce natural resources, we believe that Yield10's technologies will also contribute to addressing global food security.

Recognizing the highly concentrated nature of the seed business, the prevalence of cross-licensing of traits, and the need to stack multiple crop traits in elite seed germplasm to provide the best options for farmers for large acreage commodity crops, Yield10 does not expect to become an integrated seed company. The current major seed companies dominate the biotech crop space based largely on the early technology innovations that resulted in herbicide and pest resistance traits and have a very successful operating track record in the sector. Yield10 plans to

develop yield traits that enable farmers to increase their revenue and secure a share of that added value. To do this Yield10 plans to license its trait innovations to the major agricultural companies so that they can be deployed in elite seed varieties. The licensing - incremental value sharing model is well established in the seed sector so we intend to seek industry collaborations and partnerships with the current seed industry participants.

Yield10 will focus on its core competency, which is breakthrough science and technology innovation directed at the development of performance traits for the seed sector and new niche product opportunities such as nutritional oils and PHA biomaterials utilizing our Camelina platform. One goal of our niche crop products is to enable a clear path to product based sales and revenue to complement our licensing strategy for major crops. Here we plan to take advantage of the progress we have made using our Camelina Fast Field Testing platform for identifying and validating yield and oil content traits for major row crops and our recent breakthrough technology for low cost PHA biomaterial production, which have a wide range of potential applications and markets including water treatment and replacements for petroleum plastics.

Risks Affecting Us

Our business is subject to a number of risks and uncertainties that you should understand before making an investment decision. For example, we have a history of net losses and our commercial products may not achieve commercial success. Furthermore, our technologies are in the early stages of development and we may never commercialize a technology or product that will generate meaningful, or any, revenues. A portion of our revenue to date has been from government grants. Over time, we expect our revenue to shift from being derived primarily from collaborations and government grants to royalties based on licensing of Yield10 traits and/or sales derived from niche crop products based on our technologies, but we may not be successful in achieving this transition. As of June 30, 2019, we had an accumulated deficit of \$356.1 million. With the exception of 2012, we have incurred losses since our inception. We expect to have significant losses and negative cash flow for at least the next several years, as we incur additional costs and expenses for the continued development of our technology, including the ongoing expenses of research, development, commercialization and administration. The Company held unrestricted cash and cash equivalents of \$4.2 million at June 30, 2019. Our present capital resources are not sufficient to fund our planned operations for a twelve month period, and therefore, raise substantial doubt about our ability to continue as a going concern. As a result, our independent registered public accounting firm included an explanatory paragraph in its report on our financial statements as of and for the year ended December 31, 2018 with respect to this uncertainty. Additional risks are discussed more fully in the section entitled "Risk Factors" following this prospectus summary. These risks include, but are not limited to, the following:

- We have a history of net losses and our future profitability is uncertain.
- We will be required to raise additional funds to finance our operations and remain a going concern; we may not be able to do so when necessary, and/or the terms of any financings may not be advantageous to us.
- Raising additional funds may cause dilution to our existing stockholders, restrict our operations or require us to relinquish rights to our technologies.
- We have recently changed our corporate strategy to focus on the crop science industry, and our technologies in this area are at a very early stage of development. We may never commercialize a technology or product that will generate meaningful, or any, revenues.
- A portion of our revenue to date has been generated from government grants; continued availability of government grant funding is uncertain and contingent on compliance with the requirements of the grant.
- Our government grants may subject us to government audits, which could expose us to penalties.
- Our crop science product development cycle is lengthy and uncertain and will depend heavily on future collaborative partners.

- Our crop science program may not be successful in developing commercial products.
- Even if we or our collaborators are successful in developing commercial products that incorporate our traits, such products may not achieve commercial success.
- We may not be successful using our Camelina platform to develop and commercialize niche crops to produce specialty oils and/or PHA biomaterials.
- Consumer and government resistance to genetically modified organisms may negatively affect the ability to commercialize crops containing our traits, as well as our public image.
- We may not be able to obtain or maintain the necessary regulatory approvals for our products, which could restrict our ability to sell those products in some markets.
- If ongoing or future field trials conducted by us or our collaborators are unsuccessful, we may be unable to complete the regulatory process for, or commercialize, our products in development on a timely basis.
- Competition in traits and seeds is intense and requires continuous technological development, and, if we are unable to compete effectively, our financial results will suffer.
- Our business is subject to various government regulations and if we or our collaborators are unable to timely complete the regulatory process for our products in development, our or our collaborators' ability to market our traits could be delayed, prevented or limited.
- The products of third parties or the environment may be negatively affected by the unintended appearance of our yield trait genes.
- We rely on third parties to conduct, monitor, support, and oversee field trials and, in some cases, to maintain regulatory files for those products in development, and any performance issues by third parties, or our inability to engage third parties on acceptable terms, may impact our or our collaborators' ability to complete the regulatory process for or commercialize such products.
- If we lose key personnel or are unable to attract and retain necessary talent, we may be unable to develop or commercialize our products under development.
- Patent protection for our technologies is both important and uncertain.
- Third parties may claim that we infringe their intellectual property, and we could suffer significant litigation or licensing expense as a result.
- Portions of our crop science technology are owned by or subject to retained rights of third parties.
- We may not be successful in obtaining necessary rights to additional technologies for the development of our products through acquisitions and in-licenses.
- The intellectual property landscape around genome editing technology, such as CRISPR, is highly dynamic and uncertain, and any resolution of this uncertainty could have a material adverse effect on our business.
- We rely in part on trade secrets to protect our technology, and our failure to obtain or maintain trade secret protection could harm our business.
- A material weakness was identified in our internal control over financial reporting, which could impact our business and financial results.

- Trading volume in our stock is low and an active trading market for our common stock may not be available on a consistent basis to provide stockholders with adequate liquidity. Our stock price may be extremely volatile, and our stockholders could lose a significant part of their investment.
- We may not be able to maintain the listing of our common stock on The Nasdaq Capital Market.
- Provisions in our certificate of incorporation and by-laws and Delaware law might discourage, delay or prevent a change of control of our company or changes in our management and, therefore, depress the trading price of our common stock.
- Concentration of ownership among our existing officers, directors and principal stockholders may prevent other stockholders from influencing significant corporate decisions and depress our stock price.

Our Corporate Information

We were incorporated in Massachusetts in 1992 under the name Metabolix, Inc. In September 1998, we reincorporated in Delaware. We changed our name to Yield10 Bioscience, Inc. in January 2017 to reflect our change in mission around innovations in agricultural biotechnology focused on developing disruptive technologies for step-change improvements in crop yield and niche crop products. Our corporate headquarters are located at 19 Presidential Way, Woburn, MA 01801, and our telephone number is +1 (617) 583-1700. Our website address is www.yield10bio.com. The information contained on our website or that can be accessed through our website is not part of this prospectus and investors should not rely on any such information in deciding whether to purchase our securities.

THE OFFERING

Issuer	Yield10 Bioscience, Inc.
Class A Units Offered	We are offering up to 6,557,377 Class A Units. Each Class A Unit consists of one share of common stock and a warrant to purchase one share of our common stock (together with the shares of common stock underlying such warrants).
Offering Price per Class A Unit	[\$●] combined price for each Class A Unit.
Class B Units Offered	We are offering up to 4,000 Class B Units to purchasers who prefer not to beneficially own more than 4.99% (or, at the election of the purchaser, 9.99%) of our outstanding common stock following the consummation of this offering. Each Class B Unit consists of (i) one share of Series A Preferred Stock, par value \$0.01 per share, convertible into a number of shares of common stock equal to \$1,000.00 divided by \$0.61 (the "Conversion Price") and (ii) a number of warrants to purchase 1,639 shares of our common stock, equal to 100% of the common stock underlying each share of Series A Preferred Stock (together with the shares of common stock underlying such shares of Series A Preferred Stock and such warrants).
Offering Price per Class B Unit	\$1,000.00 combined price for each Class B Unit.
Description of warrants	The warrants will have an initial exercise price per share equal to \$[●] per share, subject to appropriate adjustment in the event of recapitalization events, stock dividends, stock splits, stock combinations, reclassifications, reorganizations or similar events affecting our common stock. We do not currently have a sufficient number of authorized shares of common stock to cover shares issuable upon exercise of the warrants being offered by this prospectus. As a result, before any warrants can become exercisable, we will seek stockholder approval of an amendment to our certificate of incorporation to implement an increase in the number of authorized shares of our common stock at a special meeting of stockholders to be called for this purpose. While our board of directors will unanimously recommend that stockholders approve the Charter Amendment, we cannot assure you that we will be able to obtain the requisite stockholder approval of the Charter Amendment. The warrants will be exercisable on any day on or after the date on which we publicly announce, through filing of a Current Report on Form 8-K, that we have sufficient authorized shares of common stock as a result of the Charter Amendment, and will expire five and one-half years after issuance.
Description of Series A Preferred Stock	Each share of Series A Preferred Stock is convertible at any time at the holder's option into a number of shares of common stock equal to \$1,000.00 divided by the Conversion Price. Notwithstanding the foregoing, we shall not effect any conversion of Series A Preferred Stock, with certain exceptions, to the extent that, after giving effect to an attempted conversion, the holder of shares of Series A Preferred Stock (together with such holder's affiliates, and any persons acting as a group together with such holder or any of such holder's affiliates) would beneficially own a number of shares of our common stock in excess of 4.99% (or, at the election of the purchaser, 9.99%) of the shares of our common stock then outstanding after giving effect to such exercise. For additional information, see "Description of Capital Stock" on page 55 of this prospectus.
Shares of common stock underlying the warrants	13,114,754 shares

Common stock to be outstanding after this offering	19,052,108 shares
Series A Preferred Stock to be outstanding after this offering	4,000 shares
Over-allotment option	We have granted to the underwriters an option to purchase a number of additional shares of common stock in an amount that is up to 15% of the number of shares of common stock sold in the primary offering (which number includes the number of shares of common stock issuable upon conversion of shares of the Series A Preferred Stock, but excludes any shares of common stock underlying the warrants issued in this offering, and any shares of common stock issued upon any exercise of the over-allotment option). These shares would be sold to the underwriters at the public offering price per share of common stock sold in the primary offering, less the underwriting discounts and commissions. This option also allows the underwriters to purchase a number of additional warrants in an amount that is up to 15% of the warrants sold in the primary offering at the public offering price per warrant set forth on the cover page hereto (which is \$0.01 per warrant), less the underwriting discounts and commissions. This option is exercisable, in whole or in part, for a period of 45 days from the date of this prospectus.
Use of proceeds	We estimate that the net proceeds to us from this offering will be approximately \$7.1 million, assuming no exercise by the underwriters of their over-allotment option. We intend to use net proceeds from this offering for working capital and general corporate purposes.
Nasdaq Capital Market symbol	YTEN
Risk factors	Investing in our securities involves a high degree of risk. See “Risk Factors” on page 9 of this prospectus to read about factors that you should consider carefully before buying our securities.

The number of shares of common stock that will be outstanding after this offering is based on 12,494,731 shares outstanding as of June 30, 2019, and excludes the shares of common stock that may be issued under the warrants to be issued in this offering and also excludes:

- 2,446,082 shares of common stock issuable upon exercise of options to purchase our common stock outstanding as of June 30, 2019 at a weighted average exercise price of \$4.61 per share;
- 63,773 shares of common stock reserved as of June 30, 2019 for future issuance under our 2018 Stock Option and Incentive Plan;
- 570,784 shares of common stock issuable upon exercise of warrants issued pursuant to the Securities Purchase Agreement we entered into with certain investors on July 3, 2017 (which warrants became exercisable on January 7, 2018 at an exercise price of \$5.04 per share and expire on January 7, 2024);
- 30,000 shares of common stock issuable upon exercise of immediately vested warrants outstanding as of June 30, 2019 and issued to an investor relations consultant on September 12, 2017 at an exercise price of \$2.90 per share and which expire on September 11, 2024; and
- 6,439,000 shares of common stock issuable upon exercise of vested Series A warrants outstanding as of June 30, 2019 pursuant to the Securities Purchase Agreement we entered into with certain investors on December 21, 2017 at an exercise price of \$2.25 per share and which expire on December 21, 2022.

Unless otherwise indicated, all information contained in this prospectus assumes no exercise by the underwriters of their over-allotment option.

RISK FACTORS

An investment in shares of our common stock involves a high degree of risk. You should carefully consider the following information about these risks, together with the other information appearing elsewhere in this prospectus, including our financial statements and related notes thereto, before deciding to invest in our common stock. The occurrence of any of the following risks could have a material adverse effect on our business, financial condition, results of operations and future growth prospects. In these circumstances, the market price of our common stock could decline, and you may lose all or part of your investment. We undertake no obligation to update any forward-looking statements, whether as a result of new information, future events or otherwise. You are advised, however, to consult any further disclosure we make in our reports filed with the Securities and Exchange Commission (the "SEC").

Risks Relating to our Financial Position

We have a history of net losses and our future profitability is uncertain.

We have recorded losses in every year since our inception, with the exception of 2012. As of June 30, 2019, our accumulated deficit was \$356.1 million. Since 1992, we have been engaged primarily in research and development and early-stage commercial activities. Because our crop science technology is at an early stage of development, we cannot be certain that the Yield10 Bioscience business will generate sufficient revenue to become profitable. We expect to continue to have significant losses and negative cash flow for at least the next several years, as we incur additional costs and expenses for the continued development of our technology, including the ongoing expenses of research, development, commercialization and administration. The amount we spend will impact our need for capital resources as well as our ability to become profitable and this will depend, in part, on the number of new technologies that we attempt to develop. We may not achieve any or all of these goals and, thus, we cannot provide assurances that we will ever be profitable or achieve significant, or any, product revenues.

Following this offering, we will have a limited number of authorized shares of common stock available for issuance and will need to seek stockholder approval to amend our charter to effect an increase in our authorized shares of common stock.

Immediately following this offering, we will not have a sufficient number of authorized shares to permit exercise of the warrants. We will seek stockholder approval of an amendment to our certificate of incorporation to effect an increase the number of authorized shares of common stock, in an amount sufficient to permit the exercise in full of the warrants and fund our business. If we do not receive the requisite stockholder approval to enable us to issue equity in the future, our operations will likely be materially adversely impacted.

In addition, an increase in the authorized number of shares of common stock and the subsequent issuance of such shares could have the effect of delaying or preventing a change in control of our company without further action by our stockholders. Shares of authorized and unissued common stock could, within the limits imposed by applicable law, be issued in one or more transactions which would make a change in control of our company more difficult, and therefore less likely. In addition, the availability of a greater number of authorized shares could result in additional dilution to existing stockholders and investors in this offering.

We will need to secure additional funding to finance our operations and may not be able to do so when necessary, and/or the terms of any financings may not be advantageous to us.

As of June 30, 2019, we held unrestricted cash and cash equivalents of \$4.3 million. In March 2019, we closed on a registered direct offering of our common stock, raising \$2.6 million, net of offering costs. We believe that these resources and the cash generated from existing grants will be sufficient to meet our projected operating requirements into the fourth quarter of 2019. We follow the guidance of Accounting Standards Codification ("ASC") Topic 205-40, *Presentation of Financial Statements-Going Concern*, in order to determine whether there is substantial doubt about the Company's ability to continue as a going concern for one year after the date its financial statements are issued. We have concluded, and our independent auditors have agreed, that substantial doubt does exist as to our ability to continue as a going concern under this standard, and as a result, our auditors

have included an explanatory paragraph in their audit opinion for our fiscal year ended December 31, 2018. We will need to secure additional funds in the near term to continue operations.

We continue to face significant challenges and uncertainties and, as a result, our available capital resources may be consumed more rapidly than currently expected due to any or all of the following:

- lower than expected revenues from grants and licenses related to our technologies;
- changes we may make to the business that affect ongoing operating expenses;
- further changes we may make to our business strategy;
- changes in our research and development spending plans; and
- other items affecting our forecasted level of expenditures and use of cash resources.

We will require additional capital resources to support the implementation of our business strategy and we may pursue one or more of a variety of financing options, including public or private equity financing, secured or unsecured debt financing, equity or debt bridge financing, as well as licensing or other collaborative arrangements. There can be no assurance that our financing efforts will be successful. If we are not able to secure such additional capital resources or otherwise fund our operations, we will be forced to explore strategic alternatives and/or wind down our operations and pursue options for liquidating our remaining assets, including intellectual property and equipment.

If we issue equity or debt securities to raise additional funds in the future, we may incur fees associated with such issuances, our existing stockholders may experience dilution from the issuance of new equity securities, we may incur ongoing interest expense and be required to grant a security interest in our assets in connection with any debt issuance, and the new equity or debt securities may have rights, preferences and privileges senior to those of our existing stockholders. In addition, utilization of our net operating loss and research and development credit carryforwards may be subject to significant annual limitations under Section 382 of the Internal Revenue Code of 1986, as amended (the "Code"), due to ownership changes resulting from equity financing transactions. If we raise additional funds through collaboration, licensing or other similar arrangements, it may be necessary to relinquish valuable rights to our potential products or proprietary technologies or grant licenses on terms that are not favorable to us.

Inadequate funding for the SEC could hinder our ability to access the public markets and obtain necessary capital in order to properly capitalize and continue our operations.

Government funding of the SEC is subject to the political process, which is inherently fluid and unpredictable. Over the last several years, including a period from late December 2018 through January 2019, the U.S. government has shut down several times and regulatory agencies such as the SEC have had to furlough employees and stop activities. Future government shutdowns could affect our ability to access the public markets and obtain necessary capital in order to properly capitalize and continue our operations, to the extent we need or elect to pursue a financing for which a registration statement must be declared effective by the SEC Staff.

We have changed our corporate strategy to focus on the crop science industry, and our technologies in this area are at a very early stage of development. We may never commercialize a technology or product that will generate meaningful, or any, revenues.

In July 2016, our board of directors approved a plan to implement a strategic restructuring under which Yield10 Bioscience has become our core business. As part of the restructuring, we discontinued our biopolymer operations, eliminated positions in our biopolymer operations and corporate organization, and sold certain of our biopolymer business assets.

The crop science products and technologies we are currently developing as a result of our strategic repositioning are at a very early stage of development, and the process of developing them is lengthy and uncertain. In addition, our current management has limited experience in developing technologies for the crop science

industry and has never commercialized a product or technology in this industry. We may never reach a point at which our efforts result in products that allow us to achieve revenue from their license or sale.

There can be no assurance that we will be able to comply with the continued listing standards of The Nasdaq Capital Market.

We cannot assure you that we will be able to comply with the standards that we are required to meet in order to maintain a listing of our common stock on The Nasdaq Capital Market ("Nasdaq"). Nasdaq listing rules require us to maintain certain closing bid price, stockholders' equity and other financial metric criteria in order for our common stock to continue trading on Nasdaq. Nasdaq Listing Rule 5550(a)(2) requires listed securities to maintain a minimum bid price of \$1.00 per share, and Listing Rule 5810(c)(3)(A) provides that a failure to meet the minimum bid price requirement exists if the deficiency continues for a period of 30 consecutive business days.

On June 25, 2019, we were notified by Nasdaq that our common stock had not maintained the minimum closing bid price of \$1.00 per share for thirty consecutive business days. We have 180 days, or until December 23, 2019, to regain compliance by maintaining a closing bid price of \$1.00 or higher for a minimum of ten consecutive business days. In the event that we do not regain compliance by December 23, 2019, we may be eligible for an additional 180 days provided that we continue to meet all other Nasdaq continued listing standards and provide a written notice of our intention to cure the deficiency during the additional extension period by effecting a reverse stock split, if necessary. If we fail to cure our current stock price deficiency or we do not continue to meet all applicable Nasdaq requirements in the future and Nasdaq determines to delist our common stock, the delisting could substantially decrease trading in our common stock and adversely affect the market liquidity of our common stock; adversely affect our ability to obtain financing on acceptable terms, if at all, for the continuation of our operations; and harm our business. Additionally, the market price of our common stock may decline further, and stockholders may lose some or all of their investment.

Currently, the sole source of our revenue is government grants; continued availability of government grant funding is uncertain and contingent on compliance with the requirements of the grant.

Historically, a portion of our revenue has been generated from payments to us from government entities in the form of government grants, whereby we are reimbursed for certain expenses incurred in connection with our research and development activities, subject to our compliance with the specific requirements of the applicable grant, including rigorous documentation requirements. To the extent that we do not comply with these requirements, the expenses that we incur may not be reimbursed. Any of our existing grants or new grants that we may obtain in the future may be terminated or modified.

Our ability to obtain grants or incentives from government entities in the future is subject to the availability of funds under applicable government programs and approval of our applications to participate in such programs. The application process for these grants and other incentives is highly competitive. We may not be successful in obtaining any additional grants, loans or other incentives. Recent political focus on reducing spending at the U.S. federal and state levels may continue to reduce the scope and amount of funds dedicated to crop science products, if such funds will continue to be available at all. To the extent that we are unsuccessful in being awarded any additional government grants in the future, we would lose a potential source of revenue.

Our government grants may subject us to government audits, which could expose us to penalties if we have failed to comply with the terms of the grants.

We may be subject to audits by government agencies as part of routine audits of our activities funded by our government grants. As part of an audit, these agencies may review our performance, cost structures and compliance with applicable laws, regulations and standards and the terms and conditions of the grant. If any of our costs are found to be allocated improperly, the costs may not be reimbursed, and any costs already reimbursed for such contract may have to be refunded. Accordingly, an audit could result in a material adjustment to our results of operations and financial condition. Moreover, if an audit uncovers improper or illegal activities, we may be subject to civil and criminal penalties and administrative sanctions.

Risks Relating to our Yield10 Bioscience Crop Science Program

The crop science product development cycle is lengthy and uncertain, and our progress will depend heavily on our ability to attract third-party investment in research under license agreements and on our ability to establish future collaborative partnerships to develop and commercialize our innovations.

The technology and processes used in our crop science program and the application of our technology to enhance photosynthetic efficiency of crops are at an early stage of development. Research and development in the seed, agricultural biotechnology, and larger agriculture industries is expensive and prolonged and entails considerable uncertainty. Completion of development work with respect to our products will require a significant investment of both time and money, if it can be completed at all. We expect that collaborations with established agricultural industry companies will be required to successfully develop and commercialize our innovations. Our initial development strategy is to make it attractive for established agricultural industry companies to invest financial and technical resources to introduce our traits into their elite germplasm for event selection and evaluation under research licenses. For example, in 2017 we entered into a non-exclusive research license with Monsanto, which was subsequently acquired by Bayer AG (“Bayer”), pursuant to which we granted Monsanto a non-exclusive research license to evaluate our novel C3003 and C3004 yield traits in soybean. We expanded the agreement with Bayer in 2019 to cover a new discovery and intellectual property related to C3004. In September 2018, we granted a non-exclusive research license to Forage Genetics, a subsidiary of Land O’Lakes, Inc., to evaluate five of our novel yield traits in forage sorghum. The traits included in the research license include C3003 as well as four traits from our GRAIN platform, C4001, C4002, C4003 and C4029. We may not be successful in establishing or maintaining suitable relationships with established agricultural industry companies for research licenses in the future, and there can be no assurance that any such relationships will result in future collaboration agreements to develop and commercialize our innovations, with terms that are satisfactory to us or at all. In addition, industry collaborators have significant resources and development capabilities and may develop products and technologies that compete with or negatively impact the development and commercialization of our technologies.

Any potential collaborative partnerships that we may enter into in the future may not be successful, which could adversely affect our ability to develop and commercialize our innovations.

We expect that collaborations with established agricultural industry companies will be required for us to successfully develop and commercialize our innovations. The agriculture industry is highly concentrated and dominated by a small number of large companies, which could impact efforts to form the collaborations that we will need in order to complete the development of our products. To the extent that we pursue such arrangements, we will face significant competition in seeking appropriate partners. Moreover, such arrangements are complex and time-consuming to negotiate, document, implement and maintain. We may not be successful in establishing or implementing such arrangements. The terms of any partnerships, joint ventures or other collaborative arrangements that we may establish may not be favorable to us.

The success of any future collaborative partnerships is uncertain and will depend heavily on the efforts and activities of our potential partners. Such arrangements are subject to numerous risks, including the risks that:

- our partners may have significant discretion in determining the efforts and resources that they will apply to the arrangement;
- our partners may not pursue the development and commercialization of our product candidates based on trial results, changes in their strategic focus, competing priorities, availability of funding, or other external factors;
- our partners may delay or abandon field trials, fail to conduct field trials that produce sufficient conclusory data, provide insufficient funding for field trials, or repeat or conduct new field trials;
- partners who have marketing, manufacturing and distribution rights with respect to a product may not commit sufficient resources to, or otherwise not perform satisfactorily in carrying out, these activities;

- to the extent that such arrangements provide for exclusive rights, we may be precluded from collaborating with others;
- our partners may not properly maintain or defend our intellectual property rights, or may use our intellectual property or proprietary information in a way that gives rise to actual or threatened litigation that could jeopardize or invalidate our intellectual property or proprietary information or expose us to potential liability;
- disputes may arise between us and a partner that causes the delay or termination of the research, development or commercialization of our current or future products, or that results in costly litigation or arbitration that diverts management attention and resources;
- such arrangements may be terminated, and, if terminated, may result in a need for additional capital for our independent pursuit of matters previously covered by such arrangement;
- our partners may own or co-own intellectual property that results from our arrangement; and
- a partner's sales and marketing activities or other operations may not be in compliance with applicable laws resulting in civil or criminal proceedings.

Our crop science program may not be successful in developing commercial products.

We and our potential future collaborators may spend many years and dedicate significant financial and other resources developing traits that will never be commercialized. Seeds containing the traits that we develop may never become commercialized for any of the following reasons:

- our traits may not be successfully validated in the target crops;
- our traits may not achieve our targeted yield improvements;
- we may not be able to secure sufficient funding to progress our traits through development and commercial validation;
- our traits may not have the desired effects sought by future collaborators for the relevant crops;
- development and validation of traits, particularly during field trials, may be adversely affected by environmental or other circumstances beyond our control;
- we or our future collaborators may be unable to obtain the requisite regulatory approvals for the seeds containing our traits, to the extent regulatory approvals are required;
- competitors may launch competing or more effective seed traits or seeds;
- a market may not exist for seeds containing our traits or such seeds may not be commercially successful;
- future collaborators may be unable to fully develop and commercialize products containing our seed traits or may decide, for whatever reason, not to commercialize such products;
- we may be unable to patent our traits in the necessary jurisdictions; and
- our efforts to develop niche crop products based on our Camelina platform, including specialty oils and PHB biomaterials are in the early stages and may not be successful.

If any of these things were to occur, it could have a material adverse effect on our business and our results of operations. Research and development in the crop science industry is expensive and prolonged and entails considerable uncertainty. Because of the stringent product performance and safety criteria applied in development of crop science products, products currently under development may neither survive the development process nor

ultimately receive any requisite regulatory approvals that may be needed to market such products. Even when such approvals are obtained, there can be no assurance that a new product will be commercially successful. In addition, research undertaken by competitors may lead to the launch of competing or improved products, which may affect sales of any products that we are able to develop.

Even if we or our future collaborators are successful in developing commercial products that incorporate our traits, such products may not achieve commercial success.

Our strategy depends upon our or our future collaborators' ability to incorporate our traits into a wide range of crops in significant markets and geographies. Even if we or our future collaborators are able to develop commercial products that incorporate our traits, any such products may not achieve commercial success for one or more of the following reasons, among others:

- products may fail to be effective in particular crops, geographies, or circumstances, limiting their commercialization potential;
- our competitors, or competitors of our collaborators, may launch competing or more effective traits or products;
- significant fluctuations in market prices for agricultural inputs and crops could have an adverse effect on the value of our traits;
- farmers are generally cautious in their adoption of new products and technologies, with conservative initial purchases and proof of product required prior to widespread deployment, and accordingly, it may take several growing seasons for farmers to adopt our or our collaborators' products on a large scale;
- we may not be able to produce high-quality seeds in sufficient amounts to meet demand; and
- we may not be able to secure the financial or other resources needed to achieve commercial success.

Our financial condition and results of operations could be materially and adversely affected if any of the above were to occur.

Our estimates of market opportunity and forecasts of market growth may prove to be inaccurate, and even if the markets in which we may compete in the future achieve growth, our business could fail to achieve the same growth rates as others in the industry.

Market opportunity estimates and market growth forecasts are subject to significant uncertainty and are based on assumptions and estimates that may not prove to be accurate. Our estimates and forecasts relating to the size and expected growth of the global seed industry and the biotechnology seeds market, and the estimated ranges of incremental value increase that a novel, newly developed crop trait may produce, may prove to be inaccurate. Even if the markets in which we may compete in the future achieve these opportunity estimates and market growth forecasts, our business could fail to grow at similar rates, if at all.

If ongoing or future field trials conducted by us or our future collaborators are unsuccessful, we may be unable to complete the regulatory process for, or commercialize, our products in development on a timely basis.

The successful completion of multi-year, multi-site field trials is critical to the success of product development and marketing efforts for products containing our traits. If our ongoing or future field trials, or those of our future collaborators, are unsuccessful or produce inconsistent results or unanticipated adverse effects on crops, or if we or our collaborators are unable to collect reliable data, regulatory review of products in development containing our traits could be delayed or commercialization of products in development containing our traits may not be possible. In addition, more than one growing season may be required to collect sufficient data to develop or market a product containing our traits, and it may be necessary to collect data from different

geographies to prove performance for customer adoption. Even in cases where field trials are successful, we cannot be certain that additional field trials conducted on a greater number of acres, or in different crops or geographies, will be successful. Generally, we or our research licensees conduct these field trials, or we pay third parties, such as farmers, consultants, contractors, and universities, to conduct field trials on our behalf. Poor trial execution or data collection, failure to follow required agronomic practices, regulatory requirements, or mishandling of products in development by our collaborators or these third parties could impair the success of these field trials.

Many factors that may adversely affect the success of our field trials are beyond our control, including weather and climatic variations, such as drought or floods, severe heat or frost, hail, tornadoes and hurricanes, uncommon or unanticipated pests and diseases, or acts of protest or vandalism. For example, if there were a prolonged or permanent disruption to the electricity, climate control, or water supply operating systems in our greenhouses or laboratories, the crops in which we or our collaborators are testing our traits and the samples we or our collaborators store in freezers, both of which are essential to our research and development activities including field tests, could be severely damaged or destroyed, adversely affecting these activities and thereby our business and results of operations. Unfavorable weather conditions including drought or excessive rain, or fluctuations in temperature, which we have experienced from time to time in our field trials, can also reduce both acreages planted and incidence, or timing of, certain crop diseases or pest infestations, each of which may halt or delay our field trials. Any field test failure we may experience may not be covered by insurance and, therefore, could result in increased cost for the field trials and development of our traits, which may negatively impact our business, results of operations, and ability to secure financing. Such factors outside of our control can create substantial volatility relating to our business and results of operations.

Competition in the market for traits and seeds is intense and requires continuous technological development, and, if we are unable to compete effectively, our financial results will suffer.

We face significant competition in the markets in which we operate. The markets for traits and agricultural biotechnology products are intensely competitive and rapidly changing. In most segments of the seed and agricultural biotechnology market, the number of products available to consumers is steadily increasing as new products are introduced. At the same time, the expiration of patents covering existing products reduces the barriers to entry for competitors. We may be unable to compete successfully against our current and future competitors, which may result in price reductions, reduced margins and the inability to achieve market acceptance for any products that we or our future collaborators commercialize containing our traits. In addition, most of our competitors have substantially greater financial, marketing, sales, distribution, research and development, and technical resources than we have, and some of our potential future collaborators have more experience in research and development, regulatory matters, manufacturing, and marketing. We anticipate increased competition in the future as new companies enter the market and new technologies become available. Our technologies may be rendered obsolete or uneconomical by technological advances or entirely different approaches developed by one or more of our competitors, which will prevent or limit our ability to generate revenues from the commercialization of our traits being developed.

Our business is subject to various government regulations in the United States and Canada, the regulatory requirements for our future products in development are evolving and are subject to change, and if there are adverse changes to the current regulatory framework, our or our future collaborators' ability to market our traits could be delayed, prevented or limited.

In the United States and Canada, where our seed traits and biotechnology-derived plant lines are developed and field tested, changes in regulatory requirements applicable to our seed traits or future products in development containing our traits could result in a substantial increase in the time and costs associated with developing and commercializing future products containing our traits, and could materially affect our ability to meet our desired development timelines or to develop and commercialize a future product containing our traits at all.

In the United States, our seed traits and any future products that are successfully developed containing our seed traits are or will be subject to USDA and U.S. Food and Drug Administration ("FDA") regulatory requirements. The USDA and FDA requirements will vary depending on the particular seed trait and the intended use of any

product that will be commercialized. Our business strategy is focused on crop yield traits and we have no current plans for the development of pesticide or herbicide traits, which would be subject to regulation by the U.S. Environmental Protection Agency ("EPA").

Within USDA, the APHIS is responsible for protecting agricultural plants under the Plant Protection Act. USDA-APHIS regulates organisms and products that are known or are suspected to be plant pests or to pose a plant pest risk, including those that have been altered or produced through various genetic engineering techniques. These genetically engineered plants are called "regulated articles" in the relevant USDA-APHIS regulations, which control the import, handling, interstate movement and release into the environment of regulated articles, including certain genetically engineered organisms undergoing confined experimental use or field trials. Seed traits developed using the insertion of recombinant DNA, such as our C3003 yield trait that leverages the biological functions of an algal gene, are regulated articles and are therefore subject to extensive USDA-APHIS oversight, including but not limited to permitting requirements for import, handling, interstate movement and release into the environment.

In recent years, we and others have submitted various petitions to USDA-APHIS to determine whether particular biotechnology-derived plants developed through the use of different genome editing techniques may be considered to be not regulated under the framework administered by the agency. In general, genome editing approaches to novel plant trait development have been considered not regulated by USDA-APHIS. In particular, we have submitted two petitions (also known as the "Am I Regulated?" letter) to USDA-APHIS's Biotechnology Regulatory Services in order to confirm that the following two oil content traits are not going to be regulated by the agency under 7 CFR part 340: (i) the single trait C3008 Camelina plant line, developed using CRISPR genome editing technology for increased oil content; and (ii) the triple-edited Camelina line that combines three gene traits, C3008a, C3008b and C3009, to increase oil production. In both cases, USDA-APHIS approved our petitions and confirmed in writing that each of these novel plant lines would not be treated as a regulated article.

The USDA also announced in March 2018 that it would not require an assessment on products that used modern forms of mutagenesis if it was clear these outcomes could occur in nature. The USDA stated at that time that it did not "have any plans to regulate plants that could otherwise have been developed through traditional breeding techniques as long as they are developed without the use of a plant pest as the donor or vector and they are not themselves plant pests." This USDA policy statement applies to genetic deletions of any size, which would include genome editing through CRISPR-Cas9 and other emerging technologies, although it remains to be seen how this policy announcement will be implemented by USDA-APHIS and what practical effect that may have on seed trait developers like us and our competitors.

There can be no guarantee that the USDA-APHIS governing regulations and policies will not change. We cannot predict whether advocacy groups will challenge existing regulations and USDA determinations, whether the USDA will alter its interpretations of existing regulations, modify existing regulations or promulgate new regulations, or whether additional laws will come into effect. If these or other developments resulted in adverse changes to the current regulatory framework, our seed traits or future products in development containing our traits could be subjected to more burdensome regulatory standards, thereby substantially increasing the time and costs associated with developing and commercializing any future products. Moreover, we cannot assure you that USDA-APHIS will analyze any of our future yield traits or products in development containing our traits in a manner consistent with its analysis of our genome edited yield traits to date. Complying with the USDA's plant pest regulations for traits that are classified as "regulated articles," including the permitting requirements for field testing and environmental release, is a costly, time-consuming process and could substantially delay or prevent the commercialization of any future products containing traits that we expected to be deemed non-regulated by USDA-APHIS under 7 CFR part 340.

In addition to USDA-APHIS regulation of plant breeding and planting, a biotechnology-derived plant also will be regulated by the FDA if it is intended to be used as human food or animal feed. The FDA regulates the safety of food for humans and animals, and foods derived from novel plant varieties must meet the same food safety requirements as foods derived from traditionally bred plants (also called conventional foods). Since 1992, the FDA has had in place a voluntary consultation process for developers of bioengineered food ("Biotechnology Consultations").

Biotechnology Consultations are data-intensive and examine the new food product's safety and nutritional profile, among other issues. Generally, the FDA has found that such food products do not pose unique health risks to humans or animals, but if a novel allergen or other distinction from the conventional food is present in the new plant variety, the agency may require specific label statements on the product to ensure that consumers are made aware of material differences between genetically engineered and conventional versions. When such a determination cannot be made, the novel plant variety may become subject to FDA premarket review and approval as a food additive.

As part of a broader effort to modernize its regulatory approach to all biotechnology-derived products, the FDA is currently re-evaluating its regulatory approach in light of the increasing prevalence of certain genome edited plants. In January 2017, the FDA asked for public input to help inform its thinking about human and animal foods derived from new plant varieties produced using genome editing techniques. Among other things, the FDA's request for comments asked for data and information in response to questions about the safety of foods from genome edited plants, such as whether certain categories of genome edited plants present food safety risks different from other plants produced through traditional plant breeding. Subsequently, in October 2018, FDA leadership issued a document entitled the "Plant and Animal Biotechnology Innovation Action Plan" ("Action Plan") that identified three key priorities for the agency in this area and stated that the FDA has reviewed the comments and other information it received in response to the January 2017 request for comments. The FDA also stated that it intends to develop guidance for industry explaining how the FDA's existing regulatory policy for foods derived from new plant varieties applies to foods produced using genome editing. The forthcoming draft guidance is expected to be released for public comment in 2019. The FDA also stated in the Action Plan that it intends to begin updating the existing procedures for voluntary Biotechnology Consultations to reflect the agency's 25 years of experience with foods derived from biotechnology plants and to incorporate any additional issues related to genome editing of food crops. Such procedural updates are expected to be developed and implemented over the next two years.

We have not participated in any Biotechnology Consultations or engaged in any informal discussions with the FDA about our novel yield traits, whether those traits have been developed using genome editing or traditional genome modification using the insertion of recombinant DNA. Any delay in the regulatory consultation process, or a determination by the FDA that future product candidates containing our traits raise different safety issues than the relevant conventional crop and therefore must be approved by the agency as a new food additive through an intensive premarket safety review process, could increase the costs associated with or delay or prevent the commercialization of the future product candidate. Such delays may lead to reduced acceptance by farmers, food manufacturers or the public and an increase in competitor products that may directly compete with ours. Further, if the FDA enacts new regulations or policies with respect to genome edited plants in particular, such policies could result in additional compliance costs or delay or prevent the commercialization of any potential commercial products containing our seed traits, which could adversely affect our ability to generate revenues and to achieve profitability.

In Canada, genetically engineered crops and the food products into which they are incorporated are regulated by multiple government agencies under a federal framework for the regulation of biotechnology products that is similar to the U.S. system. First, the Canadian Food Inspection Agency ("CFIA") is the lead agency for ensuring that a new agricultural biotechnology crop will not pose new risks to Canadian plants, animals and other agricultural commodities. The CFIA's Plant Biosafety Office ("PBO") is responsible for conducting environmental assessments of biotechnology-derived plants, referred to as "plants with novel traits" ("PNT"). Authority for the PBO includes both approving confined field trials with the PNT through permits and authorizing their "unconfined release" as a first step towards commercialization. Second, under the Food and Drugs Act and related regulations, Health Canada is responsible for reviewing a pre-market safety assessment that must be submitted by the manufacturer or importer of a "novel food," a term of art that includes any PNT or other biotechnology-derived foods. Health Canada will evaluate the data and information about the novel food and make a determination regarding whether it is safe and nutritious before it can be sold in Canada, as well as whether any restrictions are warranted under applicable law or the product's safety profile. Any commercialization of our yield crops in Canada is expected to be done by a third-party collaborator or other partner and complying with Health Canada's pre-market notification requirement and safety assessment for novel foods would be the obligation of that third-party collaborator.

Our work involving the development, greenhouse testing and field testing of novel yield trait genes in crop plants requires certain government and municipal permits and we must ensure compliance with all applicable

regulations including regulations relating to genetically engineered crops. With laboratories and greenhouses in both the U.S. and Canada, we are also subject to regulations governing the shipment of seeds and other plant material between our facilities in the U.S. and Canada, including USDA-APHIS permits for the import and export of plant materials that could pose a risk to domestic agriculture. We also have been conducting field studies of various yield traits in Canada since 2016 under PNT permits issued by Canadian regulators.

Complying with the Canadian regulations is a costly, time-consuming process and could substantially delay or prevent the commercialization of our products. In addition, we cannot assure you that CFIA and Health Canada regulations or the agencies' implementation of those regulations will not change or that the legislative framework in Canada for biotechnology-derived crops, whether for genome edited plants or plants modified using the insertion of recombinant DNA, will not be amended or otherwise changed in a manner that could result in additional compliance costs or delay or prevent the commercialization of any potential commercial products containing our seed traits, which could adversely affect our ability to generate revenues and to achieve profitability.

Failure to comply with applicable regulatory requirements may, among other things, result in fines, suspensions of regulatory approvals, product recalls, product seizures, operating restrictions and criminal prosecution.

If we or our future collaborators are unable to comply with and timely complete the regulatory process in the United States and Canada for our future products in development, our or our future collaborators' ability to market our traits could be delayed, prevented or limited.

We apply for and maintain the regulatory permits in the United States and Canada necessary for our operations, particularly those covering our field trials. We anticipate that we or our future collaborators will apply for and maintain regulatory approvals, if any, necessary for the commercialization of any future products containing our seed traits. Even if we and our collaborators make timely and appropriate applications for regulatory permits for our field trials, government delays in issuing such permits can significantly affect the development timelines for our traits, particularly if the planting period for a crop growing season expires before the necessary permits are obtained.

The regulatory process is expensive and time-consuming, and the time required to complete the process is difficult to predict and depends upon numerous factors, including the substantial discretion of the regulatory authorities. We have not completed all phases of the regulatory process for any of our traits in development. Our traits could require a significantly longer time to complete the regulatory process than expected, or may never gain approval, even if we and our collaborators expend substantial time and resources seeking such approval. The time required for regulatory approval, or any delay or denial of such approval, could negatively impact our ability to generate revenues and to achieve profitability and finance our ongoing operations. In addition, changes in regulatory review policies during the development period of any of our traits, changes in, or the enactment of, additional regulations or statutes, or changes in regulatory review practices for a submitted product application may cause a delay in obtaining approval or result in the rejection of an application for regulatory approval. Regulatory approval, if obtained, may be made subject to limitations on the intended uses for which we or our collaborators may market a future product containing our traits. These limitations could adversely affect our potential revenues.

The regulatory environment for genetically engineered crops in jurisdictions outside the United States and Canada varies greatly, and some jurisdictions have more restrictive regulations that could delay, prevent or limit our or our future collaborators' ability to market our traits.

Other jurisdictions and governmental authorities, including in South America and Asia, are increasingly taking an interest in regulating agricultural products of biotechnology. Regulatory approaches vary by jurisdiction as a result of the existing public health frameworks and phytosanitary laws, as well as other less tangible factors such as cultural and religious norms that may have an impact on individual country risk assessments and decision-making. Each jurisdiction may have its own regulatory framework, which may include restrictions and regulations on planting and growing genetically engineered plants and in the consumption and labeling of foods derived from such novel plants, and which may apply to future products containing our traits. We cannot predict future changes in the global regulatory landscape regarding genetically engineered plants or commercial products incorporating such novel plant varieties. The regulatory environment for such plants is greatly uncertain outside of the U.S. and Canada,

and some jurisdictions have more restrictive regulations that could delay, prevent or limit our or our future collaborators' ability to market our traits.

For example, regulation of all genetically engineered plants in the European Union ("EU") is far more stringent than in the U.S. and Canada. U.S. and Canadian regulators have determined that genome edited plants pose fewer risks than traditional biotechnology-derived plants subjected to modification through the insertion of recombinant DNA. In contrast, a recent EU legal ruling indicated that the existing EU regulations for genetically engineered plants modified by the insertion of recombinant DNA, which were already more stringent than corresponding U.S. and Canadian regulations, should be strictly applied to genome edited plants as well. As a result, there is a sharp distinction between how EU and U.S. and Canadian regulatory agencies oversee novel seed traits, and in particular those that are generated using the more modern techniques of genome editing.

Although we are not currently targeting EU markets for the development or commercialization of future products containing our traits, emerging oversight regimes for genetically engineered products in other jurisdictions may follow the EU approach and impose similarly strict requirements for the release of such products into the environment and their incorporation into human food or other consumer products. Such jurisdictions may also elect to regulate genetically engineered plants without distinguishing between traditional biotechnology-derived plants modified with recombinant DNA and genome edited plants. There is no guarantee that countries for which we may have or may develop future marketing plans would not take a stricter legal and regulatory approach to controlling genetically engineered plants similar to that of the EU, which could increase regulatory costs and delay, prevent or limit our or our future collaborators' ability to market our traits in such jurisdictions.

Consumer resistance to genetically engineered crops may negatively affect the ability to commercialize future crops containing our traits, as well as our public image, and may reduce any future sales of seeds containing our yield traits.

Food and feed made from genetically engineered seeds and plants are not accepted by some consumers, and in certain countries production of certain genetically engineered crops is effectively prohibited, including throughout the EU, due to concerns over such products' effects on food safety and the environment. Advocacy groups have engaged in publicity campaigns and filed lawsuits in various countries against companies and regulatory authorities, seeking to halt regulatory approval activities or influence public opinion against genetically engineered and/or genome edited products. Actions by consumer groups and others also may disrupt research and development or production of genetically engineered plants, seeds or food products that incorporate such novel plant varieties. The high public profile of the biotechnology industry in food and feed production, and a lack of consumer acceptance of the types of products to which we have devoted substantial development resources, could have a negative impact on the commercial success of any of products incorporating our traits that may successfully complete the development process, as to which no assurance can be given, and could materially and adversely affect our ability to obtain future collaborations and to finance our crop science program. Further, we could incur substantial liability and/or legal expenses if there are claims that genetically engineered crops damage the environment or contaminate other farm crops. This could distract our management and cause us to spend resources defending against such claims.

Government policies and regulations, particularly those affecting the agricultural sector and related industries, could adversely affect our operations and our ability to generate future revenues and to achieve profitability.

Agricultural production and trade flows are subject to government policies and regulations. Governmental policies and approvals of technologies affecting the agricultural industry, such as taxes, tariffs, duties, subsidies, incentives and import and export restrictions on agricultural commodities and commodity products can influence the planting of certain crops, the location and size of crop production, and the volume and types of imports and exports. Future government policies in the United States, Canada or in other countries could discourage farmers from using any of our products that may successfully complete the development process, as to which no assurance can be given. Similarly, these policies could discourage food processors from purchasing harvested crops containing our traits or could encourage the use of our competitors' products, which would put us at a commercial disadvantage and could negatively impact our ability to generate any revenues and to achieve profitability.

The products of third parties, or the environment itself, may be negatively affected by the unintended appearance of our yield trait genes.

The potential for unintended but unavoidable trace amounts, sometimes called “adventitious presence,” of yield trait genes in conventional seed, or in the grain or products produced from conventional or organic crops, could affect acceptance by the general public or by the agricultural industry of these traits. Trace amounts of yield trait genes may unintentionally be found outside our containment area in the products of third parties, which may result in negative publicity and claims of liability brought by such third parties against us. Furthermore, in the event of an unintended dissemination of our genetically engineered materials to the environment, we could be subject to claims by multiple parties, including environmental advocacy groups, as well as governmental actions such as mandated crop destruction, product recalls or additional stewardship practices and environmental cleanup or monitoring. The occurrence of any of these events could have a material adverse effect on our business and results of operations.

Loss of or damage to our elite novel trait events and plant lines would significantly slow our product development efforts.

We have a collection of elite novel trait events and plant lines in which we are developing traits for incorporation into elite germplasm and potential seed products. Our elite novel trait events and plant lines are a key strategic asset since they form the basis for the introgression of our traits into plant breeding programs. If we suffer loss or damage to our elite novel trait events and plant lines, our research and development activities could be negatively impacted.

Our insurance coverage may be inadequate to cover all the liabilities we may incur.

We face the risk of exposure to liability claims if any products that are successfully developed containing our seed traits, as to which no assurance can be given, are defective and if any product that we develop or any product that uses our technologies or incorporates any of our traits causes injury. Although we carry insurance at levels customary for companies in our industry, such coverage may become unavailable or be inadequate to cover all liabilities we may incur. There can be no assurance that we will be able to continue to maintain such insurance, or obtain comparable insurance at a reasonable cost, if at all. If we are unable to obtain sufficient insurance coverage at an acceptable cost or otherwise, or if the amount of any claim against us exceeds the coverage under our policies, we may face significant expenses.

We rely on third parties to conduct, monitor, support, and oversee field trials and, in some cases, to maintain regulatory files for those products in development, and any performance issues by third parties, or our inability to engage third parties on acceptable terms, may impact our or our future collaborators’ ability to complete the regulatory process for or commercialize such products.

We rely on third parties to conduct, monitor, support, and oversee field trials. As a result, we have less control over the timing and cost of these trials than if we conducted these trials with our own personnel. If we are unable to maintain or enter into agreements with these third parties on acceptable terms, or if any such engagement is terminated prematurely, we may be unable to conduct and complete our trials in the manner we anticipate. In addition, there is no guarantee that these third parties will devote adequate time and resources to our studies or perform as required by our contract or in accordance with regulatory requirements, including maintenance of field trial information regarding our products in development. If any of these third parties fail to meet expected deadlines, fail to transfer to us any regulatory information in a timely manner, fail to adhere to protocols, or fail to act in accordance with regulatory requirements or our agreements with them, or if they otherwise perform in a substandard manner or in a way that compromises the quality or accuracy of their activities or the data they obtain, then field trials of our traits in development may be extended or delayed with additional costs incurred, or our data may be rejected by the applicable regulatory agencies. Ultimately, we are responsible for ensuring that each of our field trials is conducted in accordance with the applicable protocol and with legal, regulatory and scientific standards, and our reliance on third parties does not relieve us of our responsibilities. We could be subject to penalties, fines and liabilities if our third-party contractors fail to perform as required.

If our relationship with any of these third parties is terminated, we may be unable to enter into arrangements with alternative parties on commercially reasonable terms, or at all. Switching or adding service providers can involve substantial cost and require extensive management time and focus. Delays may occur, which can materially impact our ability to meet our desired development timelines. If we are required to seek alternative service arrangements, the resulting delays and potential inability to find a suitable replacement could materially and adversely impact our business.

In addition, there has been an increasing trend towards consolidation in the agricultural biotechnology industry. Consolidation among our competitors and third parties upon whom we rely could lead to changes in the competitive landscape, capabilities, and strategic priorities among potential service providers, which could have an adverse effect on our business and operations.

If we lose key personnel or are unable to attract and retain necessary talent, we may be unable to develop or commercialize our products under development.

We are highly dependent on our key technical and scientific personnel, who possess unique knowledge and skills related to our research and technology. If we were to lose the services of these individuals, we may be unable to readily find suitable replacements with comparable knowledge and the experience necessary to advance the research and development of our products. Because of the unique talents and experience of many of our scientific and technical staff, competition for our personnel is intense. The loss of key personnel or our inability to hire and retain personnel who have the required expertise and skills could have a material adverse effect on our research and development efforts, our business, and our ability to secure additional required financing.

Our business and operations would suffer in the event of system failures.

We utilize information technology systems and networks to process, transmit and store electronic information in connection with our business activities. As use of digital technologies has increased, cyber incidents, including deliberate attacks and attempts to gain unauthorized access to computer systems and networks, have increased in frequency and sophistication. These threats pose a risk to the security of our systems and networks and the confidentiality, availability and integrity of our data. There can be no assurance that we will be successful in preventing cyber-attacks or successful in mitigating their efforts.

Despite the implementation of security measures, our internal computer systems and those of our contractors and consultants are vulnerable to damage from such cyber-attacks, including computer viruses, unauthorized access, natural disasters, terrorism, war and telecommunication and electrical failures. Such an event could cause interruption of our operations. For example, the loss of data from completed field tests for our yield traits could result in delays in our regulatory approval efforts and significantly increase our costs. To the extent that any disruption or security breach were to result in a loss of or damage to our data, or inappropriate disclosure of confidential or proprietary information, we could suffer reputational harm or face litigation, or adverse regulatory action and the development of our product candidates could be delayed.

Risks Relating to Intellectual Property

Patent protection for our technologies is both important and uncertain.

Our commercial success may depend in part on our obtaining and maintaining patent protection for our technologies in the United States and other jurisdictions, as well as successfully enforcing and defending this intellectual property against third-party challenges. If we are not able to obtain or defend patent protection for our technologies, then we will not be able to exclude competitors from developing or marketing such technologies, and this could negatively impact our ability to generate sufficient revenues or profits from product sales and/or licensing to justify the cost of development of our technologies and to achieve or maintain profitability. Our currently issued patents relate mainly to our historical business, and have expiration dates ranging from 2020 through 2030. New outstanding patent applications owned by or licensed to us relating to crop yield improvements have filing dates ranging from 2013 through 2019 including the recently filed new patent application on a breakthrough technology for producing PHA biomaterials in crops. This patent would have an expiration date in 2039 if granted, however, we may not be able to get sufficiently broad claims to cover the new invention.

Our patent position involves complex legal and factual questions. Accordingly, we cannot predict the breadth of claims that may be allowed or enforced in our patents or in third-party patents. Patents may not be issued for any pending or future pending patent applications owned by or licensed to us, and claims allowed under any issued patent or future issued patent owned or licensed by us may not be valid or sufficiently broad to protect our technologies. Moreover, we may be unable to protect certain of our intellectual property in the United States or in foreign countries. Foreign jurisdictions may not afford the same protections as U.S. law, and we cannot ensure that foreign patent applications will have the same scope as the U.S. patents. There will be many countries in which we will choose not to file or maintain patents because of the costs involved. Competitors may also design around our patents or develop competing technologies.

Additionally, any issued patents owned by or licensed to us now or in the future may be challenged, invalidated, or circumvented. We could incur substantial costs to bring suits or other proceedings in which we may assert or defend our patent rights or challenge the patent rights of third parties. An unfavorable outcome of any such litigation could have a material adverse effect on our business and results of operations.

Third parties may claim that we infringe their intellectual property, and we could suffer significant litigation or licensing expense as a result.

Various U.S. and foreign issued patents and pending patent applications owned by third parties exist in areas relevant to our products and processes. We could incur substantial costs to challenge third-party patents. If third parties assert claims against us or our customers alleging infringement of their patents or other intellectual property rights, we could incur substantial costs and diversion of management resources in defending these claims, and the defense of these claims could have a material adverse effect on our business. In addition, if we are unsuccessful in defending against these claims, these third parties may be awarded substantial damages, as well as injunctive or other equitable relief against us, which could effectively block our ability to make, use, sell, distribute, or market our technologies and services based on our technologies in the United States or abroad. Alternatively, we may seek licenses to such third-party intellectual property. However, we may be unable to obtain these licenses on acceptable terms, if at all. Our failure to obtain the necessary licenses or other rights could prevent the sale, manufacture, or distribution of some of our products based on our technologies and, therefore, could have a material adverse effect on our business.

Portions of our crop science technology are owned by or subject to retained rights of third parties.

We have licensed and optioned from academic institutions certain patent rights that may be necessary or important to the development and commercialization of our crop science technology. These licenses and options may not provide exclusive rights to use such intellectual property in all fields of use in which we may wish to develop or commercialize our technology. If we fail to timely exercise our option rights and/or we are unable to negotiate license agreements for optioned patent rights on acceptable terms, the academic institutions may offer such patent rights to third parties. If we fail to comply with our obligations under these license agreements, or if we are

subject to a bankruptcy or insolvency proceeding, the licensor may have the right to terminate the license. In some circumstances, we may not have the right to control the preparation, filing and prosecution of licensed patent applications or the maintenance of the licensed patents. Therefore, we cannot be certain that these patents and applications will be prosecuted, maintained and enforced in a manner consistent with the best interests of our business. Furthermore, the research resulting in certain of our licensed and optioned patent rights was funded by the U.S. government. As a result, the government may have certain rights to such patent rights and technology.

We may not be successful in obtaining necessary rights to additional technologies for the development of our products through acquisitions and in-licenses.

We may be unable to acquire or in-license additional technologies from third parties that we decide we need in order to develop our business. A number of more established companies may also pursue strategies to license or acquire crop science technologies that we may consider attractive. These established companies may have a competitive advantage over us due to their size, cash resources and greater development and commercialization capabilities. Any failure on our part to reach an agreement for any applicable intellectual property could result in a third party acquiring the related rights and thereby harm our business.

In addition, companies that perceive us to be a competitor may be unwilling to assign or license rights to us. We also may be unable to license or acquire relevant crop science technologies on terms that would allow us to make an appropriate return on our investment.

We expect that competition for acquiring and in-licensing crop science technologies that are attractive to us may increase in the future, which may mean fewer suitable opportunities for us as well as higher acquisition or licensing costs. If we are unable to successfully obtain rights to suitable crop science technologies on reasonable terms, or at all, our business and financial condition could suffer.

Our license agreements include royalty payments that we are required to make to third parties.

We are party to license agreements that require us to remit royalty payments and other payments related to our licensed intellectual property. Under our in-license agreements, we may pay upfront fees and milestone payments and be subject to future royalties. We cannot precisely predict the amount, if any, or timing of royalties we may owe in the future. Furthermore, we may enter into additional license agreements in the future, which may also include royalty, milestone and other payments.

The intellectual property landscape around genome editing technology, such as CRISPR, is highly dynamic and uncertain, and any resolution of this uncertainty could have a material adverse effect on our business.

The field of genome editing, especially in the area of CRISPR technology, is still in its infancy, and no products using this technology have reached the market. In 2018, we entered into a non-exclusive research license agreement jointly with the Broad Institute of MIT and Harvard and Pioneer, part of Corteva Agriscience™, Agriculture Division of DowDuPont Inc., for the use of CRISPR-Cas9 genome-editing technology for crops in order to demonstrate the utility of our yield trait genes in this field. The joint license covers intellectual property consisting of approximately 48 patents and patent applications on CRISPR-Cas9 technology controlled by the Broad Institute and Corteva Agriscience. Under the agreement, we have the option to renew the license on an annual basis and the right, subject to specified conditions, to convert the research license to a commercial license in the future, although there can be no assurance that we will be able to secure such commercial license on acceptable terms. CRISPR technology is uniquely suited to agricultural applications as it enables precise changes to plant DNA without the use of foreign DNA to incorporate new traits. Plants developed using CRISPR genome-editing technology have the potential to be considered not regulated by USDA-APHIS under 7 CFR part 340 for development and commercialization in the U.S., which could result in shorter developmental timelines and lower costs associated with commercialization of new traits in the U.S. as compared to regulated crops. Due to the intense research and development that is taking place by several companies, including us and our competitors, in this field, the intellectual property landscape is in flux, and it may remain uncertain for the coming years. There has been, and may continue to be, significant intellectual property related litigation and proceedings relating to this

area in the future. If it is later determined that the patent rights using the CRISPR technology that we obtained under license are invalid or owned by other parties, this could have a material adverse effect on our business.

We rely in part on trade secrets to protect our technology, and our failure to obtain or maintain trade secret protection could harm our business.

We rely on trade secrets to protect some of our technology and proprietary information, especially where we believe patent protection is not appropriate or obtainable as is the case for our GRAIN trait gene discovery platform. However, trade secrets are difficult to protect. Litigating a claim that a third party had illegally obtained and was using our trade secrets would be expensive and time consuming, and the outcome would be unpredictable. Moreover, if our competitors independently develop similar knowledge, methods and know-how, it will be difficult for us to enforce our rights and our business could be harmed.

Risks Relating to Owning our Common Stock

You will be unable to exercise the warrants and they may have no value under certain circumstances.

We will not have authorized shares available to permit exercise of the warrants and such warrants will not be exercisable if we do not obtain stockholder approval to increase the number of authorized shares of common stock in an amount sufficient to permit exercise in full of the warrants. If we are unable to obtain such approval, the warrants will have no value.

Raising additional funds may cause dilution to our existing stockholders, restrict our operations or require us to relinquish rights to our technologies.

Execution of our business plan requires additional financing. If we raise additional funds through equity offerings or offerings of equity-linked securities, including warrants or convertible debt securities, we expect that our existing stockholders will experience significant dilution, and the terms of such securities may include liquidation or other preferences that adversely affect your rights as a stockholder. Debt financing, if available, may subject us to restrictive covenants that could limit our flexibility in conducting future business activities, including covenants limiting or restricting our ability to incur additional debt, dispose of assets or make capital expenditures. We may also incur ongoing interest expense and be required to grant a security interest in our assets in connection with any debt issuance. If we raise additional funds through strategic partnerships or licensing agreements with third parties, we may have to relinquish valuable rights to our technologies or grant licenses on terms that are not favorable to us.

Trading volume in our stock can fluctuate and an active trading market for our common stock may not be available on a consistent basis to provide stockholders with adequate liquidity. Our stock price may be extremely volatile, and our stockholders could lose a significant part of their investment.

The public trading price for our common stock will be affected by a number of factors, including:

- any change in the status of our Nasdaq listing;
- the need for near-term financing to continue operations;
- reported progress in our efforts to develop crop related technologies, relative to investor expectations;
- changes in earnings estimates, investors' perceptions, recommendations by securities analysts or our failure to achieve analysts' earnings estimates;
- quarterly variations in our or our competitors' results of operations;
- general market conditions and other factors unrelated to our operating performance or the operating performance of our competitors;
- future issuances and/or sales of our securities;

- announcements or the absence of announcements by us, or our competitors, regarding acquisitions, new products, regulatory developments, significant contracts, commercial relationships or capital commitments;
- commencement of, or involvement in, litigation;
- any major change in our board of directors or management;
- changes in governmental regulations or in the status of our regulatory approvals;
- announcements related to patents issued to us or our competitors and to litigation involving our intellectual property;
- a lack of, or limited, or negative industry or security analyst coverage;
- uncertainty regarding our ability to secure additional cash resources with which to operate our business;
- a decision by our significant stockholders to increase or decrease their holdings in our common stock;
- short-selling or similar activities by third parties; and
- other factors described elsewhere in these risk factors.

As a result of these factors, our stockholders may not be able to resell their shares at, or above, their purchase price. In addition, the stock prices of many technology companies have experienced wide fluctuations that have often been unrelated to the operating performance of those companies. Any negative change in the public's perception of the prospects of industrial or agricultural biotechnology companies could depress our stock price regardless of our results of operations. These factors may have a material adverse effect on the market price and liquidity of our common stock and affect our ability to obtain required financing.

Provisions in our certificate of incorporation and by-laws and Delaware law might discourage, delay or prevent a change of control of our company or changes in our management and, therefore, depress the trading price of our common stock.

Provisions of our certificate of incorporation and by-laws and Delaware law may discourage, delay or prevent a merger, acquisition or other change in control that stockholders may consider favorable, including transactions in which our stockholders might otherwise receive a premium for their shares of our common stock. These provisions may also prevent or frustrate attempts by our stockholders to replace or remove our management.

In addition, Section 203 of the Delaware General Corporation Law ("DGCL") prohibits a publicly-held Delaware corporation from engaging in a business combination with an interested stockholder, which generally refers to a person which together with its affiliates owns, or within the last three years has owned, 15 percent or more of our voting stock, for a period of three years after the date of the transaction in which the person became an interested stockholder, unless the business combination is approved in a prescribed manner.

The existence of the foregoing provisions and anti-takeover measures could limit the price that investors might be willing to pay in the future for shares of our common stock. They could also deter potential acquirers of our company, thereby reducing the likelihood that our stockholders could receive a premium for their common stock in an acquisition.

Concentration of ownership among our officers, directors and principal stockholders may prevent other stockholders from influencing significant corporate decisions and depress our stock price.

Based on the number of shares outstanding as of October 2, 2019, our officers, directors and stockholders who hold at least 5% of our stock beneficially own a combined total of approximately 45.7 percent of our outstanding common stock, including shares of common stock subject to stock options and warrants that are currently exercisable or are exercisable within 60 days after October 2, 2019. If these officers, directors, and

principal stockholders or a group of our principal stockholders act together, they will be able to exert a significant degree of influence over our management and affairs and control matters requiring stockholder approval, including the election of directors and approval of mergers, business combinations or other significant transactions. The interests of one or more of these stockholders may not always coincide with our interests or the interests of other stockholders. For instance, officers, directors, and principal stockholders, acting together, could cause us to enter into transactions or agreements that we would not otherwise consider. Similarly, this concentration of ownership may have the effect of delaying or preventing a change in control of our company otherwise favored by our other stockholders. As of October 2, 2019, Jack W. Schuler (and his related entities) beneficially owned approximately 40.1 percent of our common stock. To the extent that this or any other significant stockholders oppose any proposal put forth for stockholder approval by our board of directors, they control a sufficient percentage of our outstanding shares to cause such proposal to either fail or be very difficult to achieve without their support. This, in turn, could have a negative effect on the market price of our common stock. It could also prevent our stockholders from realizing a premium over the market price for their shares of common stock. The concentration of ownership also may contribute to the low trading volume and volatility of our common stock.

The comprehensive tax reform bill known as the Tax Cuts and Jobs Act could adversely affect our business and financial results.

On December 22, 2017, President Trump signed into law the Tax Cuts and Jobs Act of 2017, or ("TCJA"), that significantly reformed the Code. The TCJA, among other things, includes changes to U.S. federal tax rates, imposes significant additional limitations on the deductibility of interest and net operating loss carryforwards, allows for the expensing of capital expenditures, and puts into effect the migration from a "worldwide" system of taxation to a territorial system. Our net deferred tax assets and liabilities have been revalued at the newly enacted U.S. corporate rate as of December 31, 2018. We continue to examine the impact this tax reform legislation may have on our business and we urge our stockholders to consult with their legal and tax advisors with respect to such legislation and the potential tax consequences of investing in our common stock.

SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This prospectus and the information incorporated by reference in this prospectus contain forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, or Securities Act, and Section 21E of the Securities Exchange Act of 1934 ("Exchange Act"), regarding our strategy, future, operations, future financial position, future revenues, projected costs, and plans and objectives of management. You can identify these forward-looking statements by their use of words such as "anticipate," "believe," "estimate," "expect," "intend," "may," "plan," "project," "target," "potential," "will," "would," "could," "should," "continue," and similar expressions. You also can identify them by the fact that they do not relate strictly to historical or current facts. There are a number of important risks and uncertainties that could cause our actual results to differ materially from those indicated by forward-looking statements. For a description of these risks and uncertainties, please refer to the section entitled "Risk Factors," any other risk factors set forth in any information incorporated by reference in this prospectus, as well as any other risk factors and cautionary statements we include or incorporate by reference into this prospectus in the future. While we may elect to update forward-looking statements wherever they appear in this prospectus or in the documents incorporated by reference in this prospectus, we do not assume, and specifically disclaim, any obligation to do so, whether as a result of new information, future events or otherwise.

USE OF PROCEEDS

We estimate that the net proceeds from this offering will be approximately \$7.1 million, based on an assumed offering price of \$0.61 per share, after deducting the underwriting discounts and commissions and estimated offering expenses payable by us. The last reported sales price of our common stock on The Nasdaq Capital Market on October 8, 2019 was \$0.6199. If the underwriters exercise their over-allotment option in full, we estimate that our net proceeds will be approximately \$8.2 million, after deducting the underwriting discounts and commissions and estimated offering expenses payable by us.

We intend to use net proceeds from this offering for working capital and general corporate purposes. We have not yet determined the amount of net proceeds to be used specifically for any particular purpose or the timing of these expenditures. Accordingly, our management will have significant discretion and flexibility in applying the net proceeds from the sale of these securities.

MARKET FOR OUR COMMON STOCK

Market Information

Our common stock currently trades under the symbol "YTEN" on The Nasdaq Capital Market.

Stockholders

As of October 8, 2019, there were approximately 36 stockholders of record. On October 8, 2019, the closing price of our common stock as reported by The Nasdaq Capital Market was \$0.6199 per share.

DIVIDEND POLICY

We have never declared or paid any cash dividends on our capital stock and do not expect to pay any cash dividends for the foreseeable future. We intend to use future earnings, if any, in the operation and expansion of our business. Any future determination relating to our dividend policy will be made at the discretion of our board of directors, based on our financial condition, results of operations, contractual restrictions, capital requirements, business properties, restrictions imposed by applicable law and other factors our board of directors may deem relevant.

BUSINESS

Overview

Yield10 Bioscience, Inc. is an agricultural bioscience company which uses its "Trait Factory" to develop high value seed traits for the agriculture and food industries. Specifically, Yield10 plans to efficiently develop superior gene traits for the major grain crops including corn, soybean, canola, wheat and rice that will enable step-change increases in crop yield of at least 10-20 percent. While maintaining our focus on the development of novel yield traits for key grain crops based on a licensing model, we have recently begun to execute the second part of our strategy which is to develop independent business opportunities for Yield10 in the specialty oils and niche crop product space using the oilseed Camelina. The target of this effort is sustainable business solutions to support agriculture, sustainable global food production and other specialty applications. Yield10 brings a unique history, skill set and tools, captured in its GRAIN platform, for developing advanced crop traits and increasing the concentration of specific biochemicals of commercial interest in crops. Our plan is to use GRAIN to develop a source of revenue from funded research and development collaborations for traits, products and crops not being directly pursued internally. We are currently engaged in a range of discussions with third parties with respect to different crops, traits and products in the feed, food and pharmaceutical sectors.

We are currently progressing several novel yield gene traits in our pipeline in the major North American row crops canola, soybean and corn, and the niche crop Camelina, among others. Camelina is an oilseed crop similar to canola, with significant upside potential as a production platform for edible oils and PHA biomaterials. Our approach is to focus internal resources on progressing our traits through development and field trials in Camelina and canola while leveraging third party resources to progress our traits in soybean and corn while retaining control of our intellectual property. Over the last three years, we have evaluated certain of our traits in greenhouse studies and field tests conducted in the United States and Canada. We currently have non-exclusive research license agreements in place with the Crop Science division of Bayer AG, for the evaluation of our C3003 and C3004 traits in soybean and with Forage Genetics International, LLC, a division of Land O'Lakes, Inc. for the evaluation of five yield traits in forage sorghum. Our business strategy is to progress our traits into field tests to generate validating yield data. We have progressed our evaluation of C3003 in field tests with Camelina and canola and we are planning to expand our field tests with more C3003 canola events. We plan to leverage data that we generate to support the performance of our traits in key crops to establish collaborations or to sign licenses to the traits with major agricultural companies in order to generate revenue. Yield10 Bioscience is headquartered in Woburn, Massachusetts and has an oilseed development Center of Excellence in Saskatoon, Saskatchewan, Canada.

According to a United Nations report, crop production must be increased by over 70 percent in the next 35 years to feed the growing global population, which is expected to increase from 7 billion to more than 9.6 billion by 2050. During that time period, there will be a reduction in available arable land as a result of infrastructure growth and increased pressure on scarce water resources. Consumption of meat, fish, and dairy products is also expected to increase based on dietary changes associated with increasing wealth and living standards. Harvestable food production per acre and per growing season must be increased to meet this demand. At the same time, with the increasing focus on health and wellness, food safety and sustainability in developed countries, we anticipate a rise in demand for new varieties of food and food ingredients with improved nutritional properties. With crop intensification (less land available and more production needed), we expect that improved crop genetics based on new gene traits will be a key driver of increased productivity, potentially resulting in the best performing yield traits commanding disproportionate value and disrupting the seed sector. We expect farmers and growers to be the major beneficiaries of these drivers, which represent potential opportunities for increased revenue and crop diversification. Today the global food market has an estimated value of \$5 trillion.

Crop yield is determined by the efficiency by which crops fix carbon dioxide from the air through photosynthesis and convert that fixed carbon through carbon metabolism during the growing season into harvestable grain or biomass. Yield10 brings unique capabilities and experience in advanced metabolic engineering and systems biology to optimize photosynthesis and carbon efficiency in crops to increase grain or biomass yield. These capabilities were developed based on sustained investment over many years when the Company was named Metabolix. As Metabolix, the Company solved complex biological problems in the industrial/synthetic biology space to produce bioplastics. By 2012, the Company had

begun work to increase photosynthesis in crops as part of those activities, which led to the creation in 2015 of the current Yield10 business focused on crop yield. In mid-2016 we sold our bioplastics assets to focus on our agricultural innovations and the Company was rebranded as Yield10 Bioscience in January 2017.

Exciting new genetic engineering technologies like the CRISPR technology and other approaches to genome editing hold promise to accelerate the deployment of novel traits into commercial crops. This method of making insertions or deletions of DNA into plants without the use of foreign DNA has been described as “precision breeding.” We signed a research license, with rights to convert to a commercial license, to CRISPR/Cas-9 technology in 2018 to support our genome editing program. We have taken two genome edited traits designed to boost oil content in oilseed crops through the USDA-APHIS “Am I Regulated?” petitioning process and have confirmed that the agency does not consider two of our lines to be regulated pursuant to 7 CFR part 340, clearing the way to conduct field tests in the United States. Genome editing technology as well as the streamlined regulatory process supported by USDA-APHIS for certain types of plant traits may enable agricultural innovators such as Yield10 to deploy and field test new traits more quickly, potentially resulting in a shorter path to market and reduced costs as compared to the more highly regulated path required for traditional biotechnology-derived traits.

SUMMARY OF OUR CROP YIELD TRAITS IN DEVELOPMENT	
R&D Area	Crops Under Evaluation
Seed Yield Traits-Likely Regulated¹	
C3003	Canola, soybean, sorghum and corn
C3011	Corn, Camelina and canola
Seed Yield Traits-Likely Not-Regulated²	
C3004	Camelina, canola and corn
Oil Enhancing Traits-Likely Not-Regulated²	
C3007	Camelina and canola
C3008a	Camelina (not-regulated ⁴)
Oil trait combinations - C3008a, C3008b and C3009	Camelina (not-regulated ⁴)
Additional oil traits and combinations	Research in progress (target crops to be determined)
Yield Improvement Trait Discovery Platform (Traits Potentially Non-Regulated)³	
C4001	Wheat, rice, sorghum and corn
C4002	Sorghum and corn
C4003	Wheat, rice, sorghum and corn
C4004	Wheat and rice
C4029	Sorghum

(1) C3003 and C3011 consist of microbial genes and are likely to be subject to regulation by USDA-APHIS.

(2) These traits are accessible using genome editing or other methods that do not result in the insertion of non-plant DNA. These approaches may be deemed not to be regulated by USDA-APHIS pursuant to 7CFR part 340 based on recent filings by us and other groups.

(3) Traits in this area were developed in our T3 platform and all are potentially deployable through approaches which may be not-regulated by USDA-APHIS pursuant to 7 CFR part 340.

(4) USDA-APHIS does not consider these lines submitted by Yield10 to be regulated pursuant to 7 CFR part 340. Commercial plant or plant lines or plant products derived from these lines may be regulated by the FDA or EPA.

One of the critical unmet needs in the agricultural sector is to increase the fundamental yield potential of crops to address global food security. This challenge is well suited to Yield10's unique background and expertise in metabolic modeling, genetic engineering, genome editing and next generation microbial gene systems which collectively form the

foundation of Yield10's trait development process. We refer to this trait development process as the "Trait Factory." The Trait Factory encompasses discovery of gene targets using our GRAIN platform (which stands for **Gene Ranking Artificial Intelligence Network**), genetic engineering of crops using traditional approaches or genome editing to modify those targets and generation of field data with the engineered crops. Performance and molecular data from the engineered crops are then fed back into the GRAIN system to enable refinement of specific gene targets and the identification of new trait gene targets. Modified crops with improved performance enter our development pipeline and progress on the regulated or non-regulated path to market depending on how the plants are genetically engineered. GRAIN is a powerful new tool developed primarily to focus on Yield10 trait targets including performance traits for major row crops including corn, soybean, and canola as well as our niche product opportunities based on our Camelina platform. We believe we may also be able to generate a revenue stream by providing access to our GRAIN platform to third parties interested in other trait targets and/or crops Yield10 is not pursuing.

As we continue to develop the GRAIN platform, key elements of this system have proven effective and have enabled Yield10 to produce several promising crop yield traits in our development pipeline. Yield10 has achieved and published in peer reviewed journals scientific data from growth chamber and greenhouse studies showing that significant improvements to crop yield are possible. We have achieved these results by improving fundamental crop yield through enhanced photosynthetic carbon capture and increased carbon utilization efficiency to increase seed yield. Examples of these traits and their impact on crop yield are shown below. The C3005 trait results required a complex combination of microbial genes to enhance carbon fixation during seed development and serves to highlight the power of our advanced metabolic engineering/systems biology approach. Results we have obtained based on preliminary testing of our C3003 and C3004 traits as well as our C4000 series traits support our plans to test and develop these traits in major row crops.

Examples of our traits and their impact on crop yield in growth chamber and greenhouse studies
C3003/C3004 traits: 23% - 65% increase in seed yield in oilseed crops (Camelina)
C3006 advanced synthetic biology trait: 128% increase in oilseed yield (Camelina)
C4001, C4003 traits: 70% increase in photosynthesis, 150% increase in biomass (switchgrass)

Yield10 has a pipeline of more than 10 novel yield traits in research and development and we expect to generate several proof points for our traits in various crops over the next two years. We are developing our lead yield trait C3003 in canola and recently completed its second year of field tests in Canada. We continued field tests in 2019 as we advance the trait towards commercial development by developing additional commercial canola lines with the trait and expanding field testing. We plan to undertake our first field testing of C3004 in our Camelina platform in 2019 and are working to deploy and test this promising trait in canola, soybean and corn in the future. We have proven capabilities with genome editing using the CRISPR/Cas9 system and USDA-APHIS has determined that single and multiple genome edited lines of Camelina designed to increase oil content are not considered to be regulated by the agency under 7 CFR part 340. We plan to field test these plant lines and use the data to optimize the deployment of these traits to boost oil content in canola and potentially soybean. We recently successfully edited C3007, a novel target gene for increasing oil content, in canola and these plants are now progressing through our development pipeline. We plan to continue to progress initial development and testing of multiple traits in wheat and rice. Our approach is to engineer rice and wheat plants with our gene regulator traits to increase photosynthesis and grain yield and use those plants as a source of data to generate new gene targets for genome editing. Yield10 has no plans to field test or develop wheat or rice using traditional genetic engineering technologies. We anticipate that data generated on our traits will enable us to establish revenue generating collaborations in the future for the development and commercialization of our novel yield traits in commercial crops.

We are building a portfolio of intellectual property around our crop yield technology and traits. As of June 30, 2019, we owned or held exclusive rights to 20 patents or pending patent applications worldwide related to advanced technologies for increasing yield in crops. Our portfolio of patent applications includes plant science technologies we have in-licensed globally and exclusively from the University of Massachusetts and North Carolina State University related to the yield trait gene C3003 and other advanced technologies based on advanced metabolic engineering methods to improve carbon capture and selectively control carbon partitioning in plants. Our portfolio of patent applications also includes advanced technologies for increasing oil content in oilseed crops that we in-licensed globally and exclusively from the University of Missouri in 2018 and 2019 related to the yield trait genes C3007, C3010 and C3012. We also recently filed a new patent application on a breakthrough technology for producing PHA biomaterials in oilseeds which offers the potential for very low cost production of a specialty crop with applications in water treatment and plastics replacement.

The Unmet Need: Global Population Growth Outpacing Anticipated Global Food Supply

Yield10 is targeting a critical unmet need in agriculture based on the future disconnect between agricultural supply and the growing global population. According to a United Nations study, the global population is expected to exceed 9.6 billion people by 2050 and therefore there is a need to increase global food production including in grains, protein, dairy and edible oils to meet this demand. This will need to be achieved in the face of increased pressure on land and water resources in addition to increasingly variable weather patterns. Solving this problem is a major global challenge requiring new crop innovation and technologies to fundamentally enhance crop productivity.

The Yield Gap

According to several studies described in an article published in the Public Library of Science in 2013, crop yields may no longer be increasing in different regions of the globe, and current rates of crop yield increase based on traditional plant breeding approaches are expected to fall significantly behind the levels needed to meet the demand for global food production. The researchers found that the top four global crops—maize (corn), rice, wheat and soybean—are currently witnessing average yield improvements of only between 0.9 to 1.6 percent per year, far slower than the required rates to double their production by 2050 solely from incremental yield gains. At these rates, global production of maize, rice, wheat and soybean crops may be required to increase by about 67 percent, 42 percent, 38 percent and 55 percent, respectively, by 2050, in order to meet the anticipated increase in demand for food production caused by population growth. For corn and soybean, the benefits of currently available biotechnology traits were already factored into the data cited in the studies referenced above. The yield increases needed to meet the demands of the growing global population show that a significant “yield gap” exists for each of the crops evaluated in the study.

Yield10 is focused on addressing the yield gap for major crops by utilizing modern biotechnology strategies, including metabolic engineering (synthetic biology approaches) to “build better plants,” by using our Trait Factory to optimize photosynthesis and carbon efficiency in crops to increase grain or biomass yield. Enhancement of the photosynthetic capacity of major crops is fundamentally important to crop science and an essential first step to increase the seed and/or biomass yield of plants and, therefore, food production. We have been working in the area of increasing photosynthetic carbon capture and crop yield technologies since 2012 and we have identified several potentially promising genes for increasing yield or improving crop performance.

Health and Wellness, Food Safety and Sustainability

At the same time, with the increasing focus on health and wellness, food safety and sustainability in developed countries, we anticipate a rise in demand for new varieties of food and food ingredients with improved nutritional properties. Further, concerns about food safety have led to the concept of “seed to plate,” with a focus on stringent quality control along the entire value chain. If this concept takes hold with consumers, it is likely to require identity preservation from seed to harvest and involve contract farming. This concept is currently being implemented in agricultural biotechnology, in both canola and soybean which have been modified to alter the composition of the oil produced. High oleic canola and soybean oils are being marketed as “healthier” where the value driver is the ability to make marketing claims directly to the consumer. Camelina oil has also recently been shown in clinical studies to be more effective than fish oil for controlling LDL cholesterol indicating potential use in reducing heart disease. Consumer demand to preserve the identity of specialty ingredients is expected to rise, and we believe that Yield10’s crop yield technologies and crop gene editing targets could be useful in this emerging field. Yield10 believes that these types of small acreage specialty crops have the potential for a broader range of future partnering opportunities along the entire value chain. Camelina also has considerable potential as a cover crop to reduce soil erosion and nutrient run-off from land used for row crop production. Production of PHA biomaterials in Camelina could provide economic returns for farmers to justify large acreage adoption and enable the low-cost production this product for new markets including water treatment and plastics replacement applications.

Business Strategy

Our goal is to build a successful agricultural biotechnology company centered on demonstrating and capturing the value of our traits and technologies based on three potential revenue streams. In major food and feed crops for licensing to established agricultural companies and building other revenue generating business from our new niche crop opportunities we have begun developing based on our patent protected technologies. These potential revenue streams consist of:

- Licensing of our yield and performance traits for use in major row crops;

- Product sales revenue from niche products produced in our Camelina platform and other oilseeds; and
- R&D revenue for access to our GRAIN trait gene discovery platform.

We have identified and are evaluating novel yield trait genes in our Trait Factory to help address the growing global yield gap in food and feed crops. As the primary driver of financial returns each season, crop yield is the key decision variable for farmers in making seed buying decisions, and as a result, is critical to the seed industry. Improvements in yield to the levels targeted by Yield10, for example 10-20 percent increases, would be expected to generate significant value to the seed and crop industry. For example, Yield10 is targeting an approximately 10-20 percent increase in canola and soybean yields, which, if successfully deployed across North American acreage, could result in annual incremental crop value of up to \$10 billion. By ultimately increasing the output of major food and feed crops and potentially reducing strains on scarce natural resources, we believe that Yield10's technologies will also contribute to addressing global food security.

Recognizing the highly concentrated nature of the seed business, the prevalence of cross-licensing of traits, and the need to stack multiple crop traits in elite seed germplasm to provide the best options for farmers for large acreage commodity crops, Yield10 does not expect to become an integrated seed company. The current major seed companies dominate the biotech crop space based largely on the early technology innovations that resulted in herbicide and pest resistance traits and have a very successful operating track record in the sector. Yield10 plans to develop yield traits that enable farmers to increase their revenue and secure a share of that added value. To do this Yield10 plans to license our trait innovations to the major agricultural companies so that they can be deployed in elite seed varieties. The incremental value sharing model is well established in the seed sector. Therefore, rather than replicating the downstream elements of these operations and developing our own regulatory, crop breeding or seed production capabilities, we intend to seek industry collaborations and partnerships to leverage these existing core competencies of the current seed industry. Yield10 will focus on its core competency, which is breakthrough science and technology innovation applied to the seed sector.

The type of collaborations and partnerships we seek will depend on the specific anticipated path to market for the crop. For large acreage biotech crops including canola, soybean and corn, we plan to develop proof points for our yield traits as a basis for licensing to major agricultural companies with a focus on capturing downstream value. By developing gene traits that enable the farmer to increase revenue, Yield10 believes that it can secure a share of that increased revenue in much the same way Uber generates revenue by enabling private car owners to operate in the taxi business. According to industry estimates, the timeline from discovery to full commercialization of a biotech trait in a commodity crop can be up to 13 years at a cost of up to \$130 million. Our C3003 yield trait is an algal gene, and we believe that it will be regulated as a biotech trait. As we are in the construct optimization/event selection stage, we believe that we are approximately half way along the anticipated development timeline for C3003 in canola. Our strategy is to make it attractive for major agricultural companies to invest financial and technical resources to introduce our traits into their elite germplasm for event selection and evaluation. In 2017, we signed a non-exclusive research license with the Crop Science division of Bayer AG ("Bayer") (formerly Monsanto Company), to test C3003 and C3004 in soybean. In 2019, the license was expanded to cover a new discovery and intellectual property related to C3004. Similarly, in 2018 we signed a non-exclusive research license with Forage Genetics International LLC, a division of Land O'Lakes, Inc. ("Forage Genetics"), to test a series of traits in forage sorghum. We may sign additional non-exclusive research licenses on a crop by crop basis in the future, allowing the licensees to invest their resources in progressing the trait. Our focus is on securing a share of the upside value of our traits when we finalize the economic terms of license agreements at the point where the value of the trait is well understood.

For small acreage specialty oil crops, we believe we can leverage our Camelina platform, seed yield and oil content traits to add value to the development of specialty oils focused on human nutrition and aquaculture feed markets. These crops can cost more to produce because of the unique supply chain needed when identity preservation from seed planting to final product is desired. In this area, there may be opportunities for establishing partnerships and license agreements with consumer facing companies in the food and feed sector. Our high oil content traits developed through genome editing may have shorter timelines to commercialization (3-6 years) if deployed in specialty oil crops. We are at an early stage of developing our strategy in this area but believe it may have considerable potential for Yield10.

We believe that the production of PHA biomaterials in Camelina could provide economic returns for farmers to justify large acreage adoption and enable the low-cost production of this product for new markets including water treatment and plastics replacement. We believe crop based production will enable an advantageous cost structure thereby eliminating one of the remaining significant barriers to entry for broad adoption of these biomaterials. In water treatment the PHA biomaterial acts as a growth substrate and energy source for denitrifying bacteria which convert nitrate, a primary cause of water pollution and algal growth to nitrogen gas which returns to the air. This application is technically

straight-forward, requiring only the production and shipment of PHA biomaterials in pellet form. Yield10 is in the early stages of developing a revenue generating business model for this opportunity.

PHA biomaterials are also widely useful for functionally replacing petroleum-based plastics in a wide range of packaging applications. The plastics industry, which produces more than 350 million tons of material per year globally, is facing intensive scrutiny due to the failures in plastics recycling and increasing plastic waste in the environment. As natural biomaterials, PHAs fully degrade over time in the environment yet have excellent shelf life in use. We estimate that PHA biomaterials can be produced at very low cost in oilseeds based on our newly patented technology. When we made the transition to the Yield10 business we divested our fermentation-based PHA bioplastics assets and related application technology, based on the microbial fermentation platform but retained the patents and field of PHA production in engineered crops. Yield10 plans to produce resin-grade PHA biomaterial for supply to the plastics sector.

Yield10 plans to build on its core strengths bringing new technology approaches to exploit an innovation gap in the agricultural biotechnology space that exists due to reduced investment in basic research and development resulting from the ongoing consolidation and restructuring in the agricultural sector. Yield10's mission is to translate and optimize our step-change yield trait innovations in six major food and feed crops and demonstrate their economic value to farmers and seed companies. We intend to create high-value assets in the form of proprietary yield trait gene technologies and to de-risk these assets by progressing them along the path to commercial development with increasingly larger scale field tests and multi-site field trials in major crops. We are currently deploying our yield trait genes into canola, soybean, rice, wheat and corn, by designing and progressing genetically engineered events that we believe to be suitable for the applicable regulatory approval processes and which can be readily bred into the industry's elite crop lines by plant breeding. We expect the customers for Yield10's innovations to be the large and mid-size agricultural companies that would either license or acquire rights to Yield10's yield trait genes and incorporate them into their proprietary commercial crop lines for subsequent commercialization.

We are focused on identifying and developing technologies that will enable us to produce step-change improvements to crop yield.

Yield10 is targeting a critical unmet need in agriculture based on the anticipated disconnect between agricultural supply and the growing global population. Food production must be increased by over 70 percent in the next 35 years to feed the growing global population, which is expected to increase from 7 billion to more than 9.6 billion by 2050. Global climate change is also resulting in regional shifts to historical growing conditions. Given the projection for population growth, recent studies show a "yield gap" for major food and feed crops that cannot be addressed by incremental improvements to yield brought about by traditional plant breeding and existing biotech traits. Current biotech traits deployed in crops by the seed industry are based primarily on using microbial-sourced genes to impart yield protection through herbicide, pest, disease and even drought resistance, whereas Yield10 is focused on increasing fundamental crop yield through enhanced carbon capture and utilization.

Yield10 is focused on "building better plants" using the Trait Factory to optimize photosynthesis and carbon efficiency in crops to increase grain or biomass yield targeting step-change increases in the range of 10-20 percent in crop yield.

Our History

We have a significant track record and expertise in the metabolic engineering of microbes and have made significant progress translating this capability to plants.

As part of the legacy biopolymers and biobased chemicals business of our predecessor company Metabolix, our research team developed an advanced metabolic engineering capability to alter key biochemical pathways and redirect the flow of carbon metabolic intermediates in microbes resulting in the production of PHA, a natural biomaterial, at a level of more than 80 to 90 percent by weight of microbial cells that normally did not produce any PHA. In 1997, Metabolix initiated a crop science research program to produce PHA biomaterials in crops as a low cost production system. Historically, these efforts were focused on producing PHB, a microbial carbon storage biopolymer, in high concentration in the seeds of oilseed crops or in the leaves of biomass crops such as switchgrass. The PHB biomaterial is useful as a natural water treatment product and as a replacement for petroleum-based plastics.

As we made progress on producing PHB in plants, we learned that basic carbon supply from photosynthesis was a bottleneck. To address this carbon shortfall, in 2012 we began developing new metabolic engineering and bioinformatics approaches to enhancing basic crop photosynthetic carbon capture. Discoveries from these two approaches became the foundation of our GRAIN crop trait discovery platform. We also began building intellectual property on novel yield trait

gene technologies discovered in these programs and realized that our experience in re-engineering the flow of carbon in microorganisms could be applied to building better plants. Photosynthesis is the most important biological process responsible for global food production. Improving the photosynthetic capacity of plants is an essential first step to increase seed and/or biomass yield and, therefore, food production. We must develop plants which on a per acre basis during the growing season fix more carbon and ultimately target that additional fixed carbon to seed or biomass.

Our Approach

We have assembled a pipeline of crop yield traits for development that are applicable to major commercial crops.

Our unique approach to crop yield trait discovery utilizing our GRAIN platform, which integrates advanced metabolic engineering concepts to address critical bottlenecks in carbon metabolism, has enabled us to discover a series of yield genes with potential use for producing step-change improvements in crop yield. Through our research and early development efforts we have identified and begun characterizing our C3000 and C4000 series of traits. To initially characterize the potential yield trait genes, we test many of our yield trait candidates using our Camelina platform. As a yield trait innovator, our objective is to identify novel yield traits that act at a fundamental level in crop metabolism to provide the potential for broad deployment of our traits across multiple crop types. Following our early work with these trait genes, we focus on deploying the traits for evaluation across a range of crops including canola, soybean, corn, rice, wheat, each of which are crops of high commercial interest in North America. For crops where Yield10 is not directly conducting research and development activities, we are open to licensing arrangements like the agreement we have in place with Forage Genetics for evaluation of five of our traits in forage sorghum. Our goal is to generate greenhouse and field test data that will support commercial development of the trait and enable us to form collaborations or enter into license agreements with major agricultural companies in order to incorporate our novel yield traits into their seed products. We believe that successfully launching new, high yielding seed to the market would result in higher economic benefit to growers, seed companies, and Yield10.

We believe our business model will allow us to capture value for our yield trait discoveries and provide a path to commercialization for important new yield traits for major crops.

Yield10 is working to advance our own developments as well as form business alliances to progress our traits through development, launch and commercialization. Our goal is to capture an attractive share of the added economic value resulting from the deployment of our trait genes and technologies in key crops. We are currently working on the development and deployment of our trait genes into several crops, an approach facilitated by the expiration of much of the early foundation patents in the agricultural biotechnology sector, and one of our key objectives in that regard is to demonstrate commercial proof points through field tests and multi-site field trials. Yield10 opportunities and business models for value capture include partnering or licensing with established agricultural industry companies. Key to our strategy is to retain, where practical, control of timelines and maximize, where possible, the opportunity for value creation and optionality around future value realization strategies. In 2019, we are focused on identifying and signing additional research and development collaborations to accelerate commercial development of our promising yield traits.

We have signed non-exclusive research licenses for our novel yield traits with agriculture industry leaders.

In 2017 we granted a non-exclusive global research license to Bayer to evaluate our novel yield traits C3003 and C3004 in soybean. The license was expanded in 2019 to include a new discovery and intellectual property for C3004. Bayer is a leader in the development and commercialization of biotech-derived soybean seed. In 2018, we granted a research license with a similar structure to Forage Genetics, a leader in forage crops used for animal feed, to evaluate five traits in forage sorghum.

These licenses are intended to provide market leaders in their respective crops with an attractive opportunity to test our traits and develop data at their own expense. At any time during the term, they have the option to negotiate a broader agreement with us. At the same time, we have the right to sign licenses with other companies for these traits. This structure allows us the flexibility to expand the testing of our traits with investment by other companies and to potentially enter negotiations for development and commercial licenses when the value of our traits is better understood. In 2019, we plan to explore additional opportunities to expand the testing of our traits through similar arrangements with other companies.

We are focused on developing yield traits for use in canola, soybean and corn, major North American commercial crops.

Canola, soybean and corn represent the largest North American commercial crops with approximately 195 million combined acres. The majority of the crop acreage incorporates biotechnology traits for herbicide or pesticide resistance that are deployed in elite germplasm controlled by seed companies. Recent advances in crop yield have been based primarily on the use of biotechnology traits to protect yield by managing and/or allowing the plants to outcompete weeds. We are developing our traits to complement the biotechnology traits currently utilized in these major crops by focusing on our traits to increase the inherent seed yield of the plant. In 2018, we obtained promising field test results for second generation C3003 in canola and advanced work with the trait into the early commercial development phase where we will make and test additional elite events of the C3003 trait. Our development work with C3003 and other traits in the C3000 and C4000 series, some of which may be accessible using genome editing, is progressing in canola, soybean and corn. Canola is important as an edible oil for human consumption, while soybean and corn are grown in North America mainly as animal feed.

We are testing our yield traits in wheat and rice, important staple crops for human consumption.

Wheat and rice are important staple crops used primarily for human consumption. It is estimated that more than 900 million acres of rice and wheat are grown annually worldwide. Advances in seed yield for rice and wheat have occurred primarily through plant breeding for rice and hybridization and breeding for wheat. Genetically modified, or GM, traits based on biotechnology have not been broadly introduced into these crops. Seed sales to growers for these crops typically rely on regional, local organizations to distribute and sell seed and the market is extremely fragmented. To enable production of wheat and rice to meet future global demand, increases in yields will be required. The application of genome editing to precisely incorporate yield traits into these crops may represent a way to increase yield and establish consumer acceptance of the technology and seed product. We recently published promising results with members of our C4000 series of traits showing that deployment of these traits in switchgrass as a model crop resulted in significant increases in photosynthesis and biomass yield. We are testing C4000 series traits that may be accessible through genome editing as a strategy to produce increases in seed yield in wheat and rice. If we are successful identifying yield traits accessible through genome-editing that have potential to boost seed yield in rice and/or wheat, we are likely to seek partners for further development and commercialization in these food crops.

Our GRAIN platform provides us with a unique approach for discovering novel yield trait genes.

We have integrated advanced metabolic flux modeling capabilities with transcriptome network analysis to form the foundation of our GRAIN bioinformatics gene discovery platform. This discovery platform is the core of our Trait Factory. GRAIN takes both a bottom up approach based on the flow of electrons and carbon through essential metabolic processes and a top down approach based on transcriptome network analysis. In the case of crops, the levers to increase seed yield are the metabolic infrastructure through which carbon flows from photosynthesis to seed production and the gene regulators or transcription factors which control the various pathways. Over the last 20 years, the agricultural sector has generated vast numbers of data points. During this same period, there have been very few new crop traits produced. The purpose of GRAIN is to develop a system which can convert data sets into actionable gene targets to improve crop productivity. We have employed this approach to discover a range of potential yield trait genes.

We have identified promising potential yield targets which can be modified using genome editing. We believe that such targets may be subject to less regulatory complexity in the U.S. during development and along the path to commercialization and may provide opportunities for licensing.

Genome editing techniques, including CRISPR, which involve making small targeted changes to the DNA of a target organism, have been of interest to the agricultural biotechnology industry because this approach is believed to have the potential to significantly reduce development costs and regulatory timelines for crop trait development and market introduction. In 2018, we signed a non-exclusive research license for CRISPR/Cas-9 technology with the Broad Institute of MIT and Harvard and Pioneer, part of the Corteva Agriscience Agriculture Division of DowDuPont Inc.

Announcements from USDA-APHIS, including those made in 2018, indicate that the regulatory path for genome edited plants lines that do not contain any remaining foreign DNA (i.e. DNA sequences not from the plant being engineered) from the procedure used to edit the plant may not be subject to certain USDA-APHIS crop regulations in the U.S. See “Regulatory Requirements” section below. One of the potential implications of this regulatory approach in which edited plants are subject to fewer regulatory controls than traditional genetically modified plants may be to significantly decrease the timeline and cost of developing and bringing new traits to commercialization in the U.S. The challenge now

for the agricultural biotechnology sector will be to identify gene targets for genome editing that can generate economic value. This has opened the potential for Yield10 to exploit a second tier of novel traits addressable with genome editing.

Yield10 has identified, from its internal discovery platforms and in-licensed through academic collaborations, gene targets suitable for deployment in crops through genome editing. In the course of our work, we have introduced genes coding for new metabolic pathway enzymes or global transcription factors producing high yield lines with higher rates of photosynthetic carbon fixation. Analysis of these high yielding plants has allowed identification of novel genome editing targets.

We have deployed genome editing technology based on our C3008a trait in Camelina as well as our triple edited-line based on our C3008a, C3008b and C3009 traits in Camelina, which were deemed non-regulated by USDA-APHIS in 2017 and 2018, respectively. Plants that are not regulated by USDA-APHIS may still be subject to regulation by the FDA or the EPA depending on certain characteristics and the plant's intended uses. We expect to increase our level of effort in this area in other crops, particularly canola, over the course of 2019 and are implementing a plan to deploy our genome edited traits into soybean, rice and corn. We have successfully edited the C4004 gene in rice and are currently developing performance data on the edited rice lines. We believe our genome editing targets as well as the improved crops we could develop using this approach may enable us to form collaborations or enter into license arrangements with a broader set of potential commercial partners in order to bring these genome edited traits forward into development in the near-term.

We plan to use any revenues we generate from license agreements around our genome editing targets to support our ongoing research and development efforts to enable step-changes in crop yield.

We developed the Camelina Fast Field Test model system to characterize, evaluate and de-risk novel yield trait genes.

One of the challenges the agricultural industry has faced over the years is translating early crop science discovery into value generating traits. In part this is because results from greenhouse studies in model plants have not translated well into field results in major crops. This is also in part because the plants used for discovery research have not been suitable for studies in the field and are not representative of the advanced seed or crop varieties (germplasm) used in commercial production, which have been subject to decades of intensive breeding to improve yield. Translating success when introducing non-plant genes into major crops has been very successful and the current biotechnology seed sector, which accounted for 457 million acres of crops worldwide in 2016, is based on using microbial genes in plants. The long timelines to progress early discoveries successfully into major crops and generate field data adds to the challenge.

For these reasons, Yield10 has put in place a process we call "Fast Field Testing" based on our Camelina oilseed platform. We believe that over time this will become a valuable tool in the trait discovery to translation effort. Camelina is an industrial oilseed well-suited to field trials, and we believe it is a good model for identifying promising new yield traits for canola and soybean. It is also very fast to modify and develop genetically stable seed for field planting. Ideally, we hope to be able to progress from trait identification to field planting in about 12 months. Our process is to identify trait genes of interest in Camelina and immediately begin putting them into canola and soybean, where the timelines to transform plants and generate field data are much longer. We can then progress the Fast Field Testing in Camelina and generate field data and a complete molecular analysis of plant material from the field. These results and data can then be used to inform how we progress the previously transformed canola and soybean.

We believe that this will provide the opportunity for go-no-go decisions in some cases and in other cases allow us to update our approach based on the results of our Fast Field Testing in Camelina. For example, with the longer development timelines needed to get canola and soybean ready for field testing, we expect to initiate additional modifications earlier in these crops, having identified the potential to further improve the outcome based on the results of our Fast Field Testing in Camelina.

In our 2017 and 2018 field test programs, we tested both first and second generation versions of C3003 in Camelina and in canola, an important North American oilseed crop. Overall, our findings in canola for first generation and second generation C3003 mirror closely our observations of the effect of the trait in Camelina, underscoring the value of Camelina as a predictive system for understanding the performance of our novel yield traits in development.

We are using our Camelina Field Test model system to de-risk and accelerate the demonstration of the trait gene value in major crops. As a particular trait is de-risked there is the potential for inflection points in value. If we can establish a strong correlation between the results from the Camelina system with future field data first from canola and then with soybean, then we may be able to leverage this to enter partnership and licensing discussions earlier while preserving the opportunity to capture a meaningful share of the upside value.

Through our investment in the Camelina platform Yield10 established the foundation for potential niche crop product opportunities such as nutritional oils and PHA biomaterials.

Our Oilseed Operation based in Canada provides us with unique capabilities in the development of oilseed crops.

We established our oilseeds subsidiary in Canada in 2010 to produce robust oilseed germplasm with engineered value-added traits for commercial crop production in western North America. Our oilseeds team is based in Saskatoon, Saskatchewan, with laboratories in the National Research Council (NRC) - Saskatoon facility and commercial greenhouse and laboratory facilities at nearby Innovation Place. Our team has developed and implemented technology to improve and accelerate engineering and trait evaluation of Camelina and canola. The team also plays a key role in designing and conducting greenhouse and field tests required to effectively evaluate novel yield traits.

We are establishing a network of commercial and science advisors to provide us with insight and opportunities to advance our industry alliances, crop research and development, and key intellectual property.

Yield10 named Sherri Brown, Ph.D., a former Monsanto Company executive, as a special commercial and technical advisor to the Company in 2018. Dr. Brown, who is currently a Managing Director at The Yield Lab, served from 1999-2017 in leadership positions at Monsanto, most involving the development and commercialization of new traits for corn and oilseed crops including soybean and canola.

Yield10 has pursued academic collaborations that have led to the discovery of novel yield trait genes. Researcher Danny Schnell, Ph.D. discovered the C3003 trait in an ARPA-e (a division of the U.S. Department of Energy ("DOE")) funded collaborative project at the University of Massachusetts in which Yield10 was a partner. In 2015, Prof. Schnell moved to Michigan State University where he is Chairperson, Department of Plant Biology and remains a collaborator on C3003. In 2018, Yield10 announced signing a global license agreement with the University of Missouri for advanced technology to boost oil content in oilseed crops, including C3007 and C3010, which are based on the discovery of a key regulatory mechanism controlling oil production in oilseed crops which can be used to increase oil content. Jay J. Thelen, Ph.D., Professor of Biochemistry at the University of Missouri, who discovered this mechanism, joined Dr. Schnell and Dr. Sederoff as a member of our Scientific Advisory Board in 2018.

We plan to seek U.S. and Canadian government grants to support our research and development goals.

Yield10 has been awarded grants over the last several years supporting research on strategies to improve the efficiency of photosynthesis, increase seed oil content, identify novel yield traits and test these novel traits in Camelina. This work is valuable because traits developed in Camelina have the potential to be developed and deployed in other oilseed crops. For example, in 2017, we were selected as a sub-awardee on a new DOE grant led by Michigan State University that commenced during the first quarter of 2018 to conduct research aimed at boosting oilseed yield in Camelina. We plan to continue to pursue government grants to defray research costs associated with our research and development activities.

We are operating with a lean organizational footprint which is evaluating our novel yield traits in greenhouse and field tests while maintaining efficient use of cash resources.

As of June 30, 2019, we had 25 full-time employees, with the majority directly involved with our research and development activities. We believe that our organizational capabilities are aligned with our research priorities and are complemented by our use of third-party infrastructure and certain service providers. With this approach we can leverage third-party infrastructure and capability without having to spend the time and capital needed to recreate them in-house. This is allowing us to focus our limited resources on deploying our core strengths against our key development goals. We expect to grow our research and development operations over time commensurate with building value in our business and advancing our traits through development while at the same time tightly managing overhead costs.

Our "GRAIN" Technology Platform

In the last decade there has been a dramatic expansion of new genetic engineering and systems biology tools: genomics data, metabolic engineering, high-throughput analytical tools, including whole organism gene expression analysis and metabolomics, and powerful genome editing technologies. At Yield10 we plan to build value by leveraging genome editing targets for revenue generation in the near-term while we independently work to demonstrate the economic value of our transformative genetic engineering-based yield breakthroughs in the longer term. The recent expiration of blocking patents on early inventions in the plant genetic engineering space means that we can now be more effective in research and development, leverage third-party service providers and independently drive key proof points in major

commercial crops such as canola, soybean and corn while focusing our resources on our core strengths. Yield10 is focused on increasing the inherent yield of major food and feed crops. Our goal is to “build better plants” which requires new approaches and innovation and, in our view, will most likely involve gene combinations and/or multi-gene systems.

At a fundamental level, increasing crop yield is a complex two-step carbon optimization problem. Harvested seed is mostly carbon fixed from carbon dioxide in the air by photosynthesis with oxygen coming from water in the soil and smaller amounts of nitrogen and phosphate both of which are applied as fertilizer. To achieve increased yield, the rate at which crops can fix carbon has to be increased. Based on our experience optimizing carbon flow in living systems, we know that increasing seed yield will likely require multiple trait genes to increase carbon fixation by photosynthesis at the front-end and direct the increased fixed carbon to the seed.

We have integrated advanced metabolic flux modeling capabilities with transcriptome network analysis to form the foundation of the GRAIN bioinformatics gene discovery platform. This discovery platform is the core of our Trait Factory. GRAIN takes a bottom up approach based on the flow of electrons and carbon through essential metabolic processes and a top down approach based on transcriptome network analysis. Plant growth at its core is a series of chemical reactions and these can be modeled to determine the best ways to optimize the yield of the targeted product. Advanced metabolic modeling based on flux-balance analysis and enzyme reaction thermodynamics and kinetics enables us to make predictions about which reaction modifications are most likely to achieve targeted performance improvements. However, as with all modeling approaches, the tool is only useful alongside the means and the data to test it in real plants. Here, Yield10 makes use of metabolic and transcriptome data generated from its high-photosynthesis, high-yield engineered plants as well as from academic publications and other public data to project optimal gene targets for modifications. By integrating the transcriptome network capabilities of our technology platform, we expect to be able to identify transcription factor genes whose activity profiles can be altered to optimize multiple steps in metabolic pathways or the flow of carbon in plant tissues of interest. In a crop like modern hybrid corn, which already produces vastly more seed than it needs to reproduce, our initial objective is to reduce or even eliminate the activity of the transcription factors that restrict further seed production.

We are excited about the prospects of C3003 in reducing the well-known yield losses that occur through photorespiration in C3 crops. C3 photosynthesis, the simplest type of plant photosynthetic system, exists in most agricultural crops used for human consumption, including canola, soybean, rice wheat and potato. We know C3003 has increased the rate of photosynthetic carbon fixation in our Camelina plants and we have been able to study these plants at the molecular level. Consistent with our initial hypothesis that downstream bottlenecks can be identified, we have found that in high yielding plants expressing C3003, the expression of other genes, including our C3004 trait gene is changed. We have carried out experiments to increase the activity of the C3004 trait gene in Camelina and have shown in growth chamber studies that this results in increased plant vigor, branching and up to a 65% increase in seed yield. We believe the C3004 gene, which may be engineered into crops using genome editing, has the potential to be used alone or be combined with the C3003 trait gene to further increase yield beyond what can be achieved with C3003 alone. We have work ongoing to evaluate the Camelina C3004 gene in canola, soybean and corn.

In crops having the evolutionarily advanced, more efficient C4 photosynthetic system, including corn, sugarcane and sorghum, the yield is already several-fold higher than in C3 crops. In this case, the hurdle to accomplish step-change increases in seed yield is higher as these crops are already more metabolically efficient. We validated our approach by verifying with experimental results the positive yield impact of three gene targets we identified computationally, which we believe to be an exceptional hit rate. These three yield genes, C4001, C4002 and C4003, significantly increased photosynthetic carbon capture and biomass production in switchgrass, an already high biomass yielding C4 crop. In this case our early experiments have been successful in demonstrating the potential to increase the rate of carbon fixation even in a high yielding C4 crop.

Plant scientists now have powerful genome editing tools, such as the CRISPR/Cas9 system, that enable single and multi-gene changes to be made in major crops; the challenge is knowing what combinations of genes to edit. We believe Yield10 is in a unique position to expand our learning and discover additional gene targets, or genes that need to be modulated, to optimize the flow of carbon to seed in these plants, and we have made considerable progress on this front.

Molecular analysis of high yielding plants expressing the global transcription factors has allowed the identification of 71 downstream transcription factors that are differentially expressed in the high yielding lines and are themselves targets for genetic manipulation. The expression of some of these genes is down regulated in the high yielding plants making them potentially promising targets for genome editing through well-known approaches such as CRISPR. We began by validating the predictive impact of three of these trait gene targets in switchgrass and confirmed their function and recently completed the genome editing of the first of these, C4004 in rice. We know the industry has

struggled to deploy transcription factors using traditional biotech approaches to improve crops particularly in hybrid corn. However, we are optimistic that we will be more successful introducing our global regulator genes using genome editing and believe that simple gene deletions to eliminate their function, will be significantly easier to implement and translate across crop varieties.

We are building significant capabilities and intellectual property around key oil biosynthesis pathways in plants based on technologies for increasing oil content in plants. In this area, we have focused on Acetyl-CoA Carboxylase (ACCase) as a key metabolic control point for oil production in plants and have assembled a portfolio of gene targets accessible through genome editing. ACCase gives rise to metabolic pre-cursors common to PHA biomaterials and edible oils, as well as cannabinoid oils found in industrial hemp and other plants. Given the central role of ACCase, we have been establishing a strong intellectual property position around controlling the flow of carbon at this key branch point and are advancing a number of gene targets including C3007, C3010 and C3012.

We believe our integrated GRAIN platform can be used to successfully identify new targets for improving crop yield and are working to leverage the platform in the near-term to secure research and development funding from industry partners.

Fast Field Testing System in Camelina

One of the challenges the agricultural industry has faced over the years is translating early crop science discoveries into value generating traits. This is in part because most of the plants used for discovery research have not been suitable for studies in the field. In addition, the plant systems used for discovery are not representative of the advanced seed or germplasm used in commercial production which have been subject to decades of intensive breeding to improve yield. The long timelines to progress early discoveries successfully into major crops and generate field data adds to the challenge.

In 2010, we established a research and development operation in Saskatoon, Canada staffed with leading oilseed researchers. Our team established a model for testing novel trait genes called the “Fast Field Testing” system based on our Camelina oilseed platform. We believe that this system has become a valuable tool for our yield trait discovery and translation effort. Camelina is an industrial oilseed with reasonable field performance providing a robust model for canola and soybean and it is well suited to multi-site field tests and larger scale trials. Camelina is a plant that can be readily genetically modified and bred through the efforts of our skilled staff to deliver genetically stable seed sufficient for planting in field tests. We have shown that we can go from the identification of a potential yield trait gene or combinations of genes to field planting in about 12 months. In our Fast Field Tests, we typically collect and analyze a broad set of data on our transgenic or genome edited plants including parameters such as stand establishment, flowering, maturity, seed weight, seed size, oil content and oil composition. We also perform molecular analysis on plants of interest. We are using our Camelina Fast Field Test system to identify and screen trait genes of interest while deploying them in parallel into crops of commercial interest including canola, soybean, rice, corn and wheat where the timelines to obtain stable plant lines and field data are longer.

Traits in Development

Yield10 Bioscience has ownership or licensed rights to several crop trait genes and our lead yield trait gene C3003 is currently well-positioned in terms of translation and demonstration in key crops. Yield10 has exclusive rights through ownership or licensing of patent applications, or is preparing patent applications, covering the trait genes listed in the accompanying table.

We identified the C3000 series of novel yield traits based on establishing new metabolic pathways in crops. We have tested our lead yield trait gene C3003 in Camelina in both greenhouse and field tests and have previously reported results from these studies. We are moving this promising trait forward in additional crops including canola, soybean, corn, sorghum and rice. Our other C3000 series traits may be accessible through genome editing and are being tested in various target crops as well.

We have also identified the C4000 series of novel yield traits and gene editing targets addressing increases in seed yield and biomass. We have shown that our C4000 series traits, which comprise global regulatory genes discovered through our GRAIN technology platform, may have the potential to significantly enhance photosynthesis and carbon capture in key crops. We are moving members of the C4000 series of traits forward in several crops including wheat, rice, corn and forage sorghum using mainly third party resources and capabilities while retaining control of intellectual property.

Novel Yield Trait Gene C3003

C3003 represents the lead novel yield trait gene in our trait pipeline. C3003 is a scientific discovery made in one of our academic collaborations funded by ARPA-e, a division of the DOE. Our academic collaborator is continuing work to characterize C3003 and some of this work is funded by a DOE grant under which Yield10 is a sub-awardee conducting research supported by the grant.

C3003 appears to be a unique gene that impacts photorespiration, a biochemical pathway in C3 plants that is responsible for significant losses in yield. Yield10 is progressing the introduction of the C3003 trait gene as well as improvements to the C3003 trait in Camelina, canola, soybean, corn and rice. In 2019, we are conducting additional greenhouse and field test activities to continue generating yield and agronomic data on C3003 in a variety of important crops.

Camelina

We have extensively utilized our Camelina Fast Field Testing Platform to evaluate the mechanism and effect of C3003 in crops. Over the past three growing seasons, 2016-2018, we have produced field-grown seed and field tested numerous stable Camelina seed lines containing first generation C3003, second generation C3003 and certain prototypes of traits related to C3003. Through this work, we have collected important molecular, agronomic and seed yield data that has enabled us to characterize these traits as well as understand important differences in the effects they produce in field-grown plants.

Our greenhouse and field work with C3003 in Camelina have allowed us to capture data on the performance of the trait. The results from our field tests show that first generation C3003 produces significant improvements in seed yield although the individual seed weight in these lines is decreased as compared to controls, likely due to a change in carbon partitioning in the plant. Field test results for second generation C3003 (seed specific expression of the trait), show improvements in seed yield, harvest index and overall agronomic performance, while also maintaining typical seed size as compared to control plants. There were no significant changes to oil content or oil composition with either version of the trait as compared to control plants. In our 2019 field tests, we saw some indications of drought resistance with C3003, an observation we plan to follow up on in subsequent field tests of this trait.

Underscoring the value of our Camelina Platform in the evaluation of C3003, our observations around the increases in seed yield along with differences in seed weight have been observed in some of our recent studies with canola and soybean lines. Based on encouraging data obtained in Camelina with first and second generation C3003, we are continuing to progress the evaluation of the C3003 yield trait gene in parallel in various commercial crops including canola, soybean, corn and rice, where we believe step-change increases in seed yield could improve the prospects for global food security and create considerable economic value.

Canola

Canola is an important North American oilseed crop harvested for its oil. We are targeting step-changes of 10-20% in the evaluation and development of novel traits to increase seed yield in canola. In our field tests of canola in 2018, we achieved seed yield improvements in some events at the low end of this range (11%), and based on these results, we will progress C3003 into the preliminary commercial development phase in canola in 2019. The key activities to be completed during this phase include development of commercial quality events in elite canola germplasm, execution of multi-site, multi-year field studies and development of regulatory data as appropriate.

In 2019, we are conducting additional field tests in Canada with second generation C3003 in canola. Harvest of the test fields is expected in third quarter 2019, which will enable the collection and evaluation of agronomic, seed yield, oil content and other data from the studies.

We evaluated our second generation C3003 yield trait in canola for the first time in canola in 2018. In these field tests, we monitored key agronomic and growth parameters of the plants throughout the field test and collected yield data including total weight of harvested seed, individual seed weight and oil content in our transformed plants as compared to control plants. The best second generation C3003 canola lines showed an increase in seed yield of 11 percent as compared to control plants, a statistically significant outcome. In second generation C3003 canola plants, the weight of an individual seed (measured using 1,000 seeds) was similar to control plants, an expected outcome using the second generation version of the C3003 trait.

The results we obtained in canola were similar to results obtained in prior studies with Camelina, illustrating that our Fast Field Testing system in Camelina is a valuable tool for effectively screening novel yield trait genes and

dynamically adapting our approach to trait development as we work to translate these improvements into commercially important crops.

Soybean

Yield10 has limited capabilities related to engineering soybean. However, because soybean is the leading North American oilseed crop, we initiated deployment of both first and second generation C3003 into soybean in 2016 through an academic collaborator. We recognize that the scale of this program is limited and that it will serve mainly to generate research data. Yield10 is currently exploring additional third-party options for conducting soybean transformations to increase the scope of our internal program. In 2017 we generated early greenhouse data and in 2018 we grew C3003 soybean plants at sites in Canada to produce field-grown seed. We expect that additional development work including the generation of more C3003 lines will continue in soybean with our academic collaborator in 2019.

Preliminary observations based on a small number of events from our greenhouse studies suggest that results for C3003 obtained in Camelina and canola are translating into soybean. First generation C3003 produced seeds with lower individual seed weight while typical individual seed weight was observed with second generation C3003 in soybean. Further, our greenhouse results show that there is an increase in branching in the plants for some of the events tested. This is significant because more branching provides more sites on the soybean plant for seed pods to develop which can be associated with obtaining higher yielding plants.

In December 2017, we granted a non-exclusive research license to Bayer to evaluate our novel C3003 and C3004 yield traits in soybean. Under the license, Bayer is working with C3003 in its soybean program as a strategy to improve seed yield. We anticipate that Bayer will generate field test data with C3003 pursuant to the research license. The Bayer license was expanded to include a new discovery relating to C3004 that will enable them to begin work deploying and testing the trait in their soybean program.

Corn

Corn is the highest value commercial row crop grown in the United States. We initiated an early development program in corn in late 2018 with the objective of evaluating novel seed yield and drought tolerance traits in this crop. Under this program, novel traits discovered by Yield10 are being deployed in corn by a third-party agriculture company with proven expertise introducing new traits into corn. The yield traits included in the corn development program are C3003, C3004, and C3011, as well as the transcription factors C4001, C4002, and C4003. This aspect of the development activity is expected to be completed in early 2020. We plan to engage an additional third party to conduct field testing of the novel traits in corn to evaluate the impact on seed yield.

Novel Yield Trait Gene C3004

While the role of C3004 is currently not well understood and we continue to investigate the role of the gene in plant metabolism, we believe that it may have an effect on carbon partitioning in plants. We also believe that, under certain conditions, this effect may potentially be additive with the activity of C3003. Our ongoing research will continue to investigate the activity of C3004 alone and in combination with C3003 to produce increases in seed yield in crops.

We began our investigation of C3004 in Camelina. We constructed C3004 to increase expression of the gene in Camelina. Stable plant lines were developed and we performed yield studies in a controlled environment growth chamber. In these studies, increased expression of C3004 in Camelina results in a significant increase in plant growth and vigor, increased seed yield, and in some cases increased individual seed weight. In these limited studies, six Camelina plant lines containing C3004, average seed yield (grams/plant) increased by 26 to 65 percent over control plants. We also measured tertiary branching in a subset of plants and found that the increase in seed yield seen in the plants was also accompanied by an increase in tertiary branching. While early stage and based on a small sample of events, the data suggest that C3004 may hold significant promise as a novel yield trait.

In 2019 we are conducting greenhouse and field tests in Camelina to continue to generate additional seed yield and agronomic data on C3004. We also plan to test C3004 in combination with C3003 in Camelina to investigate whether the traits could be additive or synergistic. We have also fast-tracked the deployment of C3004 into canola and corn where we will engineer lines and begin testing to determine if this trait produces improvements in seed yield in other crops. The version of the C3004 trait we tested in our Camelina studies was genetically engineered using recombinant DNA; however, we believe that it may be possible to develop versions of the trait that are genome edited, potentially enabling a path to non-regulated status for C3004 plants under current USDA-APHIS rules.

Oil Enhancing Traits

With increasing focus on health and wellness, food safety and sustainability in developed countries, we anticipate a rise in demand for new varieties of food and food ingredients with improved nutritional properties. This concept is currently being implemented in agricultural biotechnology, in both canola and soybean that have been modified to alter the composition of the oil produced. High oleic canola and soybean oils are being marketed as "healthier" than other oils; we believe the ability to make similar marketing claims directly to the consumer will be a feature of newly developed products in this space. We expect consumer demand for identity preserved specialty ingredients will rise, and we believe that Yield10's crop yield technologies and crop gene editing targets could be useful in this emerging field.

Based on our study of metabolic pathways in oilseed crops, we believe there is an opportunity to apply genome editing to significantly increase oil content in oilseed crops including canola, soybean, sunflower and safflower. In cases where the edible oil is the primary economic value driver for the crop or in cases such as high oleic soybean where the crop has been modified to improve the fatty acid profile, increasing oil content is a valuable trait. This potential also extends to Camelina where recent clinical studies have shown that Camelina sativa oil, but not fatty fish or lean fish, improved serum lipid profile in subjects with impaired glucose metabolism. This randomized, controlled study was recently published in the journal *Molecular Nutrition and Food Research*, U. Schwab, et. al. (2018). Improving the oil content and yield of Camelina seed could make this an attractive crop for producing nutritional oils. In 2017 and 2018, we received confirmation from USDA-APHIS's Biotechnology Regulatory Services (BRS) that two types of our genome-edited Camelina plant lines developed using CRISPR/Cas-9 genome editing technology for increased oil content were not considered to be regulated under 7 CFR part 340, clearing the way for field testing in the U.S. The first type is based on the inactivation of an enzyme expected to increase seed oil content in Camelina, a trait we have designated as C3008a. The other type is based on the inactivation of three enzymes to enhance the production of oil and is designated as our triple edit, or C3008a, C3008b and C3009 trait containing line. We are currently evaluating combinations of the genome editing targets to optimize oil content in Camelina and canola, and plan to do so in soybean with the objective of obtaining plant lines that are not considered to be regulated by USDA-APHIS under the current regulatory framework of 7 CFR part 340.

In 2018 we signed an exclusive global license agreement with the University of Missouri for advanced oilseed technology including C3007 and C3010, which are promising targets involved in oil biosynthesis. We are working to deploy C3007 in oilseed crops with the objective of increasing oil content through methods that could result in a plant line that is not considered regulated by USDA-APHIS under 7 CFR part 340. We have produced a genome edited version of C3007 in canola and further development and evaluation of the trait is underway. In 2019 we signed an additional exclusive global license with University of Missouri for additional oilseed technology we named C3012.

C4000 Series Traits

We have used our GRAIN platform to study global transcription factors and identify novel yield traits in the C4000 series. These traits may be powerful regulators of plant growth and represent a potentially valuable resource for identifying genome editing traits for crops. We have recently shown that traits from the C4000 series can significantly increase photosynthetic efficiency as well as aboveground and below ground biomass production in our switchgrass plants.

In 2018 in the journal *Plant Science*, we reported that our novel C4001 and C4003 traits have been shown to significantly increase plant biomass yield in switchgrass. Switchgrass plants expressing C4001 resulted in a total increase in biomass of 75-100 percent in leaves and stems as compared to controls. Expression of C4003 in switchgrass resulted in a total increase in biomass of 100-160 percent in leaves and stems as compared to control plants. Increasing biomass yield is important for forage crops such as sorghum, silage corn, and alfalfa.

We are testing certain of our C4000 series of traits to increase seed yield in wheat, rice, and corn, as well as to increase biomass in forage sorghum. Using internal resources, we have been able to progress the C4001 trait gene in rice. In a collaboration with the National Research Council of Canada we have introduced the C4001 and C4003 traits into wheat and expect to generate performance data from wheat lines in the coming year. With rice and wheat, we do not plan to evaluate traditional biotechnology traits in the field or develop them as products but to use them as a source of new genome editing trait leads. We have completed the editing of the first of the C4004 trait in rice and are currently growing these plants in the greenhouse. Forage Genetics began work with certain of our C4000 series traits through a research license signed in 2018 to assess the potential of our traits to increase biomass in forage sorghum. We also began early development work in late 2018 to assess certain C3000 and C4000 series traits in corn through a third-party agricultural company. We expect the first phase of this work to be completed by early 2020.

We expect evaluation of C4000 series traits in these target crops will continue to advance in 2019. Traits in this series and the proof points we expect to generate may provide us with an opportunity to selectively partner with others for the development of these traits in major commercial food, feed, and forage crops.

PHA Trait

While maintaining our focus on the development of novel yield traits for key crops based on a licensing model, as part of our business development activities we have been working to develop independent business opportunities for Yield10 in the specialty oils and niche crop product space. The target of this effort is sustainable business solutions to support global food production and other specialty applications. Yield10 is a pioneer in the development of technology for producing PHA/PHB biomaterials in crops. Seed-based PHA/PHB production provides an opportunity to sustainably produce these natural biodegradable materials at low cost, disrupting the cost advantage of the petroleum plastics they can functionally replace. Based on our engineering projections, we believe the costs achievable in Camelina will also enable broad use of this material for water treatment applications where it acts as a maintenance-free growth substrate for bacteria that convert nitrate to nitrogen gas thereby reducing pollution and algal growth. Scientific data has clearly shown that fertilizer (NPK) is essential for global food security, however its use is also a major source of nutrient pollution in our waterways. We need to develop sustainable economically attractive ways to reduce fertilizer run-off and simple cost-effective ways to remove it from water where it comes from multiple sources including natural processes and septic systems. This market application has been known since the 1980's but has been constrained by the high costs of fermentation-based production technologies. We believe the potential exists to use our Camelina platform as a sustainable low-cost source of PHA biomaterials to improve the overall sustainability of food production and to reduce nutrient pollution of our waterways.

A recent patent application was filed by Yield10 describing a discovery around maintaining the viability and vigor of Camelina seed containing high levels of PHA polymer. This is an important step toward the development and commercialization of a seed-based production platform for PHB using Camelina. Yield10 is in the early stages of developing a commercial business model focused on PHA produced in Camelina for water treatment applications.

We believe by developing the PHA Camelina platform as a cash cover crop we can create new sources of revenue for farmers, independent of export markets, reduce run-off from fertilizers and produce a natural biodegradable product that can be used to mitigate the impact of fertilizer run-off when it occurs as well as reduce nitrate pollution from aquaculture and septic systems. By focusing on North America we believe we can avoid the high costs and time delays associated with global deregulation of a biotech crop and potentially benefit from the ongoing modernization of the USDA-APHIS regulatory process.

PHA biomaterials are widely useful for functionally replacing petroleum-based plastics in a wide range of packaging applications. The plastics industry, which produces more than 350 million tons of material per year globally, is facing intensive scrutiny due to the failures in plastics recycling and increasing plastic waste in the environment. As natural biomaterials, PHAs fully degrade over time in the environment yet have excellent shelf life in use. We estimate that PHA biomaterials can be produced at very low cost in oilseeds based on our newly patented technology. When we made the transition to the Yield10 business we divested our PHA bioplastics (biomaterials) assets based on the microbial fermentation platform but retained the patents and field of PHA production in engineered crops. Our current approach to this market is to execute agreements with petroleum, chemical or plastics companies to commercialize this opportunity. These companies are also potential sources of funding to support the development of the PHA Camelina crop.

Target Crops

Our research and early development work in our C3000 and C4000 series traits suggests that our technology may be applicable to a wide range of crops harvested for food and animal feed uses. We believe that if novel yield traits could be successfully developed and commercialized in any of these crops, farmers would be able to improve the productivity of their land to meet rising demand for food and feed, thereby creating significant economic value.

In considering our strategy to develop our technologies we segregate our trait genes into two classes: trait genes based on using non-plant genes to add new functionality to crops which are by definition GM due to the insertion of foreign recombinant DNA; and trait genes that we may be able to deploy in lines that are not considered regulated by USDA-APHIS, which encompass our trait genes that are based exclusively on plant genes. We see the opportunity to deploy our trait technology in a broader set of food and feed crops many of which are not currently GM. We plan to pursue our GM trait genes in crops which are currently GM and where the economics can sustain the cost and timelines for deregulation. We are aware of the current USDA-APHIS GM crop regulation review and the reality that GM likely

will remain an issue for some NGO groups regardless of the science. For our GM yield trait genes, we are targeting seed yield increases on the order of 10 to 20 percent over the current elite seed lines, increases which reflect the order of magnitude step-changes necessary to address global food security.

The crops we are targeting for development are described below.

Camelina or *Camelina sativa* is an oilseed crop in limited cultivation in North America and Europe. Camelina has received recent attention as an industrial oilseed for the production of biofuels, novel industrial lipids, and oleochemicals. In addition, its meal has been identified for development as an animal feed supplement and its oil as a fish feed supplement. Recent clinical studies have shown that Camelina sativa oil, but not fatty fish or lean fish improved serum lipid profile in subjects with impaired glucose metabolism—a randomized controlled study published in the journal *Molecular Nutrition and Food Research*, U. Schwab, et. al. (2018). Improving the oil content and yield of Camelina seed could make this an attractive crop for producing nutritional oils. While it is not currently a commercially significant crop, research suggests that efforts to improve seed yield, oil content and fatty acid composition, and tolerance to heat stress may expand the commercial adoption and cultivation of Camelina. We believe that the production of PHA biomaterials in Camelina could provide economic returns for farmers to justify large acreage adoption and enable the low-cost production of this product for new markets including water treatment and plastics replacement applications. We believe crop-based production will enable an advantageous cost structure thereby eliminating one of the significant remaining barriers to entry for broad adoption of these materials.

Canola or *Brassica napus* is a cultivar of rapeseed which produces a higher value edible oil favored by consumers because it has a healthier fatty acid profile than corn or soybean oil. The canola crop was developed in Canada where it is primarily grown today with additional acreage grown in the U.S. Currently the vast majority of the canola grown in North America contains two seed enhancement technologies, herbicide tolerance and hybrid seed. Both Roundup Ready (Monsanto, now Bayer) and Liberty-Link (Bayer) varieties of canola are grown and were introduced to the market in 1990s. Approximately 24.7 million acres were planted in Canada and the U.S. in the 2018 growing season. The Canola Council of Canada has set yield goals of 52 bushels/acre for 26 million metric tons of production to meet global market demand for canola by 2025. Yield10 is targeting a 10-20 percent or greater increase in canola seed yield. With a 2017 harvest of 939 million bushels of canola (Statistics Canada) and assuming an average farm gate price of \$10.00 per bushel, a 20 percent yield increase in canola represents a total potential added annual value of \$1.9 billion that could be shared among the companies in the canola value chain.

Soybean or *Glycine max* is an oilseed crop used for food, food ingredients, food additives and animal feed. The soybean can be harvested for oil used in food and industrial applications, and soybean meal is a significant source of protein for use mostly in animal feed but also for direct human consumption. Fermented soy foods include soy sauce and tempeh, and non-fermented food uses include soy milk and tofu. Soybeans are widely cultivated in North and South America, where a majority of the seed planted is genetically modified. An estimated 94.4 million acres of soybean will be planted in the U.S. and Canada in the 2018/2019 growing season. According to the USDA, the U.S., Brazil and Argentina together represent approximately 80 percent of global soybean production. Yield10 is targeting a 20 percent or greater increase in soybean seed yield. Assuming a 2018/2019 U.S. harvest of 4.5 billion bushels (USDA) and an average farm gate price of \$10.00 per bushel, a 20 percent yield increase in soybean represents a total potential added annual value of \$8.8 billion that could be shared among the companies in the soybean value chain.

Corn is a crop grown globally and used for animal feed and for producing starch which can be used as a raw material for producing food ingredients and food additives, as well as for use in the production of paper, packaging materials and other items. GM maize was grown for the first time in the U.S. and Canada in 1997. Currently, about 80 percent of maize/corn production in the U.S. is genetically modified. It was estimated that more than 83 million acres of corn were planted in North America in the 2018 growing season. The traits commonly used in today's corn cultivars provide insect resistance and herbicide tolerance. In many GM seeds sold today, these traits are stacked ("stacked" refers to the practice of adding multiple traits to an elite plant line). Europe has limited production of GM corn, where Spain is a leading producer. In this case, the most widely used GM trait (Bt) protects against the corn borer insect. Special protocols must be followed in Europe to avoid mixing of GM corn with conventional corn. Corn has the more efficient C4 photosynthesis system and Yield10 is targeting a 10 percent yield increase in corn. With a projected 2018/2019 U.S. harvest of 14.4 billion bushels and an average per bushel price of \$3.50, a 10 percent yield increase in corn represents a total potential added annual value of \$5.1 billion that could be shared among the companies in the corn value chain.

Rice is the staple food for over 50 percent of the global population. World crop production of rice for 2018/2019 is estimated at approximately 495 million metric tons. Rice is grown in tropical and subtropical regions around the world. Rice cultivation takes place primarily in China, India and Southeast Asia. Typically, improvements to rice yield have been achieved through traditional plant breeding approaches. Genetic engineering approaches are being investigated to

develop rice hybrids and to protect rice from weeds and insect pests. Additional biotechnology approaches are being taken to improve the nutritional value of rice. While Yield10 has not established a target for yield improvement in rice, early work is underway to evaluate the potential of our technologies in this globally important food crop.

Wheat is a species of grass cultivated broadly worldwide as a staple cereal crop. Wheat requires processing to be used as food, mainly in the form of flour for bread, baked goods and pasta. Wheat may also be used as an industrial starch, as a food additive or as a production component in the textile and paper industries. Improvements to wheat yield have typically been achieved through plant breeding approaches. Wheat production ranks third among U.S. field crops in planted acreage, production and gross farm receipts behind corn and soybeans. The planted area for wheat (winter and spring varieties) in the U.S. and Canada combined for 2018 was estimated at 72 million acres.

Forage crops are grown expressly for biomass used for feeding livestock. Typical forage crops include both annual and perennial crops such as various grasses, silage corn, alfalfa and sorghum. Biotechnology traits have been previously introduced into silage corn and alfalfa. Other forage crops could be amenable to gene editing strategies to increase biomass yield per acre. We believe that our technology and traits that increase biomass may have application to forage crops.

Regulatory Requirements

Since the first successful commercialization of a biotechnology-derived agricultural crop in the 1990s, many new crop varieties have been developed and made available to farmers in the U.S. and worldwide. U.S. farmers have rapidly adopted many of these new biotechnology-derived varieties, so that in 2016, 92 percent of the corn, 93 percent of the cotton and 94 percent of the soybeans planted in the U.S. were varieties produced through traditional forms of genetic engineering. A significant percentage of the production of other crops planted and harvested in the U.S., such as alfalfa, papaya and sugar beet, are also biotechnology-derived.

Biotechnology-derived or genetically engineered crops are subject to a significant amount of regulation in the U.S. and around the world. Field tests and field trials of such crops need to ensure that traits in development do not escape or mix with native plants, and crops that may be used as human food or animal feed must meet certain safety standards, but government regulations, regulatory systems and the politics that influence them vary significantly among jurisdictions.

For purposes of this discussion, the term “GE” includes both biotechnology-derived or genetically engineered plants that are modified by the insertion of recombinant DNA (“Traditional Genome Modification”) and biotechnology-derived or genetically engineered plants that are modified through the application of more modern techniques of genome editing. We have seed traits that fall within each of these two generalized categories of GE plants, as summarized above under the subheading “*Traits in Development.*”

United States Regulation

The U.S. Government agencies primarily responsible for overseeing the products of modern agricultural biotechnology are the U.S. Department of Agriculture (USDA), the U.S. Food and Drug Administration (FDA) and the U.S. Environmental Protection Agency (EPA). Depending on its characteristics, a product may be subject to the jurisdiction of one or more of these agencies under the federal government’s 1986 Coordinated Framework for the Regulation of Biotechnology, as updated. Regulatory officials from the three agencies regularly communicate and exchange information to ensure that any safety or regulatory issues that may arise are appropriately resolved within the scope of authority afforded to each agency under their respective statutes. Other environmental laws or regulations also may be implicated, depending on the specific product and its potential applications or intended uses. EPA’s principal oversight role is for biotechnology-derived products that are intended for use as pesticides or herbicides, under the authorities granted to the agency under the Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Control Act. Our business strategy for major grain crops is to develop yield and performance traits for licensing to the major seed companies. We have no current plans for the development of pesticide or herbicide GE traits that would be subject to the procedures and requirements of the EPA under these statutes.

Our seed traits and any future products that are successfully developed containing our seed traits, however, are or will be subject to USDA and FDA regulatory requirements. Those requirements will vary depending on the particular seed trait and the type and intended use of any product that will be commercialized. Future products which we plan to produce and sell for example for use in water treatment may potentially have EPA regulatory requirements and the regulations relating to manufacturing and consumer protection will need to be addressed.

First, within USDA, the Animal and Plant Health Inspection Service (APHIS) is responsible for protecting agricultural plants from pests, diseases and noxious weeds. Under the Plant Protection Act (“PPA”), USDA-APHIS has

regulatory oversight over products of modern biotechnology that could pose such a risk to domestic agriculture and native plants. Accordingly, USDA-APHIS regulates organisms and products that are known or are suspected to be plant pests or to pose a plant pest risk, including those that have been altered or produced through various genetic engineering techniques. These GE plants are called “regulated articles” in the relevant USDA-APHIS regulations, which are codified at 7 CFR part 340 (“Part 340”). The PPA and the implementing regulations in 7 CFR part 340 empower USDA-APHIS to regulate the import, handling, interstate movement and release into the environment of regulated articles, including certain GE organisms undergoing confined experimental use or field trials. Regulated articles are reviewed to ensure that, under the proposed conditions of use, they do not present a plant pest risk by ensuring appropriate handling, confinement and disposal.

Seed traits developed using Traditional Genome Modification, such as our C3003 yield trait that leverages the biological functions of an algal gene, are regulated under 7 CFR part 340. Regulated articles are subject to extensive USDA-APHIS oversight, including but not limited to permitting requirements for import, handling, interstate movement and release into the environment.

If, however, USDA-APHIS determines that a GE plant is unlikely to present a greater plant pest risk than its unmodified counterpart, the newly developed crop will no longer be subject to the permitting and other regulatory processes that are overseen by the agency (*i.e.*, it will no longer be treated as a potential plant pest). Such a determination by the USDA-APHIS is called not regulated under the 7 CFR part 340 regulatory framework. The regulations establish detailed procedures for how a developer of a new GE plant may petition USDA-APHIS to determine if modified plant lines are not regulated under the 7 CFR part 340 framework, which is an official agency finding that the particular article is unlikely to pose a plant pest risk and therefore no longer needs to be regulated under 7 CFR part 340 and the PPA.

USDA-APHIS conducts a comprehensive science-based review of the petition to assess, among other things, plant pest risk, environmental considerations pursuant to the National Environmental Policy Act, and any potential impacts on endangered species. The duration of the petition process varies based on a number of factors, including the agency’s familiarity with similar GE products, the type and scope of the environmental review conducted, and the number and types of public comments received. If, upon the completion of the review, USDA-APHIS approves the petition and the product is no longer deemed a “regulated article,” the developer may commercialize the product, subject to any conditions set forth in the USDA-APHIS written decision issued in response to the petition for determination of non-regulated status.

As previously described, our seed traits developed using Traditional Genome Modification are regulated under 7 CFR part 340 and are subject to USDA-APHIS permitting requirements. In recent years, however, we and others have submitted various petitions to USDA-APHIS to determine whether particular GE plants developed through the use of different genome editing techniques meet the not regulated status under the 7 CFR part 340 framework administered by the agency. In general, lines developed using genome editing approaches have been deemed not to be regulated by USDA-APHIS under 7 CFR part 340. The USDA also announced in March 2018 that it would not require an assessment on products that used modern forms of mutagenesis if it was clear these outcomes could occur in nature. The USDA stated at that time that it did not “have any plans to regulate plants that could otherwise have been developed through traditional breeding techniques as long as they are developed without the use of a plant pest as the donor or vector and they are not themselves plant pests.” This USDA policy statement applies to genetic deletions of any size, which would include genome editing through CRISPR-Cas9 and other emerging technologies, although it remains to be seen how this policy announcement will be implemented by USDA-APHIS and what practical effect that may have on seed trait developers like us and our competitors.

Historically, changes to the U.S. regulatory paradigm for agricultural biotechnology have been infrequent, are typically preceded by notice, and are most often subject to public comment, but there can be no guarantee that the USDA-APHIS governing regulations and policies will not change.

We have submitted two petitions under 7 CFR part 340 for a determination of the regulatory status (also known as the “Am I Regulated?” letter) to USDA-APHIS’s Biotechnology Regulatory Services in order to confirm that the following two traits designed to increase oil content are not going to be regulated by the agency: (i) the single trait C3008 Camelina plant line, developed using CRISPR genome editing technology for increased oil content; and (ii) the triple-edited Camelina line that combines three gene traits, C3008a, C3008b and C3009, to increase oil production. In both cases, USDA-APHIS’s Biotechnology Regulatory Services approved our petitions and confirmed that each of these novel plant lines would not be treated as a regulated article.

To our knowledge, our triple-edited Camelina line which was determined to not be regulated under 7 CFR part 340 in September 2018, is the first CRISPR-edited triple-trait plant determined by the agency to be not to be regulated.

Given our business strategy to develop certain multi-trait genome edited plant lines, this achievement should facilitate our ability to put more of our novel yield traits through the petitioning process and the agency’s scientifically driven decision-making process, with the expected end result of having lines containing more of our traits treated as not to be regulated under 7 CFR part 340 (as compared to our seed traits developed using Traditional Genome Modification, which are regulated articles). We expect to continue to make appropriate use of the “Am I Regulated” letter procedures to clarify the regulatory status of our new GE seed traits as they are developed.

Also, we tested the C3008 single-trait Camelina line in a 2018 field evaluation that took place in the United States following a notification in 2017 that the line would not be regulated under 7 CFR part 340.

Separate from the plant breeding and planting issues and USDA-APHIS regulation under 7 CFR part 340, a GE plant also will be regulated by the FDA if it is intended to be used as human food or animal feed. The FDA regulates the safety of food for humans and animals, and foods derived from GE plants must meet the same food safety requirements as foods derived from traditionally bred plants (also called conventional foods).

Since 1992, the FDA has had in place a voluntary consultation process for developers of bioengineered food (“Biotechnology Consultations”). Final agency decisions and other information from these Biotechnology Consultations are made publicly available by the FDA. Biotechnology Consultations are data-intensive and examine the new food product’s safety and nutritional profile, among other issues. Generally, the FDA has found that such food products do not pose unique health risks to humans or animals, but if a novel allergen or other distinction from the conventional food is present in the new plant variety, the agency may require specific label statements on the product to ensure that consumers are made aware of material differences between GE and conventional versions. The FDA primarily derives its regulatory power from the Federal Food, Drug, and Cosmetic Act, which has been amended over time by several subsequent laws. Among other oversight and inspection responsibilities, the FDA regulates ingredients, packaging, and labeling of foods, including nutrition and health claims and the nutrition facts panel. Foods are typically not subject to premarket review and approval requirements, with limited exceptions.

As part of a broader effort to modernize its regulatory approach to all biotechnology-derived products, the FDA is currently re-evaluating its regulatory approach in light of the increasing prevalence of certain genome edited plants. In January 2017, the FDA asked for public input to help inform its thinking about human and animal foods derived from new plant varieties produced using genome editing techniques. Among other things, the FDA’s request for comments asked for data and information in response to questions about the safety of foods from genome edited plants, such as whether certain categories of genome edited plants present food safety risks different from other plants produced through traditional plant breeding.

In October 2018, FDA leadership issued a document entitled the “Plant and Animal Biotechnology Innovation Action Plan” (“Action Plan”) that identified three key priorities for the agency in this area: 1) advancing human and animal health by promoting product innovation and applying modern, efficient and risk-based regulatory pathways; 2) strengthening public outreach and communication regarding the FDA’s approach to innovative plant and animal biotechnology; and 3) increasing engagement with domestic and international partners on biotechnology issues. The Action Plan also stated that the FDA has reviewed the comments and other information it received in response to the January 2017 request for comments, and that it intends to develop guidance for the industry explaining how the FDA’s existing regulatory policy for foods derived from new plant varieties applies to foods produced using genome editing. The forthcoming draft guidance is expected to be released for public comment in 2019. The FDA also stated in the Action Plan that it intends to begin updating the existing procedures for voluntary Biotechnology Consultations to reflect the agency’s 25 years of experience with foods derived from biotechnology plants and to incorporate any additional issues related to genome editing of food crops. Such procedural updates are expected to be developed and implemented over the next two years.

Canadian Regulation

In Canada, GE crops and the food products into which they are incorporated are regulated by multiple government agencies under a federal framework for the regulation of biotechnology products that is similar to the U.S. system. First, the CFIA is the lead agency for ensuring that a new agricultural biotechnology crop will not pose new risks to Canadian plants, animals and other agricultural commodities. The PBO is responsible for conducting environmental assessments of PNTs. Authority for the PBO includes both approving confined field trials with the PNT through permits and authorizing their “unconfined release” as a first step towards commercialization. PNTs are defined in the Canadian Seeds Regulations as (i) plants into which a trait or traits have been intentionally introduced, and (ii) where the trait is new in Canada and has the potential to impact the environment. The CFIA also has in place a remuneration policy, whereby

plants containing the same mutation as a previously authorized plant of the same species are included in the authorization of the original PNT and are therefore subject to the same conditions.

Second, under the Food and Drugs Act and related regulations, Health Canada is responsible for reviewing a pre-market safety assessment that must be submitted by the manufacturer or importer of a “novel food,” a term of art that includes any PNT or other or biotechnology-derived foods. The safety assessment should provide assurances that the novel food is safe when prepared or consumed according to its intended use before it enters the Canadian market and food system. A multi-disciplinary team of experts from Health Canada will evaluate the data and information about the novel food and make a determination regarding whether it is safe and nutritious before it can be sold in Canada, as well as whether any restrictions are warranted under applicable law or the product’s safety profile. Health Canada’s final decision documents regarding the safety of these novel foods are made available to the public by the government. As in the United States, approval of a PNT or a novel food product does not take into account the method with which such product was produced. Rather, Health Canada employs a product-based (as opposed to a process-based) approach to its regulatory oversight of such emerging foods and food ingredients.

As the lead agency for public health and safety, Health Canada also works in conjunction with the CFIA on food labeling oversight when it has identified a potential health or safety issues with a food that could be mitigated through labeling or other disclosures. For example, if the biotechnology-derived food contains a new allergen that is otherwise not present in the conventional version of the food, then specific label statements will be required to alert consumers to that important health information. However, the CFIA has primary oversight over non-health issues related to food labeling, packaging, and advertising. Accordingly, the CFIA is the lead agency for ensuring that food labeling, and advertising meet the legal requirements of the Food and Drugs Act, and that labeling representations do not create a potential risk of fraud or consumer confusion and are compliant with Canada’s voluntary disclosure standard for GE food ingredients.

Environment Canada is also available to serve as a regulatory “safety net” if a novel product does not naturally fall within the jurisdiction of the CFIA, Health Canada, or the Pest Management Regulatory Agency that oversees pesticide products.

Our work involving the development, greenhouse testing and field testing of novel yield trait genes in crop plants requires certain government and municipal permits and we must ensure compliance with all applicable regulations including regulations relating to GE crops. With laboratories and greenhouses in both the U.S. and Canada, we are also subject to regulations governing the shipment of seeds and other plant material (including GE seeds and GE plant material) between our facilities in the U.S. and Canada, including USDA-APHIS and CFIA permits for the import and phytosanitary certificates for the export of plant materials that could pose a risk to domestic agriculture.

Having deployed our own research and development operations in Saskatoon, Canada in 2010, we have been conducting field studies of various yield traits in that country since 2016 under PNT permits issued by Canadian regulators. During 2018, we conducted field studies of C3003 in canola, Camelina and soybean at field sites in Canada.

Finally, as one of Canada’s major field crops, canola in particular is subject to variety registration, which is a regulatory requirement of the Seeds Act and is also administered by the CFIA. Any future sales of our seed traits or products in Canada would be done by a third-party collaborator or other partner, and that third party would be responsible for complying with registration requirements for the canola varieties, if applicable.

Regulation in Other Jurisdictions

Other jurisdictions and governmental authorities, including in South America and Asia, are increasingly taking an interest in regulating agricultural products of biotechnology. Regulatory approaches vary by jurisdiction, the existing public health framework and phytosanitary laws in the country, and other less tangible factors such as cultural and religious norms that may have an impact on individual country risk assessments and decision-making. We cannot predict future changes in the global regulatory landscape regarding GE plants subjected to Traditional Genome Modification or GE plants subjected to genome editing.

Further, although U.S. and Canadian regulatory authorities have taken similar approaches to overseeing both traditional biotechnology-derived plants and genome edited plants under their national plant health and biosafety laws, regulation of all GE plants in the EU is significantly more stringent than in North America. U.S. and Canadian regulators have also determined that genome edited GE plants pose fewer risks than those subjected to Traditional Genome Modification, while a recent EU legal ruling indicates that the existing European regulations for GE plants modified by the insertion of recombinant DNA should be strictly applied to genome edited plants as well. There is thus a sharp distinction between how European and North American regulatory agencies oversee novel seed traits, including those that

are generated using the more modern techniques of genome editing. It is possible that emerging oversight regimes for GE products in other jurisdictions could follow the EU approach and impose similar strict requirements for the release of such products into the environment and their incorporation into human food or other consumer products.

Regulation of biotechnology-derived products in the EU is primarily based on Directive 2001/18/EC (the “2001 EC Directive”). The 2001 EC Directive defines “genetically modified organisms” (“GMOs”) broadly as “organism[s], with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination.” In July 2018, the Court of Justice of the European Union (CJEU) issued an important ruling clarifying that the 2001 EC Directive and its pre-market authorization and associated risk assessment requirements required for such “GMOs” should also apply in full to organisms developed using more modern “directed” mutagenesis techniques.

The July 2018 CJEU decision is being interpreted to cover all modern genome editing tools such as CRISPR-Cas9, TALEN and oligonucleotide-directed mutagenesis. This recent clarification by the CJEU regarding the scope of EU regulations suggests that novel seed trait developers who are seeking to bring genome edited seed traits to commercial markets in the EU will face hurdles comparable to what has historically been required in Europe for introducing and commercializing Traditional Genome Modification traits.

Although we are not currently targeting European markets for the development or commercialization of our products, the EU approach to regulating GE plants without regard to the scientific distinctions between Traditional Genome Modification and directed genome editing could be adopted by emerging oversight regimes for GE products in other jurisdictions. There is no guarantee that countries for which we may have or may develop future marketing plans would not take a stricter legal and regulatory approach to controlling GE plants similar to that of the EU.

License Agreement with the University of Massachusetts

Pursuant to a license agreement with the University of Massachusetts (“UMASS”) dated as of June 30, 2015, we have an exclusive, worldwide license under certain patents and patent applications, including issued patents covering our yield trait gene C3003, relating to the manufacture of plants with enhanced photosynthesis. The agreement provides an exclusive, worldwide license to make, have made, use, offer for sale, sell, have sold and import any transgenic plant seed or plant grown therefrom or transgenic plant material developed for sale to a farmer or grower for planting in the field, which transgenic plant seed or plant grown therefrom or transgenic plant material is covered by, embodies or is derived from (in whole or in part) one or more issued or pending claims of the licensed patents or patent applications.

We are required to use diligent efforts to develop licensed products throughout the field of use and to introduce licensed products into the commercial market. In that regard, we are obligated to fulfill certain development and regulatory milestones relating to C3003, including completion of multi-site field demonstrations of a crop species in which C3003 has been introduced, and filing for regulatory approval of a crop species in which C3003 has been introduced within a specified period. Our failure to achieve any milestone provided for under the agreement would, if we are unable to reach agreement with UMASS as to a potential adjustment of the applicable milestone, give UMASS the right to terminate the agreement, following a notice period.

We are obligated to pay UMASS milestone payments relating to any regulatory filings and approvals covered by the agreement, royalties on any sales of licensed products following regulatory approval, as well as a percentage of any sublicense income related to the licensed products.

We may terminate the agreement at any time upon 90 days prior written notice to UMASS. Either party may terminate for material breach immediately upon written notice for a breach that is not cured within 60 days after receiving written notice of the breach. In addition, UMASS may terminate this agreement with respect to certain patent rights immediately upon written notice in the event we contest the validity or enforceability of such patent rights.

License Agreement with the University of Missouri

Pursuant to a license agreement with the University of Missouri (“UM”) dated as of May 17, 2018, we have an exclusive, worldwide license to two novel gene technologies to boost oil content in crops. Both technologies are based on significant new discoveries around the function and regulation of Acetyl-CoA carboxylase (“ACCase”), a key rate-limiting enzyme involved in oil production. The first technology, named C3007, is a gene for a negative controller that inhibits the enzyme activity of ACCase. The second technology, named C3010, is a gene which, if over-expressed, results in increased activity of ACCase. The UM license was expanded during May 2019 to include an exclusive worldwide license to a third gene in the ACCase complex, that we have designated C3012, that may complement the activity of C3007 to boost oil content in crops.

We are required to use diligent efforts to develop licensed products throughout the licensed field and to introduce licensed products into the commercial market. In that regard, we are obligated to fulfill certain research, development and regulatory milestones relating to C3007, C3010 and C3012, including completion of multi-site field demonstrations of a crop species in which C3007, C3010 and C3012 have been introduced, and filing for regulatory approval of a crop species in which C3007, C3010 and C3012 have been introduced within a specified period. Our failure to achieve any milestone provided for under the license agreement would, if we are unable to reach agreement with UM as to a potential adjustment of the applicable milestone, give UM the right to terminate the license agreement or render it nonexclusive.

We are obligated to pay UM a license execution payment, milestone payments relating to any regulatory filings and approvals covered by the license agreement, royalties on any sales of licensed products following regulatory approval, as well as a percentage of any sublicense royalties related to the licensed products.

We may terminate the license agreement at any time upon 90 days' prior written notice to UM. Either party may terminate the license agreement upon written notice for a breach that is not cured within 30 days after receiving written notice of the breach. In addition, UM may terminate the license agreement with respect to certain patent rights immediately upon written notice in the event we contest the validity or enforceability of such patent rights.

Agricultural Industry Landscape

Following advances in biotechnology in the 1970s through early 1990s, the first genetically modified ("GM") crops were commercially introduced in the U.S. in the years 1994 and 1995. Today, the U.S. leads the world in the adoption of GM crops in terms of crop value and acreage planted. GM crops have had both their supporters and their detractors over the years. Consumer sentiment including concerns about the safety of GM crops have limited the introduction and adoption of GM crops in Europe. However, recent studies by the National Academy of Science continue to support the 20 year history of safe use of GM crops.

The International Service for the Acquisition of Agri-Biotech Applications (ISAAA), an industry research group, reported that 457 million acres worldwide were planted with GM crops in 2016, the most recent year where data is available. The planting of GM crops is centered in the Americas with North America at approximately 45 percent of the acres and South America at approximately 43 percent. China and India follow with approximately 8 percent and the balance of the total worldwide GM crop acreage in 2016 was planted in the EU and the rest of world. The primary GM crops in the U.S. are corn, soybean, cotton and sugar beet. In Canada, the oilseed crop canola is the primary GM crop. Cotton is the primary GM crop grown in India and China.

In contrast to the Americas, the EU has been resistant to the adoption of GM crops and has relied heavily on plant breeding programs for capturing crop yield improvements over the last 20 years. In 2016, Spain was the largest producer of GM crops in Europe, based on cultivation of GM corn representing approximately 20 percent of the country's crop that year. Certain GM crops have been approved for cultivation in some European countries, while other countries have imposed outright bans on cultivation of GM crops.

According to the market research firm, Research and Markets, the total global seed business was estimated at \$68 billion in 2017 and is projected to grow to more than \$100 billion by 2022. According to an ISAAA report, the global GM seed business represented a \$17.2 billion market in 2017 and biotech crops were grown on approximately 469 million acres that year. The traits being commercialized today by the agricultural industry mainly address crop protection, which involves preventing crop damage by weeds, insects and other pests that lower expected crop yield. As technology has advanced, "trait stacking," or the practice of adding multiple traits to an elite plant line, has become commonplace as a strategy to protect yield. As the industry has developed, the practice of inter-licensing traits between research and development driven seed companies has led to a proliferation of branded seed products on the market today.

The GM seed business is dominated by large multinational companies and their subsidiaries including BASF, Bayer, DowDuPont, Syngenta and AgReliant. These companies have significant resources, experience and track records of successfully developing, testing and commercializing high performing seed lines as well as new traits for GM crops. They offer farmers conventional and biotechnology seeds as well as crop protection chemicals, biologicals, fertilizers and other products and technologies aimed at supporting the on-farm efficiency of managing crops in the field as well as managing the overall cost of crop production to successful harvest. Many of these companies were recently involved in consolidation of the sector with the DowDuPont merger, the acquisition of Syngenta by ChemChina, and the acquisition of Monsanto by Bayer in 2018.

Privately owned, U.S. retail seed companies play a key role in the industry by developing, marketing and selling high performing seed to U.S. farmers. These companies include Beck's Hybrids and Stine Seed. These companies have capabilities in both biotechnology and plant breeding. They source traits from the multinational companies and input these

traits into elite plant germplasm to produce seeds optimized for a variety of soil, climate and field conditions. Both companies offer a broad arrange of GM corn and soybean products to their customers.

Recent advances in biotechnology including gene editing have led to the formation of companies focusing on yield trait discovery, biologicals for pest control, agbiome strategies and precision agriculture. There are startups, privately held and publicly traded companies involved in this space. Such companies include AgBiome, Arcadia Biosciences, Benson Hill Biosystems, BioCeres, Calyxt, Cibus, Evogene, Inari, Indigo, Kaiima, Marrone Bio Innovation, and Pairwise Plants, many of which have greater resources and experience than we have.

Intellectual Property

Our continued success depends in large part on our proprietary technology. As of June 30, 2019, we owned or held exclusive rights to 20 patents and pending patent applications worldwide related to advanced technologies for increasing yield in crops. Our portfolio of patent applications includes plant science technologies we have in-licensed globally and exclusively from the University of Massachusetts and North Carolina State University related to the yield trait gene C3003 and other advanced technologies based on advanced metabolic engineering methods to improve carbon capture and selectively control carbon partitioning in plants. Our portfolio of patent applications also includes advanced technologies for oilseed crops we in-licensed globally and exclusively from the University of Missouri in 2018 and 2019 related to the yield trait genes C3007, C3010 and C3012.

We continue to seek, develop and evaluate new technologies and related intellectual property that might enhance our Company's business strategy, industry position or deployment options.

Employees

As of June 30, 2019, we had 25 full-time employees. Of those employees, 21 were in research and development. Among our staff, 11 hold Ph.D.'s and 12 hold masters' or bachelors' degrees in their respective disciplines. Our technical staff has expertise in the following areas: plant genetics, plant biology, microbial genetics, bioinformatics, metabolic engineering and systems biology. Our headquarters are located in Massachusetts, and we maintain a research and development facility, including greenhouse facilities, in Saskatoon, Canada. None of our employees are subject to a collective bargaining agreement. We consider our relationship with our employees to be good.

Corporate History and Investor Information

We changed our name to Yield10 Bioscience, Inc. in January 2017 to reflect our change in mission around innovations in agricultural biotechnology focused on developing disruptive technologies for step-change improvements in crop yield. In 1992, our Company was incorporated in Massachusetts under the name Metabolix, Inc. In September 1998, we reincorporated in Delaware. Financial and other information about our Company is available on our website at www.yield10bio.com.

PRINCIPAL STOCKHOLDERS

The following table sets forth certain information with respect to the beneficial ownership of our common stock as of October 2, 2019 for (a) our named executive officers, (b) our directors, (c) our executive officers and directors as a group, and (d) each stockholder known to us to beneficially own more than five percent of our common stock. Beneficial ownership is determined in accordance with the rules of the SEC and includes voting or investment power with respect to the securities. We deem shares that may be acquired by an individual or group within 60 days following October 2, 2019 pursuant to the exercise of options or warrants to be outstanding for the purpose of computing the percentage ownership of such individual or group, but are not deemed to be outstanding for the purpose of computing the percentage ownership of any other person shown in the table. Except as otherwise indicated, we believe that the stockholders named in the table have sole voting and investment power with respect to all shares shown to be beneficially owned by them based on information provided to us by these stockholders. Percentage ownership is based on a total of 12,567,582 shares of our common stock issued and outstanding on October 2, 2019. Unless otherwise noted below, the address of each person listed on the table is c/o Yield10 Bioscience, Inc., 19 Presidential Way, Woburn, MA 01801.

Category	Beneficial Owner	Shares of Common Stock (1)	Options Exercisable Within 60 Days (2)	Warrants Exercisable Within 60 Days (2)	RSUs Vesting Within 60 Days (2)	Total Shares Beneficially Owned	Percentage of Outstanding Shares (3)
5% Stockholders	Jack W. Schuler (4) 100 N. Field Drive Suite 360 Lake Forest, IL 60045	3,804,885	—	2,067,136	—	5,872,021	40.1%
	Lynne H. Brum (5)	31,520	96,583	—	—	128,103	1.0%
Directors and Named Executive Officers	Oliver P. Peoples (6)	91,752	326,875	—	—	418,627	3.2%
	Kristi Snell (7)	28,022	181,834	—	—	209,856	1.6%
	Richard Hamilton	3,041	26,431	—	—	29,472	0.2%
	Peter Kellogg	5,302	37,333	—	—	42,635	0.3%
	Joseph Shaulson (8)	35,295	169,030	—	—	204,325	1.6%
	Anthony J. Sinskey (9)	12,372	47,218	—	—	59,590	0.5%
	Robert L. Van Nostrand	11,293	67,492	—	—	78,785	0.6%

All directors and executive officers as a group (9 persons)

(10)		243,590	1,050,048	—	—	1,293,638	9.5%
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- (1) Beneficial ownership, as such term is used herein, is determined in accordance with Rule 13d-3(d)(1) promulgated under the Securities Exchange Act of 1934, as amended, and includes voting and/or investment power with respect to shares of our common stock. Unless otherwise indicated, the named person possesses sole voting and investment power with respect to the shares.
- (2) Consists of shares of common stock subject to stock options and warrants held by the person that are currently vested or will vest within 60 days after October 2, 2019.
- (3) Percentages of ownership are based upon 12,567,582 shares of common stock issued and outstanding as of October 2, 2019. Shares of common stock that may be acquired pursuant to options and warrants that are vested and exercisable within 60 days after October 2, 2019, are deemed outstanding for computing the percentage ownership of the person holding such options, but are not deemed outstanding for the percentage ownership of any other person.
- (4) The reported securities consist of 2,838,128 shares of common stock and 2,067,136 shares of common stock underlying the warrants owned by the JWS Living Trust, 965,914 shares of common stock owned by the Schuler Family Foundation, and 843 shares of common stock owned by the Renate Schuler Trust. Mr. Schuler has sole voting and investment power over the shares issued to the JWS Living Trust, the Schuler Family Foundation and Renate Schuler Trust. Beneficial ownership information for Mr. Schuler has been derived from his historical SEC filings.
- (5) Includes 23,991 shares held for Ms. Brum in the Company's 401(k) plan.
- (6) Includes 24,124 shares held for Dr. Peoples in the Company's 401(k) plan.
- (7) Includes 23,433 shares held for Dr. Snell in the Company's 401(k) plan.
- (8) Includes 1,470 shares held for Mr. Shaulson in the Company's 401(k) plan.
- (9) Includes 822 shares owned by Dr. Sinskey's spouse and 166 shares owned by a trust over which Dr. Sinskey may be deemed to share voting and investment power. Dr. Sinskey disclaims beneficial ownership of such shares.
- (10) Includes a total of 95,737 shares held for current executive officers and Mr. Shaulson, our former President and Chief Executive Officer, in the Company's 401(k) plan.

CAPITALIZATION

The following table sets forth our cash and cash equivalents and our capitalization as of June 30, 2019:

- on an actual basis; and
- on an as adjusted basis to give effect to the sale of 6,557,377 Class A Units and 4,000 Class B Units in this offering, at an assumed public offering price of \$0.61, the application of the net proceeds of this offering and after deducting the underwriting discounts and commissions and estimated offering expenses payable by us.

<i>in thousands</i>	(unaudited) As of June 30, 2019	
	Actual	As Adjusted
Cash, cash equivalents and short-term investments	\$ 4,250	\$ 11,364
Stockholders' Equity		
Preferred stock (\$0.01 par value per share); 5,000,000 shares authorized; no shares issued or outstanding, actual and 4,000 shares issued and outstanding on an adjusted basis	–	3,680
Common stock (\$0.01 par value per share); 60,000,000 shares authorized; 12,494,731 shares issued and outstanding, actual and 19,052,108 shares issued and outstanding, on an adjusted basis	125	191
Additional paid-in capital	360,516	363,884
Accumulated other comprehensive loss	(118)	(118)
Accumulated deficit	(356,069)	(356,069)
Total stockholders' equity	\$ 4,454	\$ 11,568
Total capitalization	\$ 4,454	\$ 11,568

You should read this table together with “Item 2-Management’s Discussion and Analysis of Financial Condition and Results of Operations” in our Quarterly Report on Form 10-Q filed on August 12, 2019 and with our consolidated financial statements and the accompanying notes contained therein.

DILUTION

If you acquire shares of our common stock in this offering, your ownership interest will be diluted to the extent of the difference between the public offering price per share of our common stock and the pro forma net tangible book value per share of our common stock after this offering. Our historical net tangible book value of common stock as of June 30, 2019 was \$4.5 million, or \$0.36 per share of common stock. Historical net tangible book value per share represents the amount of our total tangible assets less total liabilities, divided by the total number of shares of common stock outstanding.

The last reported sales price per share of our common stock on The Nasdaq Capital Market on October 8, 2019 was \$0.6199. After giving effect to the sale of 6,557,377 shares of common stock and the conversion of all outstanding shares of our Series A Preferred Stock into 6,557,377 shares of common stock at an assumed public offering price of \$0.61 per share and after deducting estimated offering expenses payable by us, our pro forma net tangible book value as of June 30, 2019 would have been \$11.6 million, or \$0.45 per share of common stock. This represents an immediate increase in pro forma net tangible book value of \$0.09 per share to our existing stockholders and an immediate dilution in pro forma net tangible book value of \$0.16 per share to investors

participating in this offering. The following table illustrates this per share dilution:

Assumed public offering price per share	\$0.61
Historical net tangible book value per share as of June 30, 2019	\$0.36
Increase in net tangible book value per share attributable to this offering	\$0.09
Pro forma net tangible book value per share after this offering	\$0.45
Dilution per share to new investors in the offering	\$0.16

The information discussed above is based on an assumed public offering price of \$0.61, is illustrative only and will change based on actual pricing and other terms in this offering determined at pricing. The table and calculations set forth above are based on the number of shares of common stock outstanding as of June 30, 2019 and excludes the shares of common stock that may be issued under the warrants to be issued in this offering and also excludes:

- 2,446,082 of common stock issuable upon exercise of options to purchase our common stock outstanding as of June 30, 2019 at a weighted average exercise price of \$4.61 per share;
- 63,773 shares of common stock reserved as of June 30, 2019 for future issuance under our 2018 Stock Option and Incentive Plan;
- 570,784 shares of common stock issuable upon exercise of warrants issued pursuant to the Securities Purchase Agreement we entered into with certain investors on July 3, 2017 (which warrants became exercisable on January 7, 2018 at an exercise price of \$5.04 per share and expire on January 7, 2024);
- 30,000 shares of common stock issuable upon exercise of immediately vested warrants issued to an investor relations consultant on September 12, 2017 at an exercise price of \$2.90 per share and which expire on September 11, 2024; and
- 6,439,000 shares of common stock issuable upon exercise of vested Series A warrants outstanding as of June 30, 2019 pursuant to the Securities Purchase Agreement we entered into with certain investors on December 21, 2017 at an exercise price of \$2.25 per share and which expire on December 21, 2022.

To the extent that options or warrants are exercised, there will be further dilution to new investors.

DESCRIPTION OF OUR CAPITAL STOCK

General

The following summary of our capital stock is based on certain provisions of our amended and restated certificate of incorporation, as amended, and amended and restated by-laws and on the applicable provisions of the DGCL. This summary does not purport to be complete and is qualified in its entirety by reference to the applicable provisions in our amended and restated certificate of incorporation, as amended, and amended and restated by-laws and the DGCL. For a complete description you should refer to our amended and restated certificate of incorporation, as amended, and our amended and restated by-laws, copies of which have been incorporated by reference herein, and to the applicable provisions of the DGCL.

Our authorized capital stock consists of 65,000,000 shares, with a par value of \$0.01 per share, of which:

- 60,000,000 shares are designated as common stock; and
- 5,000,000 shares are designated as undesignated preferred stock.

Description of Securities Being Registered

We are offering Class A Units, with each Class A Unit consisting of one share of common stock and a warrant to purchase one share of our common stock at an exercise price per share of \$[•], together with the shares of common stock underlying such warrants, at a public offering price of \$[•] per Class A Unit. The Class A Units will not be certificated and the shares of common stock and warrants part of such units are immediately separable and will be issued separately in this offering.

We are also offering to those purchasers whose purchase of Class A Units in this offering would result in the purchaser, together with its affiliates and certain related parties, beneficially owning more than 4.99% (or, at the election of the purchaser, 9.99%) of our outstanding common stock following the consummation of this offering, the opportunity to purchase, in lieu of the number of Class A Units that would result in ownership in excess of 4.99% (or, at the election of the purchaser, 9.99%), Class B Units. Each Class B Unit will consist of one share of Series A Preferred Stock, par value \$0.01 per share, convertible into shares of common stock and a warrant to purchase 100% of the shares of the common stock underlying each share of Series A Preferred Stock at an exercise price per share of \$[•], together with the shares of common stock underlying such shares of Series A Preferred Stock and warrants, at a public offering price of \$[•] per Class B Unit. The Class B Units will not be certificated and the shares of Series A Preferred Stock and the warrants part of such units are immediately separable and will be issued separately in this offering. The Series A Preferred Stock will only be entitled to dividends in the event dividends are paid on our common stock and will not have voting rights or any preferences over common stock, including liquidation rights.

Description of Series A Preferred Stock Included in the Units

Our board of directors has designated 4,000 shares of our preferred stock as Series A Preferred Stock (“Series A Preferred Shares”), none of which are currently issued and outstanding. The preferences and rights of the Series A Preferred Shares will be as set forth in a Certificate of Designation (the “Series A Certificate of Designation”) to be filed as an exhibit to the registration statement of which this prospectus is a part.

In the event of a liquidation, the holders of Series A Preferred Shares are entitled to participate on an as-converted-to-Common Stock basis with holders of the Common Stock in any distribution of assets of the Company to the holders of the Common Stock. The Series A Certificate of Designation provides, among other things, that we shall not pay any dividends on shares of Common Stock (other than dividends in the form of Common Stock) unless and until such time as we pay dividends on each Series A Preferred Share on an as-converted basis. Other than as set forth in the previous sentence, the Series A Certificate of Designation provides that no other dividends shall be paid on Series A Preferred Shares and that we shall pay no dividends (other than dividends in the form of common stock) on shares of Common Stock unless we simultaneously comply with the previous sentence. The Series A Certificate of Designation does not provide for any restriction on the repurchase of Series A Preferred Shares by us while there is any arrearage in the payment of dividends on the Series A Preferred Shares. There are no sinking fund provisions applicable to the Series A Preferred Shares.

With certain exceptions, as described in the Series A Certificate of Designation, the Series A Preferred Stock has no voting rights. However, as long as any shares of Series A Preferred Stock remain outstanding, the Series A Certificate of Designation provides that we shall not, without the affirmative vote of holders of a majority of the then-outstanding Series A Preferred Stock, (a) alter or change adversely the powers, preferences or rights given to the Series A Preferred Stock or alter or amend the Series A Certificate of Designation, (b) increase the number of authorized shares of Series A Preferred Stock or (c) effect a stock split or reverse stock split of the Series A Preferred Stock or any like event.

Each share of Series A Preferred Stock is convertible at any time at the holder’s option into a number of shares of common stock equal to \$1,000.00 divided by the Series A Conversion Price. The “Series A Conversion Price” is initially \$[•] and is subject to adjustment for stock splits, stock dividends, distributions, subdivisions and combinations. Notwithstanding the foregoing, the Series A Certificate of Designation further provides that we shall not effect any conversion of Series A Preferred Stock, with certain exceptions, to the extent that, after giving effect to an attempted conversion, the holder of Series A Preferred Shares (together with such holder’s affiliates, and any persons acting as a group together with such holder or any of such holder’s affiliates) would beneficially own a

number of shares of Common Stock in excess of 4.99% (or, at the election of the holder, 9.99%) of the shares of our Common Stock then outstanding after giving effect to such exercise (the "Preferred Stock Beneficial Ownership Limitation"); provided, however, that upon notice to the Company, the holder may increase or decrease the Preferred Stock Beneficial Ownership Limitation, provided that in no event shall the Preferred Stock Beneficial Ownership Limitation exceed 9.99% and any increase in the Preferred Stock Beneficial Ownership Limitation will not be effective until 61 days following notice of such increase from the holder to us.

Subject to certain conditions, at any time following the issuance of the Series A Preferred Stock, we will have the right to cause each holder of the Series A Preferred Stock to convert all or part of such holder's Series A Preferred Stock in the event that (i) the volume weighted average price of our common stock for 30 consecutive trading days (the "Measurement Period") exceeds 300% of the initial conversion price of the Series A Preferred Stock (subject to adjustment for forward and reverse stock splits, recapitalizations, stock dividends and similar transactions), (ii) the daily trading volume on each Trading Day during such Measurement Period exceeds \$175,000 per trading day and (iii) the holder is not in possession of any information that constitutes or might constitute, material non-public information which was provided by the Company. Our right to cause each holder of the Series A Preferred Stock to convert all or part of such holder's Series A Preferred Stock shall be exercised ratably among the holders of the then outstanding preferred stock.

We do not intend to apply for listing of the Series A Preferred Stock on any securities exchange or other trading system.

Description of Warrants Included in the Units

The material terms and provisions of the warrants being offered pursuant to this prospectus are summarized below. This summary of some provisions of the warrants is not complete. For the complete terms of the warrants, you should refer to the form of warrant to be filed as an exhibit to the registration statement of which this prospectus is a part.

Each warrant is exercisable to purchase one of a share of our common stock at a price equal to \$[•] per share, starting on the date on which we publicly announce, through the filing of a Current Report on Form 8-K, that we have sufficient authorized shares of common stock to allow the full exercise of the warrants, until five and one-half years after the date of the closing of this offering. The holder of a warrant will not be deemed a holder of our underlying common stock until the warrant is exercised. Pursuant to a warrant agency agreement between us and American Stock Transfer & Trust Company, LLC, as warrant agent, the warrants will be issued in book-entry form and shall initially be represented only by one or more global warrants deposited with the warrant agent, as custodian on behalf of The Depository Trust Company, or DTC, and registered in the name of Cede & Co. a nominee of DTC, or as otherwise direct by DTC.

Subject to limited exceptions, a holder of warrants will not have the right to exercise any portion of its warrants if the holder (together with such holder's affiliates, and any persons acting as a group together with such holder or any of such holder's affiliates) would beneficially own a number of shares of common stock in excess of 4.99% (or, at the election of the purchaser, 9.99%) of the shares of our Common Stock then outstanding after giving effect to such exercise (the "Beneficial Ownership Limitation"); provided, however, that upon notice to the Company, the holder may increase or decrease the Preferred Stock Beneficial Ownership Limitation, provided that in no event shall the Beneficial Ownership Limitation exceed 9.99% and any increase in the Beneficial Ownership Limitation will not be effective until 61 days following notice of such increase from the holder to us.

The exercise price and the number of shares issuable upon exercise of the warrants is subject to appropriate adjustment in the event of recapitalization events, stock dividends, stock splits, stock combinations, reclassifications, reorganizations or similar events affecting our common stock. The warrant holders must pay the exercise price in cash upon exercise of the warrants, unless such warrant holders are utilizing the cashless exercise provision of the warrants. On the expiration date, unexercised warrants will automatically be exercised via the "cashless" exercise provision.

Upon the holder's exercise of a warrant, we will issue the shares of common stock issuable upon exercise of the warrant within two trading days following our receipt of a notice of exercise, provided that payment of the

exercise price has been made (unless exercised to the extent permitted via the “cashless” exercise provision). Prior to the exercise of any warrants to purchase common stock, holders of the warrants will not have any of the rights of holders of the common stock purchasable upon exercise, including the right to vote, except as set forth therein. Warrant holders may exercise warrants only if the issuance of the shares of common stock upon exercise of the warrants is covered by an effective registration statement, or an exemption from registration is available under the Securities Act and the securities laws of the state in which the holder resides. We intend to use commercially reasonable efforts to have the registration statement, of which this prospectus forms a part, effective when the warrants are exercised. The warrant holders must pay the exercise price in cash upon exercise of the warrants unless there is not an effective registration statement or, if required, there is not an effective state law registration or exemption covering the issuance of the shares underlying the warrants (in which case, the warrants may only be exercised via a “cashless” exercise provision).

We do not currently have a sufficient number of authorized shares of common stock to cover shares issuable upon exercise of the warrants being offered by this prospectus. As a result, before any warrants can become exercisable, we will seek stockholder approval of an amendment to our certificate of incorporation to implement an increase in the number of authorized shares of our common stock at a special meeting of stockholders to be called for this purpose. While our board of directors will unanimously recommend that stockholders approve the Charter Amendment, we cannot assure you that we will be able to obtain the requisite stockholder approval of the Charter Amendment. The warrants will be exercisable on any day on or after the date on which we publicly announce, through filing of a Current Report on Form 8-K, that we have sufficient authorized shares of common stock as a result of the Charter Amendment.

We do not intend to apply for listing of the warrants on any securities exchange or other trading system.

Common Stock

The holders of our common stock are entitled to one vote per share on all matters submitted to a vote of our stockholders and do not have cumulative voting rights. Subject to preferences that may be applicable to any preferred stock outstanding at the time, the holders of outstanding shares of common stock are entitled to receive ratably any dividends declared by our board of directors out of assets legally available. Upon our liquidation, dissolution or winding up, holders of our common stock are entitled to share ratably in all assets remaining after payment of liabilities and the liquidation preference of any then outstanding shares of preferred stock. Holders of common stock have no preemptive or conversion rights or other subscription rights. There are no redemption or sinking fund provisions applicable to our common stock.

Preferred Stock

Our amended and restated certificate of incorporation, as amended, authorizes it to issue up to 5,000,000 shares of \$0.01 par value undesignated preferred stock. Our board of directors may designate the rights, preferences, privileges and restrictions of the preferred stock, including dividend rights, conversion rights, voting rights, terms of redemption, liquidation preference, sinking fund terms and the number of shares constituting any series or the designation of any series. As of June 30, 2019, no preferred stock was issued or outstanding.

Warrants

As of June 30, 2019, we had warrants outstanding to purchase 7,039,784 shares of our common stock.

Anti-Takeover Provisions

Certain provisions of the DGCL and our amended and restated certificate of incorporation, as amended, and amended and restated by-laws may have the effect of delaying, deferring or discouraging another party from acquiring control of our company. These provisions, which are summarized below, may discourage certain types of coercive takeover practices and inadequate takeover bids and encourage anyone seeking to acquire control of our company to first negotiate with our board of directors. These provisions might also have the effect of preventing changes in our management and could make it more difficult to accomplish transactions that stockholders might otherwise deem to be in their best interests. However, we believe that the advantages gained by protecting our

ability to negotiate with any unsolicited and potentially unfriendly acquirer outweigh the disadvantages of discouraging such proposals, because, among other reasons, the negotiation of such proposals could result in improving their terms.

Amended and Restated Certificate of Incorporation and By-law Provisions

Our amended and restated certificate of incorporation, as amended, and amended and restated by-laws include a number of provisions that may have the effect of delaying, deferring or discouraging another party from acquiring control of our company or preventing changes in our management, including the following:

- *Issuance of Undesignated Preferred Stock.* Our board of directors has the authority, without further action by the stockholders, to issue up to 5,000,000 shares of undesignated preferred stock with rights, preferences and privileges designated from time to time by our board of directors without further action by stockholders. These rights, preferences and privileges could include dividend rights, conversion rights, voting rights, terms of redemption, liquidation preferences and sinking fund terms, any or all of which may be greater than the rights of common stock.
- *Size of the Board of Directors and Filling Vacancies.* The number of directors constituting our board of directors may be set only by resolution adopted by a majority vote of our entire board of directors. Any vacancy on our board of directors, however occurring, including a vacancy resulting from an increase in the size of the board of directors, may only be filled by the affirmative vote of a majority of our directors then in office, even if less than a quorum.
- *Classified Board.* Our board of directors is divided into three classes of directors, with staggered three-year terms. Only one class of directors will be elected at each annual meeting of our stockholders, with the other classes continuing for the remainder of their respective three-year terms.
- *No Cumulative Voting.* Our amended and restated certificate of incorporation, as amended, and amended and restated by-laws do not permit cumulative voting in the election of directors. Cumulative voting allows a stockholder to vote a portion, or all of its shares for one or more candidates. The absence of cumulative voting makes it more difficult for a minority stockholder to gain a seat.
- *Removal of Directors.* Directors can only be removed by our stockholders for cause and removal of a director will require a 75% stockholder vote.
- *No Written Consent of Stockholders.* All stockholder actions are required to be taken by a vote of the stockholders at an annual or special meeting. Stockholders may not take action by written consent in lieu of a meeting. The inability of stockholders to take action by written consent means that a stockholder would need to wait until the next annual or special meeting to bring business before the stockholders for a vote.
- *Special Meetings of Stockholders.* Special meetings of our stockholders may be called only by our board of directors acting pursuant to a resolution approved by the affirmative vote of a majority of the directors then in office. Only those matters set forth in the notice of the special meeting may be considered or acted upon at a special meeting of our stockholders.
- *Advance Notice Requirements for Stockholder Proposals and Director Nominations.* Our amended and restated by-laws provide advance notice procedures for stockholders seeking to bring business before our annual meeting of stockholders or to nominate candidates for election as directors at our annual meeting of stockholders. These procedures provide that notice must be given in writing not later than the close of business on the 90th day nor earlier than the close of business on the 120th day prior to the first anniversary of the preceding year's annual meeting. These procedures may have the effect of precluding the conduct of certain business at a meeting if the proper procedures are not followed or may discourage or deter a potential acquirer from conducting a solicitation of proxies to elect its own slate of directors or otherwise attempt to obtain control of us.

- *Amendment to Amended and Restated Certificate of Incorporation and By-laws.* Any amendment, repeal or modification of certain provisions of our amended and restated certificate of incorporation or amended and restated by-laws requires a 75% stockholder vote. Provisions requiring such supermajority vote include, among other things, any amendment, repeal or modification of the provisions relating to the classification of our board of directors, the requirement that stockholder actions be effected at a duly called annual or special meeting of our stockholders and the designated parties entitled to call a special meeting of our stockholders.

Section 203 of the DGCL

We are subject to Section 203 of the DGCL. In general, Section 203 of the DGCL prohibits a publicly held Delaware corporation from engaging in a “business combination” with an “interested stockholder” for a three-year period following the time that this stockholder becomes an interested stockholder, unless it satisfies one of the following conditions:

- the transaction is approved by the board of directors prior to the time that the interested stockholder became an interested stockholder;
- upon consummation of the transaction which resulted in the stockholder becoming an interested stockholder, the interested stockholder owned at least 85% of the voting stock of the corporation outstanding at the time the transaction commenced; or

In general, Section 203 defines “business combination” to include the following:

- at or subsequent to such time that the stockholder became an interested stockholder, the business combination was approved by the board of directors and authorized at an annual or special meeting of stockholders by at least two-thirds of the outstanding voting stock which is not owned by the interested stockholder.
- any merger or consolidation involving the corporation and the interested stockholder;
- any sale, lease, exchange, mortgage, pledge, transfer or other disposition of the assets of the corporation with an aggregate market value of 10% or more of either the aggregate market value of all assets of the corporation on a consolidated basis or the aggregate market value of all of the outstanding stock of the corporation involving the interested stockholder;
- subject to certain exceptions, any transaction that results in the issuance or transfer by the corporation of any stock of the corporation to the interested stockholder;
- any transaction involving the corporation that has the effect of increasing the proportionate share of the stock or any class or series of the corporation beneficially owned by the interested stockholder; or
- the receipt by the interested stockholder of the benefit of any loans, advances, guarantees, pledges or other financial benefits by or through the corporation.

In general, Section 203 defines an “interested stockholder” as an entity or person who, together with the stockholder’s affiliates and associates (as defined in Section 203), beneficially owns, or within three years prior to the time of determination of interested stockholder status did own, 15% or more of the outstanding voting stock of the corporation.

Treatment of Options Upon Change of Control

In general, under the terms of our Stock Option and Incentive Plans and our Stock Issuance Plan and our executive employment agreements, in the event of certain change in control transactions, if the successor corporation does not assume our outstanding options or issue replacement awards, or if an option holder’s employment is involuntarily terminated in connection with such change in control, the vesting of the options outstanding under such plans will accelerate.

Transfer Agent and Registrar

The transfer agent and registrar for our Common Stock is American Stock Transfer & Trust Company, LLC. The transfer agent's telephone number is (718) 921-8200.

Stock Exchange Listing

Our Common Stock is listed on The Nasdaq Capital Market under the symbol "YTEN".

UNDERWRITING

We have entered into an underwriting agreement dated , 2019 with Ladenburg Thalmann & Co., Inc., as the representative of the underwriters (the “representative”) named below and the sole book-running manager of this offering. Subject to the terms and conditions of the underwriting agreement, the underwriters have agreed to purchase the number of our securities set forth opposite its name below.

<u>Underwriter</u>	<u>Class A Units</u>	<u>Class B Units</u>
Ladenburg Thalmann & Co., Inc.	[•]	[•]
Total	[•]	[•]

A copy of the underwriting agreement will be filed as an exhibit to the registration statement of which this prospectus is a part.

We have been advised by the underwriters that they propose to offer the units directly to the public at the public offering price set forth on the cover page of this prospectus. Any securities sold by the underwriters to securities dealers will be sold at the public offering price less a selling concession not in excess of \$[•] per share and \$[•] per warrant. The underwriting agreement provides that the underwriters' obligation to purchase the securities we are offering is subject to conditions contained in the underwriting agreement.

No action has been taken by us or the underwriters that would permit a public offering of the units, or the shares of common stock, shares of preferred stock and warrants included in the units, in any jurisdiction outside the United States where action for that purpose is required. None of our securities included in this offering may be offered or sold, directly or indirectly, nor may this prospectus or any other offering material or advertisements in connection with the offer and sales of any of the securities offering hereby be distributed or published in any jurisdiction except under circumstances that will result in compliance with the applicable rules and regulations of that jurisdiction. Persons who receive this prospectus are advised to inform themselves about and to observe any restrictions relating to this offering of securities and the distribution of this prospectus. This prospectus is neither an offer to sell nor a solicitation of any offer to buy the securities in any jurisdiction where that would not be permitted or legal.

The underwriters have advised us that they do not intend to confirm sales to any account over which they exercise discretionary authority.

Underwriting Discount and Expenses

The following table summarizes the underwriting discount and commission to be paid to the underwriters by us.

	Per Class A Unit (1)	Per Class B Unit (1)	Total	Total Including Over- Allotment ⁽²⁾
Public offering price	\$ [•]	\$ [•]	\$ [•]	\$ [•]
Underwriting discount and commissions to be paid to the underwriters by us (3)	[•]	[•]	[•]	[•]
Proceeds to us (before expenses)	\$ [•]	\$ [•]	\$ [•]	\$ [•]

- (1) The public offering price and underwriting discount corresponds to (x) in respect of the Class A Units (i) a public offering price per share of common stock of \$[*] and (ii) a public offering price per warrant of \$ [*] and (y) in respect of the Class B Units (i) a public offering price per share of Series A Preferred Stock of \$[*] and (ii) a public offering price per warrant of \$[*].
- (2) We have granted the representative an option, which is exercisable not later than 45 days after the date of this prospectus, to purchase a number of additional shares of common stock in an amount that is up to 15% of the number of shares of common stock sold in the primary offering (which number includes the number of shares of common stock issuable upon conversion of shares of the Series A Preferred Stock, but excludes any shares of common stock underlying the warrants issued in this offering, and any shares of common stock issued upon any exercise of the over-allotment option). These shares would be sold to the representative at the public offering price per share of common stock sold in the primary offering, less the underwriting discounts and commissions. Further, the option we have granted to the representative is also exercisable not later than 45 days after the date of this prospectus to purchase a number of additional warrants in an amount that is up to 15% of the warrants sold in the primary offering at the public offering price per warrant set forth on the cover page hereto (which is \$[*] per warrant), less the underwriting discounts and commissions. The representative may exercise the option to cover over-allotments, if any, made in connection with this offering. If any additional shares of common stock and/or warrants are purchased from us under this over-allotment option, the representative will offer these shares of common stock and/or warrants on the same terms as those on which the other securities are being offered.
- (3) Underwriting discounts and commissions per Unit with respect to the sale of Units to the public will be 8% and underwriting discounts and commissions per Unit with respect to the sale of Units to certain Company investors and insiders will be 3%.

We estimate the total expenses payable by us for this offering to be approximately \$886,000, which amount includes (i) the underwriting discount of 8% per Unit with respect to the sale of Units to the public and 3% per Unit with respect to the sale of Units to certain Company insiders (8% per Unit with respect to the sale of Units to the public if the underwriters' over-allotment option is exercised in full); and (ii) reimbursement of the accountable expenses of the representative equal to \$90,000 including the legal fees of the representative being paid by us and (iii) other estimated company expenses of approximately \$158,000 which includes legal, accounting, and printing costs and various fees associated with the registration and listing of our shares.

The securities we are offering are being offered by the underwriters subject to certain conditions specified in the underwriting agreement.

Over-allotment Option

We have granted the representative an option, which is exercisable not later than 45 days after the date of this prospectus, to purchase a number of additional shares of common stock in an amount that is up to 15% of the number of shares of common stock sold in the primary offering (which number includes the number of shares of common stock issuable upon conversion of shares of the Series A Preferred Stock, but excludes any shares of common stock underlying the warrants issued in this offering, and any shares of common stock issued upon any exercise of the over-allotment option). These shares would be sold to the representative at the public offering price per share of common stock sold in the primary offering, less the underwriting discounts and commissions. Further, the option we have granted to the representative is also exercisable not later than 45 days after the date of this prospectus to purchase a number of additional warrants in an amount that is up to 15% of the warrants sold in the primary offering at the public offering price per warrant set forth on the cover page hereto (which is \$[*] per warrant), less the underwriting discounts and commissions. The representative may exercise the option to cover over-allotments, if any, made in connection with this offering. If any additional shares of common stock and/or warrants are purchased from us under this over-allotment option, the representative will offer these shares of common stock and/or warrants on the same terms as those on which the other securities are being offered.

Nasdaq Listing

Our common stock is currently traded on The Nasdaq Capital Market under the symbol "YTEN." On October 8, 2019 the closing price of our common stock was \$0.6199 per share. We do not intend to apply for listing of the Series A Preferred Stock or warrants on any securities exchange or other trading system.

Determination of Offering Price

The public offering price of the securities offered by this prospectus will be determined by negotiation between us and the underwriters. Among the factors considered in determining the public offering price of the units were:

- our history and our prospects;

- the industry in which we operate;
- our past and present operating results;
- the previous experience of our executive officers; and
- the general condition of the securities markets at the time of this offering.

The offering price stated on the cover page of this prospectus should not be considered an indication of the actual value of the securities sold in this offering. That price is subject to change as a result of market conditions and other factors and we cannot assure you that the shares of common stock, shares of Series A Preferred Stock and warrants sold in this offering can be resold at or above the public offering price.

Lock-up Agreements and Other Lock-up Restrictions

Our officers, directors and each of their respective affiliates and associated persons have agreed with the representative to be subject to a lock-up period of 90 days following the date of this prospectus. This means that, during the applicable lock-up period, such persons may not offer for sale, contract to sell, sell, distribute, grant any option, right or warrant to purchase, pledge, hypothecate or otherwise dispose of, directly or indirectly, any shares of our common stock or any securities convertible into, or exercisable or exchangeable for, shares of our common stock. Certain limited transfers are permitted during the lock-up period if the transferee agrees to these lock-up restrictions. We have also agreed, in the underwriting agreement, to similar lock-up restrictions on the issuance and sale of our securities for 90 days following the closing of this offering, although we will be permitted to issue stock options or stock awards to directors, officers and employees under our existing plans. The lock-up period is subject to an additional extension to accommodate for our reports of financial results or material news releases. The representative may, in its sole discretion and without notice, waive the terms of any of these lock-up agreements.

We have also agreed, in the underwriting agreement, to similar lock-up restrictions on the issuance and sale of our securities for 90 days following the closing of this offering (subject to an early termination if, after 45 days, the closing price of our common stock exceeds the public offering price per Class A Unit for three consecutive trading days).

Stockholder Approval

We have agreed to hold a stockholders meeting no later than 60 days after the date of the underwriting agreement in order to seek stockholder approval for an amendment to our certificate of incorporation to increase the number of shares of common stock we are authorized to issue in an amount sufficient to permit the exercise in full of the warrants in accordance with their terms. In the event that we are unable to effect an increase in our authorized shares of common stock, the warrants will not be exercisable and will have no value.

Other Relationships

Upon completion of this offering, and subject to certain conditions, we have granted the representative a right of first refusal to act as lead or co-lead bookrunner or lead or co-lead placement agent in connection with any subsequent public or private offering of equity securities or other capital markets financing by us. This right of first refusal extends for 9 months from the closing date of this offering. The terms of any such engagement of the representative will be determined by separate agreement.

Stabilization, Short Positions and Penalty Bids

In order to facilitate the offering, the underwriters may engage in transactions that stabilize, maintain or otherwise affect the price of our shares of common stock. In connection with the offering, the underwriters may purchase and sell our shares of common stock in the open market. These transactions may include short sales, purchases on the open market to cover positions created by short sales and stabilizing transactions. Short sales involve the sale by the underwriters of a greater number of shares of common stock than they are required to purchase in the offering. "Covered" short sales are sales made in an amount not greater than the underwriters' option

to purchase additional shares of common stock in the offering pursuant to the exercise of their over-allotment option to purchase additional shares of common stock and/or warrants. The underwriters may close out, or satisfy, any covered short position by either exercising the over-allotment option, in which case the shares of common stock or warrants would be purchased directly from us, or purchasing shares of common stock in the open market. Because none of our warrants, including those to be sold in this offering, are publicly listed for trading on a securities exchange, the underwriters would need to purchase warrants directly from us as part of an exercise of the over-allotment option in order to be able to deliver both of the components of the units that are being sold to the investors in the offering when closing out any covered short position. The underwriters will pay the same price for any exercise of the over-allotment options as the public offering price for the securities sold in this offering, less the underwriting discount. With respect to a share of common stock, this price will be \$[●] per share, and with respect to a warrant, this price will be \$[●] per warrant. In determining the source of shares of common stock that may be needed to close out a covered short position, the underwriters will consider, among other things, the price of common stock that is then available for purchase in the open market as compared to the price at which they may purchase shares of common stock directly from us through the over-allotment option. "Naked" short sales are sales in excess of the over-allotment option. The underwriters must close out any naked short position by purchasing shares of common stock in the open market. A naked short position is more likely to be created if the underwriters are concerned that there may be downward pressure on the price of our shares of common stock in the open market after pricing that could adversely affect investors who purchase in the offering.

- Stabilizing transactions permit bids to purchase the underlying security so long as the stabilizing bids do not exceed a specific maximum.
- Penalty bids permit the underwriters to reclaim a selling concession from a syndicate member when the securities originally sold by the syndicate member are purchased in a stabilizing or syndicate covering transaction to cover syndicate short positions.

These stabilizing transactions and penalty bids may have the effect of raising or maintaining the market prices of our securities or preventing or retarding a decline in the market prices of our securities. As a result the price of our common stock may be higher than the price that might otherwise exist in the open market. Neither we nor the underwriters make any representation or prediction as to the effect that the transactions described above may have on the price of our common stock. These transactions may be effected on Nasdaq, in the over-the-counter market or on any other trading market and, if commenced, may be discontinued at any time.

In connection with this offering, the underwriters also may engage in passive market making transactions in our common stock in accordance with Regulation M during a period before the commencement of offers or sales of shares of our common stock in this offering and extending through the completion of the distribution. In general, a passive market maker must display its bid at a price not in excess of the highest independent bid for that security. However, if all independent bids are lowered below the passive market maker's bid that bid must then be lowered when specific purchase limits are exceeded. Passive market making may stabilize the market price of the securities at a level above that which might otherwise prevail in the open market and, if commenced, may be discontinued at any time.

Neither we, nor the underwriters make any representation or prediction as to the direction or magnitude of any effect that the transactions described above may have on the prices of our securities. In addition, neither we nor the underwriters make any representation that the underwriters will engage in these transactions or that any transactions, once commenced will not be discontinued without notice.

Indemnification

We have agreed to indemnify the underwriters against certain liabilities, including certain liabilities arising under the Securities Act or to contribute to payments that the underwriters may be required to make for these liabilities.

DISCLOSURE OF COMMISSION POSITION ON INDEMNIFICATION FOR SECURITIES ACT LIABILITIES

Insofar as indemnification for liabilities arising under the Securities Act may be permitted to directors, officers, and controlling persons of the registrant pursuant to the foregoing provisions, or otherwise, the registrant has been informed that in the opinion of the SEC such indemnification is against public policy as expressed in the Securities Act and is, therefore, unenforceable.

LEGAL MATTERS

Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C., Boston, Massachusetts, will pass upon the validity of the issuance of the securities offered by this prospectus. Certain legal matters in connection with this offering will be passed upon for the underwriters by Ellenoff Grossman & Schole LLP, New York, New York.

EXPERTS

The consolidated financial statements of Yield10 Bioscience, Inc. as of December 31, 2018 and December 31, 2017, and for each of the years in the two-year period ended December 31, 2018 incorporated in this Prospectus by reference to the Yield10 Bioscience, Inc.'s Current Report on Form 8-K filed on September 9, 2019 have been audited by RSM US LLP, an independent registered public accounting firm, as stated in their report thereon (which report expresses an unqualified opinion and includes an explanatory paragraph relating to the change in method of accounting for leasing transactions due to the adoption of Financial Accounting Standard Board's Accounting Standards Update 2016-02, *Leases* and an explanatory paragraph relating to going concern), incorporated herein by reference, and have been incorporated in this Prospectus and Registration Statement in reliance upon such report and upon authority of such firm as experts in accounting and auditing.

WHERE YOU CAN FIND MORE INFORMATION

We file annual, quarterly and other periodic reports, proxy statements and other information with the SEC. You can read our SEC filings over the Internet at the SEC's website at www.sec.gov.

Our Internet address is www.yield10bio.com. There we make available free of charge, on or through the investor relations section of our website, annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K and amendments to those reports filed pursuant to Section 13(a) or 15(d) of the Exchange Act as soon as reasonably practicable after we electronically file such material with the SEC. The information found on our website is not part of this prospectus supplement or the accompanying prospectus.

INCORPORATION OF CERTAIN DOCUMENTS BY REFERENCE

The SEC allows us to "incorporate by reference" much of the information we file with them, which means that we can disclose important information to you by referring you to those publicly available documents. The information that we incorporate by reference in this prospectus is considered to be part of this prospectus. Because we are incorporating by reference future filings with the SEC, this prospectus is continually updated and those future filings may modify or supersede some of the information included or incorporated in this prospectus. You should refer to the registration statement, including the exhibits, for further information about us and the securities we may offer pursuant to this prospectus. Statements in this prospectus regarding the provisions of certain documents filed with, or incorporated by reference in, the registration statement are not necessarily complete and each statement is qualified in all respects by that reference. We incorporate by reference into this prospectus the documents listed below and any future filings made by us with the SEC under Sections 13(a), 13(c), 14 or 15(d) of the Exchange Act (1) after the date of this prospectus and prior to the time that all of the securities offered by this prospectus are sold or the earlier termination of the offering, and (2) after the date of the initial registration statement of which this prospectus forms a part and prior to the effectiveness of the registration statement (except in each case in which the information contained in such documents is "furnished" and not "filed"). The documents we are incorporating by reference as of their respective dates of filing are:

- Annual Report on Form 10-K for the year ended December 31, 2018, filed with the SEC on March 28, 2019;
- The portions of our Definitive Proxy Statement on Schedule 14A that are deemed "filed" with the SEC under the Exchange Act, filed on April 4, 2019;
- Quarterly Reports on Form 10-Q filed with the SEC on May 15, 2019 and August 12, 2019, as amended where applicable;
- Current Reports on Form 8-K filed with the SEC on March 15, 2019, March 25, 2019, May 9, 2019, May 23, 2019, July 1, 2019, August 12, 2019, August 19, 2019, and September 9, 2019 (except in each case in which the information contained in such documents is "furnished" and not "filed").
- The description of our common stock contained in Item 1 of our Registration Statement on Form 8-A filed with the SEC on November 6, 2006, including any amendments or reports filed for the purpose of updating the description.

We will provide, without charge to each person, including any beneficial owner, to whom this prospectus is delivered, upon written or oral request of such person, a copy of any or all of the documents incorporated herein by reference other than exhibits, unless such exhibits are specifically incorporated by reference into such documents or this document. Requests for such documents should be addressed in writing or by telephone to:

Investor Relations
Yield10 Bioscience, Inc.
19 Presidential Way
Woburn, Massachusetts 01801
(617) 583-1700



Class A Units consisting of one share of common stock and one warrant and Class B Units consisting of one share of Series A Preferred Stock and warrants (and shares of common stock underlying shares of Series A Preferred Stock and warrants)

Prospectus

Ladenburg Thalmann

_____, 2019

PART II INFORMATION NOT REQUIRED IN PROSPECTUS

Item 13. Other Expenses of Issuance and Distribution.

The following table sets forth the costs and expenses, payable by the Company in connection with the registration and sale of the securities being registered. All amounts are estimates except the SEC registration fee.

	Amount to be paid (\$)
SEC registration fee	\$ 2,567.44
Legal fees and expenses	150,000.00
Accounting fees and expenses	80,000.00
Other	15,000.00
Total	\$ 247,567.44

Item 14. Indemnification of Directors and Officers.

Pursuant to Section 145 of the DGCL, our amended and restated by-laws provide that each director or officer of Yield10 Bioscience, who was or is made a party or is threatened to be made a party to or is involved in any threatened, pending or completed action, suit or proceeding, whether civil, criminal, administrative or investigative, by reason of the fact that he or she, or a person of whom he or she is the legal representative, is or was a director or officer of Yield10 Bioscience, or is or was serving at the request of Yield10 Bioscience as a director, officer, employee or agent of another corporation or of a partnership, joint venture, trust or other enterprise, including service with respect to employee benefit plans, shall be indemnified and held harmless by Yield10 Bioscience to the fullest extent authorized by the DGCL.

Pursuant to Section 102(b)(7) of the DGCL, Article 7 of our amended and restated certificate of incorporation, as amended, eliminates the liability of a director to us or our stockholders for monetary damages for such a breach of fiduciary duty as a director, except for liabilities arising:

- from any breach of the director's duty of loyalty to us or our stockholders;
- from acts or omissions not in good faith or which involve intentional misconduct or a knowing violation of law;
- under Section 174 of the DGCL; and
- from any transaction from which the director derived an improper personal benefit.

We carry insurance policies insuring our directors and officers against certain liabilities that they may incur in their capacity as directors and officers. In addition, we have entered into indemnification agreements with our directors and officers.

The foregoing discussion of our certificate of incorporation, by-laws and Delaware law is not intended to be exhaustive and is qualified in its entirety by such certificate of incorporation, by-laws or law.

Item 15. Recent Sales of Unregistered Securities

On October 1, 2019, the Company issued 48,565 shares of common stock, to participants in its Yield10 Bioscience, Inc. 401(k) Plan as quarterly matching contributions. The issuance of these securities is exempt from registration pursuant to Section 3(a)(2) of the Securities Act as exempted securities.

Item 16. Exhibits and Financial Statement Schedules.

See Exhibit Index following the signature page to this Registration Statement.

Item 17. Undertakings.

The undersigned registrant hereby undertakes:

(1) To file, during any period in which offers or sales are being made, a post-effective amendment to this registration statement:

(i) To include any prospectus required by Section 10(a)(3) of the Securities Act;

(ii) To reflect in the prospectus any facts or events arising after the effective date of the registration statement (or the most recent post-effective amendment thereof) which, individually or in the aggregate, represent a fundamental change in the information set forth in the registration statement. Notwithstanding the foregoing, any increase or decrease in volume of securities offered (if the total dollar value of securities offered would not exceed that which was registered) and any deviation from the low or high end of the estimated maximum offering range may be reflected in the form of prospectus filed with the Commission pursuant to Rule 424(b) if, in the aggregate, the changes in volume and price represent no more than a 20 percent change in the maximum aggregate offering price set forth in the "Calculation of Registration Fee" table in the effective registration statement.

(iii) To include any material information with respect to the plan of distribution not previously disclosed in the registration statement or any material change to such information in the registration statement;

(2) That, for the purpose of determining any liability under the Securities Act, each such post-effective amendment shall be deemed to be a new registration statement relating to the securities offered therein, and the offering of such securities at that time shall be deemed to be the initial bona fide offering thereof.

(3) To remove from registration by means of a post-effective amendment any of the securities being registered which remain unsold at the termination of the offering.

(4) That, for the purpose of determining liability under the Securities Act to any purchaser: each prospectus filed pursuant to Rule 424(b) as part of a registration statement relating to an offering, other than registration statements relying on Rule 430B or other than prospectuses filed in reliance on Rule 430A, shall be deemed to be part of and included in the registration statement as of the date it is first used after effectiveness; provided, however, that no statement made in a registration statement or prospectus that is part of the registration statement or made in a document incorporated or deemed incorporated by reference into the registration statement or prospectus that is part of the registration statement will, as to a purchaser with a time of contract of sale prior to such first use, supersede or modify any statement that was made in the registration statement or prospectus that was part of the registration statement or made in any such document immediately prior to such date of first use.

(5) Insofar as indemnification for liabilities arising under the Securities Act may be permitted to directors, officers, and controlling persons of the registrant pursuant to the foregoing provisions, or otherwise, the registrant has been advised that in the opinion of the SEC such indemnification is against public policy as expressed in the Securities Act and is, therefore, unenforceable. In the event that a claim for indemnification against such liabilities (other than the payment by the registrant of expenses incurred or paid by a director, officer or controlling person of the registrant in the successful defense of any action, suit or proceeding) is asserted by such director, officer or controlling person in connection with the securities being registered, the registrant will, unless in the opinion of its counsel the matter has been settled by controlling precedent, submit to a court of appropriate jurisdiction the question whether such indemnification by it is against public policy as expressed in the Act and will be governed by the final adjudication of such issue.

EXHIBIT INDEX

The exhibits listed below are filed as part of or incorporated by reference into this Registration Statement on Form S-1. Where certain exhibits are incorporated by reference from a previous filing, the exhibit numbers and previous filings are identified in parentheses.

Exhibit No.	Identification of Exhibit
1.1 *	Form of Underwriting Agreement.
2.1	Purchase Agreement between Metabolix, Inc. and CJ Research Center LLC, dated September 16, 2016, (incorporated by reference herein to the exhibits to the Company's Report on Form 8-K filed on September 21, 2016 (File No. 001-33133)).
3.1	Amended and Restated Certificate of Incorporation of the Company, as amended (incorporated by reference herein to the exhibits to the Company's Quarterly Report on Form 10-Q for the quarter ended June 30, 2018 (File No. 001-33133)).
3.2	Amended and Restated By-Laws of the Company (incorporated by reference herein to the exhibits to the Company's Report on Form 8-K filed on January 6, 2017 (File No. 001-33133)).
3.3 *	Form of Certificate of Designation of Series A Preferred Stock.
4.1	Specimen Stock Certificate for shares of the Registrant's Common Stock (incorporated by reference herein to the exhibits to the Company's Registration Statement on Form S-1/A filed on September 21, 2006 (File No. 333-135760)).
4.2 *	Form of Series A Preferred Stock Certificate.
4.3	Form of Investor Warrant to Purchase Common Stock (incorporated by reference herein to the exhibits to the Company's Report on Form 8-K filed on July 5, 2017 (File No. 001-33133)).
4.4	Form of Series A Common Warrant to purchase shares of Common Stock (incorporated by reference herein to the exhibits to the Company's Registration Statement on Form S-1/A filed December 15, 2017 (File No. 333-221283)).
4.5 *	Form of Common Warrant to purchase shares of Common Stock to be issued in this offering.
5.1 *	Opinion of Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C.
10.1 @	2006 Stock Option and Incentive Plan (incorporated by reference herein to the exhibits to the Company's Registration Statement on Form S-1/A filed on October 20, 2006 (File No. 333-135760)).
10.1.1 @	2006 Stock Option and Incentive Plan, Form of Incentive Stock Option Agreement (incorporated by reference herein to the exhibits to the Company's Registration Statement on Form S-1/A filed on October 20, 2006 (File No. 333-135760)).
10.1.2 @	2006 Stock Option and Incentive Plan, Form of Non-Qualified Stock Option Agreement (incorporated by reference herein to the exhibits to the Company's Registration Statement on Form S-1/A filed on October 20, 2006 (File No. 333-135760)).
10.1.3 @	2006 Stock Option and Incentive Plan, Form of Director Non-Qualified Stock Option Agreement (incorporated by reference herein to the exhibits to the Company's Registration Statement on Form S-1/A filed on October 20, 2006 (File No. 333-135760)).
10.2 @	2014 Stock Option and Incentive Plan, Revised and Restated (incorporated by reference herein to the Company's Quarterly Report on Form 10-Q for the quarter ended June 30, 2015 (File No. 001-33133)).
10.2.1 @	2014 Stock Option and Incentive Plan, Form of Incentive Stock Option Award (incorporated by reference herein to the exhibits to the Company's 2014 Annual Report on Form 10-K filed on March 25, 2015 (File No. 001-33133)).
10.2.2 @	2014 Stock Option and Incentive Plan, Form of Non-Qualified Stock Option Award (incorporated by reference herein to the exhibits to the Company's 2014 Annual Report on Form 10-K filed on March 25, 2015 (File No. 001-33133)).

- [10.2.3](#) @ 2014 Stock Option and Incentive Plan, Form of Restricted Stock Unit Award (incorporated by reference herein to the exhibits to the Company's 2014 Annual Report on Form 10-K filed on March 25, 2015 (File No. 001-33133)).
- [10.2.4](#) @ 2018 Stock Option and Incentive Plan (incorporated by reference herein to the exhibits to the Company's Quarterly Report on Form 10-Q for the quarter ended June 30, 2018 (File No. 001-33133)).
- [10.2.5](#) @ 2018 Stock Option and Incentive Plan, form of Stock Option Agreement (incorporated by reference herein to the exhibits to the Company's Annual Report on Form 10-K filed on March 28, 2019 (File No. 001-33133)).
- [10.3](#) @ Employment Agreement between the Company and Oliver P. Peoples dated March 28, 2017 (incorporated by reference herein to the exhibits to the Company's 2016 Annual Report on Form 10-K filed on March 30, 2017 (File No. 001-33133)).
- [10.4](#) @ Employment Agreement between the Company and Charles B. Haaser dated March 28, 2017 (incorporated by reference herein to the exhibits to the Company's 2016 Annual Report on Form 10-K filed on March 30, 2017 (File No. 001-33133)).
- [10.5](#) @ Employment Agreement between the Company and Lynne H. Brum dated March 28, 2017 (incorporated by reference herein to the exhibits to the Company's 2016 Annual Report on Form 10-K filed on March 30, 2017 (File No. 001-33133)).
- [10.6](#) @ Employment Agreement between the Company and Kristi Snell dated March 28, 2017 (incorporated by reference herein to the exhibits to the Company's 2016 Annual Report on Form 10-K filed on March 30, 2017 (File No. 001-33133)).
- [10.7](#) @ Noncompetition, Confidentiality and Inventions Agreement between the Company and each of Oliver Peoples, Charles Haaser, Lynne H. Brum and Kristi Snell, dated March 28, 2017 (incorporated by reference herein to the exhibits to the Company's 2016 Annual Report on Form 10-K filed on March 30, 2017 (File No. 001-33133)).
- [10.8](#) @ Form of Indemnification Agreement between the Registrant and its Directors and Officers (incorporated by reference herein to the exhibits to the Company's Registration Statement on Form S-1/A filed on October 20, 2006 (File No. 333-135760)).
- [10.9](#) @ Non-Qualified Stock Option Agreement between the Company and Joseph Shaulson dated December 19, 2013 (incorporated by reference herein to the exhibits to the Company's Quarterly Report on Form 10-Q for the quarter ended March 31, 2014 (File No. 001-33133)).
- [10.10](#) @ Restricted Stock Unit Award Agreement between the Registrant and Joseph Shaulson dated March 24, 2014 (incorporated by reference herein to the exhibits to the Company's Quarterly Report on Form 10-Q for the quarter ended March 31, 2014 (File No. 001-33133)).
- [10.11](#) @ Separation Agreement between the Company and Joseph Shaulson, dated as of November 3, 2016 (incorporated by reference herein to the exhibits to the Company's Annual Report on Form 10-K filed on March 30, 2017 (File No. 001-33133)).
- [10.12](#) Lease between Fortune Wakefield, LLC and Metabolix, Inc. dated March 30, 2007 (incorporated by reference herein to the exhibits to the Company's Quarterly Report on Form 10-Q for the quarter ended March 31, 2007 (File No. 001-33133)).
- [10.12.1](#) First Amendment of Lease between Fortune Wakefield, LLC and Metabolix, Inc. dated February 29, 2012 (incorporated by reference herein to the exhibits to the Company's Quarterly Report on Form 10-Q for the quarter ended March 31, 2012 (File No. 001-33133)).
- [10.12.2](#) Second Amendment of Lease between Fortune Wakefield, LLC and Metabolix, Inc. dated October 24, 2013 (incorporated by reference herein to the exhibits to the Company's 2013 Annual Report on Form 10-K filed on March 28, 2014 (File No. 001-33133)).
- [10.13](#) Securities Purchase Agreement dated June 15, 2015 between the Company and the Investors named therein (incorporated by reference herein to the exhibits to the Company's Report on Form 8-K filed on June 17, 2015 (File No. 001-33133)).
- [10.14](#) Standstill Agreement dated June 19, 2015 between the Company and Jack W. Schuler, Renate Schuler and the Schuler Family Foundation (incorporated by reference herein to the exhibits to the Company's Report on Form 8-K filed on June 17, 2015 (File No. 001-33133)).

- [10.15](#) Lease Agreement between the Company and ARE MA Region No. 20, LLC dated January 20, 2016 for the premises located at 19 Presidential Way, Woburn, MA (incorporated by reference herein to the exhibits to the Company's Report on Form 8-K filed on January 26, 2016 (File No. 001-33133)).
- [10.16](#) Common Stock Purchase Agreement, dated October 7, 2015 between Metabolix, Inc. and Aspire Capital Fund, LLC (incorporated by reference herein to the exhibits to the Company's Report on Form 8-K filed on October 7, 2015 (File No. 001-33133)).
- [10.17](#) + Exclusive License Agreement, dated as of June 30, 2015, between the Company and the University of Massachusetts (incorporated by reference herein to the exhibits to the Company's 2016 Annual Report on Form 10-K filed on March 30, 2017 (File No. 001-33133)).
- [10.18](#) Sublease between CJ Research Center LLC and the Company, dated as of September 16, 2016 (incorporated by reference herein to the exhibits to the Company's 2016 Annual Report on Form 10-K filed on March 30, 2017 (File No. 001-33133)).
- [10.19](#) Form of Securities Purchase Agreement, dated as of July 3, 2017, by and among the Company and the purchasers named therein (incorporated by reference herein to the exhibits to the Company's Report on Form 8-K filed on July 5, 2017 (File No. 333-33133)).
- [10.20](#) + Exclusive License Agreement, dated May 17, 2018, between the Company and the University of Missouri (incorporated by reference herein to the exhibits to the Company's Quarterly Report on Form 10-Q for the quarter ended June 30, 2018 (File No. 001-33133)).
- [10.21](#) Form of Securities Purchase Agreement, dated as of March 14, 2019, by and among the Company and the purchasers named therein (incorporated by reference herein to the exhibits on Form 8-K filed on March 15, 2019 (File No. 001-33133)).
- [14.1](#) Yield10 Bioscience, Inc. Code of Business Conduct and Ethics (incorporated by reference herein to the exhibits to the Company's 2018 Annual Report on Form 10-K filed on March 28, 2019)
- [21.1](#) Subsidiaries of the Registrant (incorporated by reference herein to the exhibits to the Company's 2018 Annual Report on Form 10-K filed on March 28, 2019) (File No. 001-33133)).
- [23.1](#) * Consent of RSM US LLP, an independent registered public accounting firm.
- [23.3](#) Consent of Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C. (included in Exhibit 5.1).
- 24.1 Power of Attorney (included in the signature pages to the Registration Statement).
- 101.1 The following financial information from the Yield10 Bioscience, Inc. Annual Report on Form 10-K for the year ended December 31, 2018 formatted in XBRL; (i) Consolidated Balance Sheets, December 31, 2018 and December 31, 2017; (ii) Consolidated Statements of Operations, Years Ended December 31, 2018 and 2017; (iii) Consolidated Statements of Comprehensive Income (Loss), Years Ended December 31, 2018 and 2017; (iv) Consolidated Statements of Cash Flows, Years Ended December 31, 2018 and 2017; and (v) Consolidated Statements of Stockholders' Equity for the Years Ended December 31, 2018 and 2017; and (vi) Notes to Consolidated Financial Statements (incorporated by reference herein to the exhibits to the Company's 2018 Annual Report on Form 10-K filed March 30, 2019 (File No. 001-33133)).

* Filed herewith.

@ Indicates a management contract or any compensatory plan, contract or arrangement.

+ Confidential treatment has been requested for certain portions of this document.

SIGNATURES

Pursuant to the requirements of the Securities Act of 1933, the registrant has duly caused this Amendment No. 1 to the Registration Statement on Form S-1 to be signed on its behalf by the undersigned, thereunto duly authorized, in the City of Woburn, Massachusetts, on October 11, 2019.

By /s/ Oliver P. Peoples
 Oliver P. Peoples
 President and Chief Executive Officer

Pursuant to the requirements of the Securities Act of 1933, this Amendment No. 1 to the Registration Statement on Form S-1 has been signed below by the following persons in the capacities and on the dates indicated.

<u>Signatures</u>	<u>Title</u>	<u>Date</u>
<u>/s/ Oliver P. Peoples</u> Oliver P. Peoples	Director, President and Chief Executive Officer (Principal Executive Officer)	October 11, 2019
<u>/s/ Charles B. Haaser</u> Charles B. Haaser	Chief Accounting Officer (Principal Financial Officer and Principal Accounting Officer)	October 11, 2019
<u>/s/ *</u> Joseph Shaulson	Director	October 11, 2019
<u>/s/ *</u> Peter N. Kellogg	Director	October 11, 2019
<u>/s/ *</u> Richard Hamilton	Director	October 11, 2019
<u>/s/ *</u> Anthony J. Sinskey	Director	October 11, 2019
<u>/s/ *</u> Robert L. Van Nostrand	Director	October 11, 2019

*By: /s/ Oliver P. Peoples Oliver P. Peoples
 Attorney-in-Fact

_____ SHARES OF COMMON STOCK,
 _____ SHARES OF SERIES A CONVERTIBLE PREFERRED STOCK (CONVERTIBLE INTO _____ SHARES OF
 COMMON STOCK),
 WARRANTS EXERCISABLE INTO _____ SHARES OF COMMON STOCK
 OF
 YIELD10 BIOSCIENCE, INC.
 UNDERWRITING AGREEMENT

_____, 2019

Ladenburg Thalmann & Co. Inc.

As the Representative of the

Several underwriters, if any, named in Schedule I hereto

4400 Biscayne Boulevard, 14th Floor

Miami, Florida 33137

Ladies and Gentlemen:

The undersigned, Yield10 Bioscience, Inc., a company incorporated under the laws of Delaware (collectively with its subsidiaries and affiliates, including, without limitation, all entities disclosed or described in the Registration Statement as being subsidiaries or affiliates of Yield10 Bioscience, Inc., the "Company"), hereby confirms its agreement (this "Agreement") with the several underwriters (such underwriters, including the Representative (as defined below), the "Underwriters" and each an "Underwriter") named in Schedule I hereto for which Ladenburg Thalmann & Co. Inc. is acting as representative to the several Underwriters (the "Representative" and if there are no Underwriters other than the Representative, references to multiple Underwriters shall be disregarded and the term Representative as used herein shall have the same meaning as Underwriter) on the terms and conditions set forth herein.

It is understood that the several Underwriters are to make a public offering of the Public Securities as soon as the Representative deems it advisable to do so. The Public Securities are to be initially offered to the public at the public offering price set forth in the Prospectus. The Representative may from time to time thereafter change the public offering price and other selling terms.

It is further understood that you will act as the Representative for the Underwriters in the offering and sale of the Closing Securities and, if any, the Option Securities in accordance with this Agreement.

ARTICLE I
DEFINITIONS

1.1 Definitions. In addition to the terms defined elsewhere in this Agreement, (a) capitalized terms that are not otherwise defined herein have the meanings given to such terms in the Certificate of Designation (as defined herein) and (b) the following terms have the meanings set forth in this Section 1.1:

“Action” shall have the meaning ascribed to such term in Section 3.1(k).

“Affiliate” means with respect to any Person, any other Person that, directly or indirectly through one or more intermediaries, controls or is controlled by or is under common control with such Person as such terms are used in and construed under Rule 405 under the Securities Act.

“Amendment” means the amendment to the Company’s articles of incorporation that either effects a reverse stock split or increases the number of authorized shares of Common Stock in either case such that all of the Warrants may be exercised in full by the holders of the Warrants.

“Authorized Share Increase Date” means, subject to Authorized Share Approval, the date on which the Amendment is filed and accepted with the State of Delaware

“Authorized Share Approval” means approval of the Amendment by the shareholders of the Company.

“Board of Directors” means the board of directors of the Company.

“Business Day” means any day except any Saturday, any Sunday, any day which is a federal legal holiday in the United States or any day on which banking institutions in the State of New York are authorized or required by law or other governmental action to close.

“Certificate of Designation” means the Certificate of Designation to be filed prior to the Closing by the Company with the Secretary of State of Delaware in the form of Exhibit F attached hereto.

“Closing” means the closing of the purchase and sale of the Closing Securities pursuant to Section 2.1.

“Closing Date” means the hour and the date on the Trading Day on which all conditions precedent to (i) the Underwriters’ obligations to pay the Closing Purchase Price and (ii) the Company’s obligations to deliver the Closing Securities, in each case, have been satisfied or waived, but in no event later than 10:00 a.m. (New York City time) on the second (2nd) Trading Day following the date hereof or at such earlier time as shall be agreed upon by the Representative and the Company.

“Closing Preferred Shares” shall have the meaning ascribed to such term in Section

2.1(a)(ii).

“Closing Purchase Price” shall have the meaning ascribed to such term in Section 2.1(b), which aggregate purchase price shall be net of the underwriting discounts and commissions.

“Closing Securities” shall have the meaning ascribed to such term in Section 2.1(a)(iii).

“Closing Shares” shall have the meaning ascribed to such term in Section 2.1(a)(i).

“Closing Warrants” shall have the meaning ascribed to such term in Section 2.1(a)(iii).

“Combined Purchase Price” shall have the meaning ascribed to such term in Section 2.1(b).

“Commission” means the United States Securities and Exchange Commission.

“Common Stock” means the common stock of the Company, par value \$0.01 per share, and any other class of securities into which such securities may hereafter be reclassified or changed.

“Common Stock Equivalents” means any securities of the Company or the Subsidiaries which would entitle the holder thereof to acquire at any time Common Stock, including, without limitation, any debt, preferred stock, right, option, warrant or other instrument that is at any time convertible into or exercisable or exchangeable for, or otherwise entitles the holder thereof to receive, Common Stock.

“Company Auditor” means RSM US LLP, with offices located at 80 City Square, Boston, Massachusetts 02129.

“Company Counsel” means Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C, with offices located at One Financial Center, Boston, Massachusetts 02111.

“Conversion Price” shall have the meaning ascribed to such term in the Certificate of Designation.

“Conversion Shares” shall have the meaning ascribed to such term in the Certificate of Designation.

“Disclosure Schedules” means the Disclosure Schedules of the Company delivered concurrently herewith.

“Effective Date” shall have the meaning ascribed to such term in Section 3.1(f).

“EGS” means Ellenoff Grossman & Schole LLP, with offices located at 1345 Avenue

of the Americas, New York, New York 10105.

“Exchange Act” means the Securities Exchange Act of 1934, as amended, and the rules and regulations promulgated thereunder.

“Execution Date” shall mean the date on which the parties execute and enter into this Agreement.

“Exempt Issuance” means the issuance of (a) shares of Common Stock, options or other equity-based awards to employees, officers or directors of the Company pursuant to any stock or option plan duly adopted for such purpose by a majority of the non-employee members of the Board of Directors or a majority of the members of a committee of non-employee directors established for such purpose, (b) shares of Common Stock to employees participating in the Company’s existing 401(k) plan as matching contributions pursuant to such plan, (c) securities upon the exercise or exchange of or conversion of any Securities issued hereunder and/or other securities exercisable or exchangeable for or convertible into shares of Common Stock issued and outstanding on the date of this Agreement, provided that such securities have not been amended since the date of this Agreement to increase the number of such securities or to decrease the exercise price, exchange price or conversion price of such securities or to amend the term of such securities, or (d) securities issued pursuant to acquisitions or strategic transactions approved by a majority of the disinterested directors of the Company, provided that such securities are issued as “restricted securities” (as defined in Rule 144) and carry no registration rights that require or permit the filing of any registration statement in connection therewith within ninety (90) days following the Closing Date, and provided that any such issuance shall only be to a Person (or to the equity holders of a Person) which is, itself or through its subsidiaries, an operating company or an owner of an asset in a business synergistic with the business of the Company and shall provide to the Company additional benefits in addition to the investment of funds, but shall not include a transaction in which the Company is issuing securities primarily for the purpose of raising capital or to an entity whose primary business is investing in securities.

“FCPA” means the Foreign Corrupt Practices Act of 1977, as amended.

“FINRA” means the Financial Industry Regulatory Authority.

“GAAP” shall have the meaning ascribed to such term in Section 3.1(i).

“Indebtedness” means (a) any liabilities for borrowed money or amounts owed in excess of \$50,000 (other than trade accounts payable incurred in the ordinary course of business), (b) all guaranties, endorsements and other contingent obligations in respect of indebtedness of others, whether or not the same are or should be reflected in the Company’s consolidated balance sheet (or the notes thereto), except guaranties by endorsement of negotiable instruments for deposit or collection or similar transactions in the ordinary course of business; and (c) the present value of any lease payments in excess of \$50,000 due under leases required to be capitalized in accordance with GAAP.

“Liens” means a lien, charge, pledge, security interest, encumbrance, right of first refusal, preemptive right or other restriction.

“Lock-Up Agreements” means the lock-up agreements that are delivered on the date hereof by each of the Company’s officers and directors and each holder of Common Stock and Common Stock Equivalents holding, on a fully diluted basis, more than 5% of the Company’s issued and outstanding Common Stock, in the form of Exhibit H attached hereto.

“Material Adverse Effect” means (i) a material adverse effect on the legality, validity or enforceability of any Transaction Document, (ii) a material adverse effect on the results of operations, assets, business, prospects or condition (financial or otherwise) of the Company and the Subsidiaries, taken as a whole or (iii) a material adverse effect on the Company’s ability to perform in any material respect on a timely basis its obligations under any Transaction Document.

“Offering” shall have the meaning ascribed to such term in Section 2.1(c).

“Option Closing Date” shall have the meaning ascribed to such term in Section 2.2(c).

“Option Closing Purchase Price” shall have the meaning ascribed to such term in Section 2.2(b), which aggregate purchase price shall be net of the underwriting discounts and commissions.

“Option Securities” shall have the meaning ascribed to such term in Section 2.2(a)(ii).

“Option Shares” shall have the meaning ascribed to such term in Section 2.2(a)(i).

“Option Warrants” shall have the meaning ascribed to such term in Section 2.2(a).

“Over-Allotment Option” shall have the meaning ascribed to such term in Section 2.2.

“Person” means an individual or corporation, partnership, trust, incorporated or unincorporated association, joint venture, limited liability company, joint stock company, government (or an agency or subdivision thereof) or other entity of any kind.

“Preferred Stock” means up to _____ shares of the Company’s Series A Convertible Preferred Stock issued or issuable pursuant to Section 2.1(a)(ii) and having the rights, preferences and privileges set forth in the Certificate of Designation.

“Preferred Stock Agency Agreement” means the addendum to the Company’s Transfer Agency and Registrar Services Agreement with the Transfer Agent, pursuant to which the Transfer Agent agrees to act as transfer agent and conversion agent for the Preferred Stock, in the form of Exhibit G attached hereto.

“Preliminary Prospectus” means, if any, any preliminary prospectus relating to the Securities included in the Registration Statement or filed with the Commission pursuant to Rule 424(b).

“Proceeding” means an action, claim, suit, investigation or proceeding (including, without limitation, an informal investigation or partial proceeding, such as a deposition), whether commenced or threatened.

“Prospectus” means the final prospectus filed for the Registration Statement.

“Prospectus Supplement” means, if any, any supplement to the Prospectus complying with Rule 424(b) of the Securities Act that is filed with the Commission.

“Public Securities” means, collectively, the Closing Securities and, if any, the Option Securities.

“Registration Statement” means, collectively, the various parts of the registration statement prepared by the Company on Form S-1 (File No. 333-233683) with respect to the Securities, each as amended as of the date hereof, including the Prospectus and Prospectus Supplement, if any, the Preliminary Prospectus, if any, and all exhibits filed with or incorporated by reference into such registration statement and includes the Rule 462(b) Registration Statement.

“Required Approvals” shall have the meaning ascribed to such term in Section 3.1(e).

“Required Minimum” means, as of any date, the maximum aggregate number of shares of Common Stock then issued or potentially issuable in the future pursuant to the Transaction Documents, including any Underlying Shares issuable upon exercise in full of all Warrants or conversion in full of all shares of Preferred Stock, ignoring any conversion or exercise limits set forth therein.

“Rule 424” means Rule 424 promulgated by the Commission pursuant to the Securities Act, as such Rule may be amended or interpreted from time to time, or any similar rule or regulation hereafter adopted by the Commission having substantially the same purpose and effect as such Rule.

“Rule 462(b) Registration Statement” means the registration statement prepared by the Company as a post-effective amendment to the Registration Statement, which was filed with the Commission on or prior to the date hereof and became automatically effective pursuant to Rule 462(b) promulgated by the Commission pursuant to the Securities Act.

“SEC Reports” shall have the meaning ascribed to such term in Section 3.1(i).

“Securities” means the Closing Securities, the Option Securities and the Underlying Shares.

“Securities Act” means the Securities Act of 1933, as amended, and the rules and

regulations promulgated thereunder.

“Share Purchase Price” shall have the meaning ascribed to such term in Section 2.1(b).

“Shares” means, collectively, the shares of Common Stock delivered to the Underwriters in accordance with Section 2.1(a)(i) and Section 2.2(a).

“Subsidiary” means any subsidiary of the Company and shall, where applicable, also include any direct or indirect subsidiary of the Company formed or acquired after the date hereof.

“Trading Day” means a day on which the principal Trading Market is open for trading.

“Trading Market” means any of the following markets or exchanges on which the Common Stock is listed or quoted for trading on the date in question: the NYSE American, the Nasdaq Capital Market, the Nasdaq Global Market, the Nasdaq Global Select Market, or the New York Stock Exchange (or any successors to any of the foregoing).

“Transaction Documents” means this Agreement, the Warrants, the Warrant Agency Agreement, the Certificate of Designation, the Preferred Stock Agency Agreement, the Lock-Up Agreements, and any other documents or agreements executed in connection with the transactions contemplated hereunder.

“Transfer Agent” means American Stock Transfer & Trust Company, LLC, with offices located at 6201 15th Avenue, Brooklyn, New York 11219, and any successor transfer agent of the Company.

“Underlying Shares” means, collectively, the Shares, the Conversion Shares and the Warrant Shares.

“Warrant Agency Agreement” means the warrant agency agreement dated on or about the date hereof, between the Company and American Stock Transfer & Trust Company, LLC in the form of Exhibit E attached hereto.

“Warrant Purchase Price” shall have the meaning ascribed to such term in Section 2.1(b).

“Warrant Shares” means the shares of Common Stock issuable upon exercise of the Warrants.

“Warrants” means the Common Stock purchase warrants delivered to the Underwriters in accordance with Section 2.1(a)(iii) and Section 2.2, which Warrants shall be exercisable immediately and have a term of exercise equal to _____ years, in the form of Exhibit D-1 attached hereto.

ARTICLE II

PURCHASE AND SALE

2.1 Closing.

(a) Upon the terms and subject to the conditions set forth herein, the Company agrees to sell in the aggregate _____ shares of Common Stock, _____ shares of Preferred Stock, and _____ Warrants, and each Underwriter agrees to purchase, severally and not jointly, at the Closing, the following securities of the Company:

(i) the number of shares of Common Stock (the "Closing Shares") set forth opposite the name of such Underwriter on Schedule I hereof;

(ii) the number of shares of Preferred Stock (the "Closing Preferred Shares") set forth opposite the name of such Underwriter on Schedule I hereof; and

(iii) Warrants to purchase up to ___% of the sum of the number of Closing Shares and shares of Common Stock underlying the Closing Preferred Shares set forth opposite the name of such Underwriter on Schedule I hereof plus the aggregate number of Conversion Shares underlying the Closing Preferred Shares set forth opposite the name of such Underwriter on Schedule I hereof (the "Closing Warrants" and, collectively with the Closing Shares and the Closing Preferred Shares, the "Closing Securities"), which Warrants shall have an exercise price of \$____, subject to adjustment as provided therein.

(b) The aggregate purchase price for the Closing Securities shall equal the amount set forth opposite the name of such Underwriter on Schedule I hereto (the "Closing Purchase Price"). The combined purchase price for one Share and a Warrant to purchase ___ Warrant Share shall be \$___ (the "Combined Purchase Price") which shall be allocated as \$_____ per Share (the "Share Purchase Price") and \$_____ per Warrant (the "Warrant Purchase Price"). Notwithstanding the foregoing, as to _____ Shares, Warrants to purchase _____ Shares sold to Company investors set forth on Schedule I hereto, the "Combined Purchase Price" shall be \$_____. The combined purchase price for one Closing Preferred Share and Warrants to purchase ___ Warrant Shares and shall be \$_____ (the "Combined Preferred Purchase Price") which shall be allocated as \$_____ per Preferred Share and \$_____ per Warrant; and

(c) On the Closing Date, each Underwriter shall deliver or cause to be delivered to the Company, via wire transfer, immediately available funds equal to such Underwriter's Closing Purchase Price and the Company shall deliver to, or as directed by, such Underwriter its respective Closing Securities and the Company shall deliver the other items required pursuant to Section 2.3 deliverable at the Closing. Upon satisfaction of the covenants and conditions set forth in Sections 2.3 and 2.4, the Closing shall occur at the offices of EGS or such other location as the Company and Representative shall mutually agree. The Public Securities are to be offered initially to the public at the offering price set forth on the cover page of the Prospectus (the "Offering").

(d) The Company acknowledges and agrees that, with respect to any Notice(s) of Conversion (as defined in the Certificate of Designation) delivered by a Holder (as defined in the Certificate of Designation) on or prior to 12:00 p.m. (New York City time) on the Closing Date, which Notice(s) of Conversion may be delivered at any time after the time of execution of this Agreement, the Company shall deliver the Conversion Shares (as defined in the Certificate of Designation) subject to such notice(s) to the Holder by 4:00 p.m. (New York City time) on the Closing Date and the Closing Date shall be the Share Delivery Date (as defined in the Certificate of Designation) under the Certificate of Designation. The Company acknowledges and agrees that the Holders are third-party beneficiaries of this covenant of the Company.

2.2 Over-Allotment Option.

(a) For the purposes of covering any over-allotments in connection with the distribution and sale of the Closing Securities, the Representative is hereby granted an option (the “Over-Allotment Option”) to purchase, in the aggregate, up to _____ shares of Common Stock (the “Option Shares”) and Warrants to purchase up to _____ shares of Common Stock (the “Option Warrants”) and, collectively with the Option Shares, the “Option Securities”) which may be purchased in any combination of Option Shares and/or Option Warrants at the Share Purchase Price and/or the Warrant Purchase Price, respectively.

(b) In connection with an exercise of the Over-Allotment Option, (a) the purchase price to be paid for the Option Shares is equal to the product of the Share Purchase Price multiplied by the number of Option Shares to be purchased and (b) the purchase price to be paid for the Option Warrants is equal to the product of the Warrant Purchase Price multiplied by the number of Option Warrants (the aggregate purchase price to be paid on an Option Closing Date, the “Option Closing Purchase Price”).

(c) The Over-Allotment Option granted pursuant to this Section 2.2 may be exercised by the Representative as to all (at any time) or any part (from time to time) of the Option Securities within 45 days after the Execution Date. An Underwriter will not be under any obligation to purchase any Option Securities prior to the exercise of the Over-Allotment Option by the Representative. The Over-Allotment Option granted hereby may be exercised by the giving of oral notice to the Company from the Representative, which must be confirmed in writing by overnight mail or facsimile or other electronic transmission setting forth the number of Option Shares and/or Option Warrants to be purchased and the date and time for delivery of and payment for the Option Securities (each, an “Option Closing Date”), which will not be later than two (2) full Business Days after the date of the notice or such other time as shall be agreed upon by the Company and the Representative, at the offices of EGS or at such other place (including remotely by facsimile or other electronic transmission) as shall be agreed upon by the Company and the Representative. If such delivery and payment for the Option Securities does not occur on the Closing Date, each Option Closing Date will be as set forth in the notice. Upon exercise of the Over-Allotment Option, the Company will become obligated to convey to the Underwriters, and, subject to the terms and conditions set forth herein, the Underwriters will become obligated to purchase,

the number of Option Shares and/or Option Warrants specified in such notice. The Representative may cancel the Over-Allotment Option at any time prior to the expiration of the Over-Allotment Option by written notice to the Company.

2.3 Deliveries. The Company shall deliver or cause to be delivered to each Underwriter (if applicable) the following:

(i) At the Closing Date, the Closing Shares and, as to each Option Closing Date, if any, the applicable Option Shares, which shares shall be delivered via The Depository Trust Company Deposit or Withdrawal at Custodian system for the accounts of the several Underwriters;

(ii) At the Closing Date, the Closing Preferred Shares shall be delivered via The Depository Trust Company Deposit or Withdrawal at Custodian system for the accounts of the several Underwriters;

(iii) At the Closing Date, the Closing Warrants and, as to each Option Closing Date, if any, the applicable Option Warrants via The Depository Trust Company Deposit or Withdrawal at Custodian system for the accounts of the several Underwriters;

(iv) At the Closing Date, the Warrant Agency Agreement duly executed by the parties thereto;

(v) At the Closing Date, the Preferred Stock Agency Agreement duly executed by the parties thereto;

(vi) At the Closing Date, evidence of the filing and acceptance of the Certificate of Designation from the Secretary of State of Delaware;

(vii) At the Closing Date, a legal opinion of Company Counsel addressed to the Underwriters, including, without limitation, a negative assurance letter, substantially in the form of Exhibit A attached hereto and as to the Closing Date and as to each Option Closing Date, if any, a bring-down opinion from Company Counsel in form and substance reasonably satisfactory to the Representative, including, without limitation, a negative assurance letter, addressed to the Underwriters and in form and substance satisfactory to the Representative;

(viii) Contemporaneously herewith, a cold comfort letter, addressed to the Underwriters and in form and substance satisfactory in all respects to the Representative from the Company Auditor dated as of the date of this Agreement, and a bring-down letter dated as of the Closing Date and each Option Closing Date, if any;

(ix) On the Closing Date and on each Option Closing Date, the duly executed and delivered Officer's Certificate, substantially in the form required by Exhibit B attached hereto;

(x) On the Closing Date and on each Option Closing Date, the duly executed and delivered Secretary's Certificate, substantially in the form required by Exhibit C attached hereto; and

(xi) Contemporaneously herewith, the duly executed and delivered Lock-Up Agreements.

2.4 Closing Conditions. The respective obligations of each Underwriter hereunder in connection with the Closing and each Option Closing Date are subject to the following conditions being met:

(i) the accuracy in all material respects when made and on the date in question (other than representations and warranties of the Company already qualified by materiality, which shall be true and correct in all respects) of the representations and warranties of the Company contained herein (unless as of a specific date therein);

(ii) all obligations, covenants and agreements of the Company required to be performed at or prior to the date in question shall have been performed in all material respects;

(iii) the delivery by the Company of the items set forth in Section 2.3 of this Agreement;

(iv) the Registration Statement shall be effective on the date of this Agreement and at each of the Closing Date and each Option Closing Date, if any, no stop order suspending the effectiveness of the Registration Statement shall have been issued and no proceedings for that purpose shall have been instituted or shall, to the Company's knowledge, be pending or contemplated by the Commission and any request on the part of the Commission for additional information shall have been complied with to the reasonable satisfaction of the Representative;

(v) by the Execution Date, if required by FINRA, the Underwriters shall have received clearance from FINRA as to the amount of compensation allowable or payable to the Underwriters as described in the Registration Statement;

(vi) the Closing Shares, the Option Shares and the Underlying Shares shall have been approved for listing on the Trading Market; and

(vii) prior to and on each of the Closing Date and each Option Closing Date, if any: (i) there shall have been no material adverse change or development involving a prospective material adverse change in the condition or prospects or the business activities, financial or otherwise, of the Company from the latest dates as of which such condition is set forth in the Registration Statement and Prospectus; (ii) no action suit or proceeding, at law or in equity, shall have been pending or threatened against the Company or any Affiliate of the Company before or by any court or federal or state commission, board or other administrative agency wherein an unfavorable decision, ruling or finding may materially adversely affect the business, operations, prospects or financial condition or income of the

Company, except as set forth in the Registration Statement and Prospectus; (iii) no stop order shall have been issued under the Securities Act and no proceedings therefor shall have been initiated or threatened by the Commission; and (iv) the Registration Statement and the Prospectus and any amendments or supplements thereto shall contain all material statements which are required to be stated therein in accordance with the Securities Act and the rules and regulations thereunder and shall conform in all material respects to the requirements of the Securities Act and the rules and regulations thereunder, and neither the Registration Statement nor the Prospectus nor any amendment or supplement thereto shall contain any untrue statement of a material fact or omit to state any material fact required to be stated therein or necessary to make the statements therein, in light of the circumstances under which they were made, not misleading.

ARTICLE III. REPRESENTATIONS AND WARRANTIES

3.1 Representations and Warranties of the Company. Except as set forth in the Disclosure Schedules, which Disclosure Schedules shall be deemed a part hereof and shall qualify any representation or warranty otherwise made herein to the extent of the disclosure contained in the corresponding section of the Disclosure Schedules, the Company represents and warrants to the Underwriters as of the Execution Date, as of the Closing Date and as of each Option Closing Date, if any, as follows:

(a) Subsidiaries. All of the direct and indirect Subsidiaries of the Company are set forth in the SEC Reports. The Company owns, directly or indirectly, all of the capital stock or other equity interests of each Subsidiary free and clear of any Liens, and all of the issued and outstanding shares of capital stock of each Subsidiary are validly issued and are fully paid, non-assessable and free of preemptive and similar rights to subscribe for or purchase securities. If the Company has no Subsidiaries, all other references to the Subsidiaries or any of them in the Transaction Documents shall be disregarded.

(b) Organization and Qualification. The Company and each of the Subsidiaries is an entity duly incorporated or otherwise organized, validly existing and in good standing under the laws of the jurisdiction of its incorporation or organization, with the requisite power and authority to own and use its properties and assets and to carry on its business as currently conducted. Neither the Company nor any Subsidiary is in violation nor default of any of the provisions of its respective certificate or articles of incorporation, bylaws or other organizational or charter documents. Each of the Company and the Subsidiaries is duly qualified to conduct business and is in good standing as a foreign corporation or other entity in each jurisdiction in which the nature of the business conducted or property owned by it makes such qualification necessary, except where the failure to be so qualified or in good standing, as the case may be, could not have or reasonably be expected to result in a Material Adverse Effect and no Proceeding has been instituted in any such

jurisdiction revoking, limiting or curtailing or seeking to revoke, limit or curtail such power and authority or qualification.

(c) Authorization; Enforcement. The Company has the requisite corporate power and authority to enter into and to consummate the transactions contemplated by this Agreement and each of the other Transaction Documents and otherwise to carry out its obligations hereunder and thereunder. The execution and delivery of this Agreement and each of the other Transaction Documents by the Company and the consummation by it of the transactions contemplated hereby and thereby have been duly authorized by all necessary action on the part of the Company and no further action is required by the Company, the Board of Directors or the Company's stockholders in connection herewith or therewith other than in connection with the Required Approvals. This Agreement and each other Transaction Document to which it is a party has been (or upon delivery will have been) duly executed by the Company and, when delivered in accordance with the terms hereof and thereof, will constitute the valid and binding obligation of the Company enforceable against the Company in accordance with its terms, except (i) as limited by general equitable principles and applicable bankruptcy, insolvency, reorganization, moratorium and other laws of general application affecting enforcement of creditors' rights generally, (ii) as limited by laws relating to the availability of specific performance, injunctive relief or other equitable remedies and (iii) insofar as indemnification and contribution provisions may be limited by applicable law.

(d) No Conflicts. The execution, delivery and performance by the Company of this Agreement and the other Transaction Documents to which it is a party, the issuance and sale of the Securities and the consummation by it of the transactions contemplated hereby and thereby do not and will not (i) conflict with or violate any provision of the Company's or any Subsidiary's certificate or articles of incorporation, bylaws or other organizational or charter documents, or (ii) conflict with, or constitute a default (or an event that with notice or lapse of time or both would become a default) under, or result in the creation of any Lien upon any of the properties or assets of the Company or any Subsidiary, or give to others any rights of termination, amendment, anti-dilution or similar adjustments, acceleration or cancellation (with or without notice, lapse of time or both) of, any agreement, credit facility, debt or other instrument (evidencing a Company or Subsidiary debt or otherwise) or other understanding to which the Company or any Subsidiary is a party or by which any property or asset of the Company or any Subsidiary is bound or affected, or (iii) subject to the Required Approvals, conflict with or result in a violation of any law, rule, regulation, order, judgment, injunction, decree or other restriction of any court or governmental authority to which the Company or a Subsidiary is subject (including federal and state securities laws and regulations), or by which any property or asset of the Company or a Subsidiary is bound or affected; except in the case of each of clauses (ii) and (iii), such as could not have or reasonably be expected to result in a Material Adverse Effect.

(e) Filings, Consents and Approvals. The Company is not required to obtain any consent, waiver, authorization or order of, give any notice to, or make any filing or registration with, any court or other federal, state, local or other governmental authority or other Person in connection with the execution, delivery and performance by the Company of the Transaction Documents, other than: (i) the filing with the Commission of the Prospectus, (ii) application(s) to each applicable Trading Market for the listing of the Shares, Warrant Shares and Conversion Shares for trading thereon in the time and manner required thereby, and (iii) such filings as are required to be made under applicable state securities laws (collectively, the “Required Approvals”).

(f) Registration Statement. The Company has filed with the Commission the Registration Statement, including any related Prospectus or Prospectuses, for the registration of the Securities under the Securities Act, which Registration Statement has been prepared by the Company in all material respects in conformity with the requirements of the Securities Act and the rules and regulations of the Commission under the Securities Act. The Registration Statement has been declared effective by the Commission on the date hereof (the “Effective Date”) and was post-effectively amended by the Rule 462(b) Registration Statement which is effective on the date hereof. The Company has advised the Representative of all further information (financial and other) with respect to the Company required to be set forth therein in the Registration Statement and Prospectus. Any reference in this Agreement to the Registration Statement, the Prospectus or any Prospectus Supplement shall be deemed to refer to and include the documents incorporated by reference therein; and any reference in this Agreement to the terms “amend,” “amendment” or “supplement” with respect to the Registration Statement, the Prospectus or any Prospectus Supplement shall be deemed to refer to and include the filing of any document under the Exchange Act after the date of this Agreement, or the issue date of the Prospectus as the case may be, deemed to be incorporated therein by reference. All references in this Agreement to financial statements and schedules and other information which is “contained,” “included,” “described,” “referenced,” “set forth” or “stated” in the Registration Statement, the Prospectus (and all other references of like import) shall be deemed to mean and include all such financial statements and schedules and other information which is or is deemed to be incorporated by reference in the Registration Statement, or the Prospectus, as the case may be. No stop order suspending the effectiveness of the Registration Statement or the use of the Prospectus has been issued, and no proceeding for any such purpose is pending or has been initiated or, to the Company's knowledge, is threatened by the Commission. For purposes of this Agreement, “free writing prospectus” has the meaning set forth in Rule 405 under the Securities Act. The Company will not, without the prior consent of the Representative, prepare, use or refer to, any free writing prospectus.

(g) Issuance of Securities. The Securities are duly authorized and, when issued and paid for in accordance with the applicable Transaction Documents, will be duly and validly issued, fully paid and nonassessable, and free and clear of all

Liens imposed by the Company. The Underlying Shares, when issued in accordance with the terms of the Transaction Documents, will be validly issued, fully paid and nonassessable, and free and clear of all Liens imposed by the Company. Other than with respect to the Warrant Shares, the Company has reserved from its duly authorized capital stock, a number of shares of Common Stock for issuance of the Underlying Shares at least equal to the Required Minimum on the date hereof. The holders of the Securities will not be subject to personal liability by reason of being such holders. The Securities are not and will not be subject to the preemptive rights of any holders of any security of the Company or similar contractual rights granted by the Company. All corporate action required to be taken for the authorization, issuance and sale of the Securities has been duly and validly taken. The Securities conform in all material respects to all statements with respect thereto contained in the Registration Statement.

(h) Capitalization. The capitalization of the Company is as set forth in the SEC Reports. The Company has not issued any capital stock since its most recently filed periodic report under the Exchange Act, other than pursuant to the exercise of employee stock options under the Company's stock option plans and the vesting of restricted stock units under the Company's equity compensation plans, the issuance of shares of Common Stock to employees participating in the Company's 401(k) plan as matching contributions pursuant to such plan, the issuance of shares of Common Stock to employees pursuant to the Company's employee stock purchase plans and pursuant to the conversion and/or exercise of Common Stock Equivalents outstanding as of the date of the most recently filed periodic report under the Exchange Act. No Person has any right of first refusal, preemptive right, right of participation, or any similar right to participate in the transactions contemplated by the Transaction Documents. Other than as disclosed in the Prospectus, and except as a result of (i) the purchase and sale of the Securities, and (ii) the issuance of the shares of Common Stock to employees participating in the Company's 401(k) plan as matching contributions pursuant to such plan, there are no outstanding options, warrants, scrip rights to subscribe to, calls or commitments of any character whatsoever relating to, or securities, rights or obligations convertible into or exercisable or exchangeable for, or giving any Person any right to subscribe for or acquire, any shares of Common Stock, or contracts, commitments, understandings or arrangements by which the Company or any Subsidiary is or may become bound to issue additional shares of Common Stock or Common Stock Equivalents. The issuance and sale of the Securities will not obligate the Company to issue shares of Common Stock or other securities to any Person (other than the Underwriters) and will not result in a right of any holder of Company securities to adjust the exercise, conversion, exchange or reset price under any of such securities. All of the outstanding shares of capital stock of the Company are duly authorized, validly issued, fully paid and nonassessable, have been issued in compliance with all federal and state securities laws, and none of such outstanding shares was issued in violation of any preemptive rights or similar rights to subscribe for or purchase securities. The authorized shares of the Company conform in all material respects to all

statements relating thereto contained in the Registration Statement and the Prospectus. No further approval or authorization of any stockholder, the Board of Directors or others is required for the issuance and sale of the Securities. Except as set forth on Schedule 3.1(h), there are no stockholders agreements, voting agreements or other similar agreements with respect to the Company's capital stock to which the Company is a party or, to the knowledge of the Company, between or among any of the Company's stockholders.

(i) SEC Reports; Financial Statements. The Company has filed all reports, schedules, forms, statements and other documents required to be filed by the Company under the Securities Act and the Exchange Act, including pursuant to Section 13(a) or 15(d) thereof, for the two years preceding the date hereof (or such shorter period as the Company was required by law or regulation to file such material) (the foregoing materials, including the exhibits thereto and documents incorporated by reference therein, together with the Prospectus and any Prospectus Supplement, being collectively referred to herein as the "SEC Reports") on a timely basis or has received a valid extension of such time of filing and has filed any such SEC Reports prior to the expiration of any such extension. As of their respective dates, the SEC Reports complied in all material respects with the requirements of the Securities Act and the Exchange Act, as applicable, and none of the SEC Reports, when filed, contained any untrue statement of a material fact or omitted to state a material fact required to be stated therein or necessary in order to make the statements therein, in light of the circumstances under which they were made, not misleading. The financial statements of the Company included in the SEC Reports comply in all material respects with applicable accounting requirements and the rules and regulations of the Commission with respect thereto as in effect at the time of filing. Such financial statements have been prepared in accordance with United States generally accepted accounting principles applied on a consistent basis during the periods involved ("GAAP"), except as may be otherwise specified in such financial statements or the notes thereto and except that unaudited financial statements may not contain all footnotes required by GAAP, and fairly present in all material respects the financial position of the Company and its consolidated Subsidiaries as of and for the dates thereof and the results of operations and cash flows for the periods then ended, subject, in the case of unaudited statements, to normal, immaterial, year-end audit adjustments. The agreements and documents described in the Registration Statement, the Prospectus, any Prospectus Supplement and the SEC Reports conform to the descriptions thereof contained therein and there are no agreements or other documents required by the Securities Act and the rules and regulations thereunder to be described in the Registration Statement, the Prospectus, any Prospectus Supplement or the SEC Reports or to be filed with the Commission as exhibits to the Registration Statement, that have not been so described or filed. Each agreement or other instrument (however characterized or described) to which the Company is a party or by which it is or may be bound or affected and (i) that is referred to in the Registration Statement, the Prospectus, any Prospectus Supplement or the SEC Reports, or (ii) is material to the Company's business, has been duly authorized and

validly executed by the Company, is in full force and effect in all material respects and is enforceable against the Company and, to the Company's knowledge, the other parties thereto, in accordance with its terms, except (x) as such enforceability may be limited by bankruptcy, insolvency, reorganization or similar laws affecting creditors' rights generally, (y) as enforceability of any indemnification or contribution provision may be limited under the federal and state securities laws, and (z) that the remedy of specific performance and injunctive and other forms of equitable relief may be subject to the equitable defenses and to the discretion of the court before which any proceeding therefore may be brought. None of such agreements or instruments has been assigned by the Company, and neither the Company nor, to the best of the Company's knowledge, any other party is in default thereunder and, to the best of the Company's knowledge, no event has occurred that, with the lapse of time or the giving of notice, or both, would constitute a default thereunder. To the best of the Company's knowledge, performance by the Company of the material provisions of such agreements or instruments will not result in a violation of any existing applicable law, rule, regulation, judgment, order or decree of any governmental agency or court, domestic or foreign, having jurisdiction over the Company or any of its assets or businesses, including, without limitation, those relating to environmental laws and regulations.

(j) Material Changes; Undisclosed Events, Liabilities or Developments. Since the date of the latest audited financial statements included within the SEC Reports, except as specifically disclosed in a subsequent SEC Report filed prior to the date hereof, (i) there has been no event, occurrence or development that has had or that could reasonably be expected to result in a Material Adverse Effect, (ii) the Company has not incurred any liabilities (contingent or otherwise) other than (A) trade payables and accrued expenses incurred in the ordinary course of business consistent with past practice and (B) liabilities not required to be reflected in the Company's financial statements pursuant to GAAP or disclosed in filings made with the Commission, (iii) the Company has not altered its method of accounting, (iv) the Company has not declared or made any dividend or distribution of cash or other property to its stockholders or purchased, redeemed or made any agreements to purchase or redeem any shares of its capital stock, (v) the Company has not issued any equity securities to any officer, director or Affiliate, except pursuant to existing Company equity compensation or stock purchase plans or the Company's 401(k) plan, and (vi) no officer or director of the Company has resigned from any position with the Company. The Company does not have pending before the Commission any request for confidential treatment of information. Except for the issuance of the Securities contemplated by this Agreement, no event, liability, fact, circumstance, occurrence or development has occurred or exists or is reasonably expected to occur or exist with respect to the Company or its Subsidiaries or their respective businesses, properties, operations, assets or financial condition that would be required to be disclosed by the Company under applicable securities laws at the time this representation is made or deemed made that has not been publicly disclosed at least 1 Trading Day prior to the date that this representation is made. Unless otherwise

disclosed in an SEC Report filed prior to the date hereof, the Company has not: (i) issued any securities or incurred any liability or obligation, direct or contingent, for borrowed money; or (ii) declared or paid any dividend or made any other distribution on or in respect to its capital stock.

(k) Litigation. There is no action, suit, inquiry, notice of violation, proceeding or investigation pending or, to the knowledge of the Company, threatened against or affecting the Company, any Subsidiary or any of their respective properties before or by any court, arbitrator, governmental or administrative agency or regulatory authority (federal, state, county, local or foreign) (collectively, an “Action”) which (i) adversely affects or challenges the legality, validity or enforceability of any of the Transaction Documents or the Securities or (ii) could, if there were an unfavorable decision, have or reasonably be expected to result in a Material Adverse Effect. Neither the Company nor any Subsidiary, nor any director or officer thereof, is or has been the subject of any Action involving a claim of violation of or liability under federal or state securities laws or a claim of breach of fiduciary duty. There has not been, and to the knowledge of the Company, there is not pending or contemplated, any investigation by the Commission involving the Company or any current or former director or officer of the Company. The Commission has not issued any stop order or other order suspending the effectiveness of any registration statement filed by the Company or any Subsidiary under the Exchange Act or the Securities Act.

(l) Labor Relations. No labor dispute exists or, to the knowledge of the Company, is imminent with respect to any of the employees of the Company, which could reasonably be expected to result in a Material Adverse Effect. None of the Company’s or its Subsidiaries’ employees is a member of a union that relates to such employee’s relationship with the Company or such Subsidiary, and neither the Company nor any of its Subsidiaries is a party to a collective bargaining agreement, and the Company and its Subsidiaries believe that their relationships with their employees are good. To the knowledge of the Company, no executive officer of the Company or any Subsidiary, is, or is now expected to be, in violation of any material term of any employment contract, confidentiality, disclosure or proprietary information agreement or non-competition agreement, or any other contract or agreement or any restrictive covenant in favor of any third party, and the continued employment of each such executive officer does not subject the Company or any of its Subsidiaries to any liability with respect to any of the foregoing matters. The Company and its Subsidiaries are in compliance with all U.S. federal, state, local and foreign laws and regulations relating to employment and employment practices, terms and conditions of employment and wages and hours, except where the failure to be in compliance could not, individually or in the aggregate, reasonably be expected to have a Material Adverse Effect.

(m) Compliance. Neither the Company nor any Subsidiary: (i) is in default under or in violation of (and no event has occurred that has not been waived

that, with notice or lapse of time or both, would result in a default by the Company or any Subsidiary under), nor has the Company or any Subsidiary received notice of a claim that it is in default under or that it is in violation of, any indenture, loan or credit agreement or any other agreement or instrument to which it is a party or by which it or any of its properties is bound (whether or not such default or violation has been waived), (ii) is in violation of any judgment, decree or order of any court, arbitrator or other governmental authority or (iii) is or has been in violation of any statute, rule, ordinance or regulation of any governmental authority, including without limitation all foreign, federal, state and local laws relating to taxes, environmental protection, occupational health and safety, product quality and safety and employment and labor matters, except in each case as could not have or reasonably be expected to result in a Material Adverse Effect.

(n) Regulatory Permits. The Company and the Subsidiaries possess all certificates, authorizations and permits issued by the appropriate federal, state, local or foreign regulatory authorities necessary to conduct their respective businesses as described in the SEC Reports, except where the failure to possess such permits could not reasonably be expected to result in a Material Adverse Effect (each, a “Material Permit”), and neither the Company nor any Subsidiary has received any notice of proceedings relating to the revocation or modification of any Material Permit. The disclosures in the Registration Statement concerning the effects of Federal, State, local and all foreign regulation on the Company’s business as currently contemplated are correct in all material respects.

(o) Title to Assets. The Company and the Subsidiaries have good and marketable title in fee simple to all real property owned by them and good and marketable title in all personal property (excluding the Intellectual Property Rights, which are covered in Section 3.1(p)) owned by them that is material to the business of the Company and the Subsidiaries, in each case free and clear of all Liens, except for (i) Liens as do not materially affect the value of such property and do not materially interfere with the use made and proposed to be made of such property by the Company and the Subsidiaries and (ii) Liens for the payment of federal, state or other taxes, for which appropriate reserves have been made therefor in accordance with GAAP and, the payment of which is neither delinquent nor subject to penalties. Any real property and facilities held under lease by the Company and the Subsidiaries are held by them under valid, subsisting and enforceable leases with which the Company and the Subsidiaries are in compliance, except where failure to be in compliance could not reasonably be expected to have a Material Adverse Effect.

(p) Intellectual Property. To their knowledge, the Company and the Subsidiaries have, or have rights to use, all patents, patent applications, trademarks, trademark applications, service marks, trade names, trade secrets, inventions, copyrights, licenses and other intellectual property rights and similar rights necessary or required for use in connection with their respective businesses as described in the SEC Reports and which the failure to so have could have a Material Adverse Effect

(collectively, the “Intellectual Property Rights”). None of, and neither the Company nor any Subsidiary has received a notice (written or otherwise) that any of, the Intellectual Property Rights has expired, terminated or been abandoned, or is expected to expire or terminate or be abandoned, within two (2) years from the date of this Agreement. Neither the Company nor any Subsidiary has received, since the date of the latest audited financial statements included within the SEC Reports, a written notice of a claim or otherwise has any knowledge that the Intellectual Property Rights violate or infringe upon the rights of any Person, except as could not have or reasonably be expected to have a Material Adverse Effect. To the knowledge of the Company, all such Intellectual Property Rights are enforceable and there is no existing infringement by another Person of any of the Intellectual Property Rights. The Company and its Subsidiaries have taken reasonable security measures to protect the secrecy, confidentiality and value of all of their intellectual properties, except where failure to do so could not, individually or in the aggregate, reasonably be expected to have a Material Adverse Effect.

(q) Insurance. The Company and the Subsidiaries are insured by insurers of recognized financial responsibility against such losses and risks and in such amounts as are prudent and customary in the businesses in which the Company and the Subsidiaries are engaged, including, but not limited to, directors and officers insurance coverage at least equal to the aggregate Closing Purchase Price. Neither the Company nor any Subsidiary has any reason to believe that it will not be able to renew its existing insurance coverage as and when such coverage expires or to obtain similar coverage from similar insurers as may be necessary to continue its business without a significant increase in cost.

(r) Transactions With Affiliates and Employees. Except as set forth in the SEC Reports, none of the officers or directors of the Company or any Subsidiary and, to the knowledge of the Company, none of the employees of the Company or any Subsidiary is presently a party to any transaction with the Company or any Subsidiary (other than for services as employees, officers and directors), including any contract, agreement or other arrangement providing for the furnishing of services to or by, providing for rental of real or personal property to or from, providing for the borrowing of money from or lending of money to or otherwise requiring payments to or from, any officer, director or such employee or, to the knowledge of the Company, any entity in which any officer, director, or any such employee has a substantial interest or is an officer, director, trustee, stockholder, member or partner, in each case in excess of \$120,000 other than for (i) payment of salary or consulting fees for services rendered, (ii) reimbursement for expenses incurred on behalf of the Company and (iii) other employee benefits, including stock option and restricted stock agreements under any equity compensation plan of the Company.

(s) Sarbanes-Oxley; Internal Accounting Controls. The Company and the Subsidiaries are in compliance with any and all applicable requirements of the Sarbanes-Oxley Act of 2002 that are effective as of the date hereof, and any and all

applicable rules and regulations promulgated by the Commission thereunder that are effective as of the date hereof and as of the Closing Date. The Company and the Subsidiaries maintain a system of internal accounting controls sufficient to provide reasonable assurance that: (i) transactions are executed in accordance with management's general or specific authorizations, (ii) transactions are recorded as necessary to permit preparation of financial statements in conformity with GAAP and to maintain asset accountability, (iii) access to assets is permitted only in accordance with management's general or specific authorization, and (iv) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action is taken with respect to any differences. The Company and the Subsidiaries have established disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) for the Company and the Subsidiaries and designed such disclosure controls and procedures to ensure that information required to be disclosed by the Company in the reports it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the Commission's rules and forms. The Company's certifying officers have evaluated the effectiveness of the disclosure controls and procedures of the Company and the Subsidiaries as of the end of the period covered by the most recently filed periodic report under the Exchange Act (such date, the "Evaluation Date"). The Company presented in its most recently filed periodic report under the Exchange Act the conclusions of its certifying officers about the effectiveness of the disclosure controls and procedures based on their evaluations as of the Evaluation Date. As disclosed in the SEC Reports, the Company's certifying officers concluded that a material weakness related to the calculation of stock compensation expense existed as of the Evaluation Date. Except for work undertaken to remediate such weakness, since the Evaluation Date, there have been no changes in the internal control over financial reporting (as such term is defined in the Exchange Act) of the Company and its Subsidiaries that have materially affected, or is reasonably likely to materially affect, the internal control over financial reporting of the Company and its Subsidiaries.

(t) Certain Fees. Except as set forth in the Prospectus or any Prospectus Supplement, no brokerage or finder's fees or commissions are or will be payable by the Company, any Subsidiary or Affiliate of the Company to any broker, financial advisor or consultant, finder, placement agent, investment banker, bank or other Person with respect to the transactions contemplated by the Transaction Documents. To the Company's knowledge, there are no other arrangements, agreements or understandings of the Company or, to the Company's knowledge, any of its stockholders that may affect the Underwriters' compensation, as determined by FINRA. The Company has not made any direct or indirect payments (in cash, securities or otherwise) to: (i) any person, as a finder's fee, consulting fee or otherwise, in consideration of such person raising capital for the Company or introducing to the Company persons who raised or provided capital to the Company; (ii) any FINRA member; or (iii) any person or entity that has any direct or indirect affiliation or association with any FINRA member, within the twelve months prior

to the Execution Date. None of the net proceeds of the Offering will be paid by the Company to any participating FINRA member or its affiliates, except as specifically authorized herein.

(u) Investment Company. The Company is not, and is not an Affiliate of, and immediately after receipt of payment for the Securities will not be or be an Affiliate of, an “investment company” within the meaning of the Investment Company Act of 1940, as amended. The Company shall conduct its business in a manner so that it will not become an “investment company” subject to registration under the Investment Company Act of 1940, as amended.

(v) Registration Rights. Other than as disclosed in the SEC Reports, no Person has any right to cause the Company or any Subsidiary to effect the registration under the Securities Act of any securities of the Company or any Subsidiary.

(w) Listing and Maintenance Requirements. The Common Stock is registered pursuant to Section 12(b) of the Exchange Act, and the Company has taken no action designed to, or which to its knowledge is likely to have the effect of, terminating the registration of the Common Stock under the Exchange Act nor has the Company received any notification that the Commission is contemplating terminating such registration. Except as disclosed in the SEC Reports, the Company has not, in the 12 months preceding the date hereof, received notice from any Trading Market on which the Common Stock is or has been listed or quoted to the effect that the Company is not in compliance with the listing or maintenance requirements of such Trading Market. The Company is, and following the Closing hereunder, has no reason to believe that it will not in the foreseeable future continue to be, in compliance with all such listing and maintenance requirements, other than with respect to future compliance with the minimum bid price requirement and the minimum stockholders’ equity requirement. The Common Stock is currently eligible for electronic transfer through the Depository Trust Company or another established clearing corporation and the Company is current in payment of the fees of the Depository Trust Company (or such other established clearing corporation) in connection with such electronic transfer.

(x) Application of Takeover Protections. The Company and the Board of Directors have taken all necessary action, if any, in order to render inapplicable any control share acquisition, business combination, poison pill (including any distribution under a rights agreement) or other similar anti-takeover provision under the Company’s certificate of incorporation (or similar charter documents) or the laws of its state of incorporation that is or could become applicable as a result of the Underwriters and the Company fulfilling their obligations or exercising their rights under the Transaction Documents.

(y) Disclosure; 10b-5. The Registration Statement (and any further documents to be filed with the Commission in connection with the Offering) contains all exhibits and schedules as required by the Securities Act. Each of the Registration

Statement and any post-effective amendment thereto, if any, at the time it became effective, complied in all material respects with the Securities Act and the Exchange Act and the applicable rules and regulations under the Securities Act and did not and, as amended or supplemented, if applicable, will not, contain any untrue statement of a material fact or omit to state a material fact required to be stated therein or necessary to make the statements therein not misleading. The Prospectus and any Prospectus Supplement, each as of its respective date, comply in all material respects with the Securities Act and the Exchange Act and the applicable rules and regulations. Each of the Prospectus and any Prospectus Supplement, as amended or supplemented, did not and will not contain as of the date thereof any untrue statement of a material fact or omit to state a material fact necessary in order to make the statements therein, in light of the circumstances under which they were made, not misleading. Any further SEC Reports, to be filed and incorporated by reference in the Prospectus or any Prospectus Supplement, when such documents are filed with the Commission, will conform in all material respects to the requirements of the Exchange Act and the applicable rules and regulations, as applicable, and will not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements therein, in light of the circumstances under which they were made not misleading. No post-effective amendment to the Registration Statement reflecting any facts or events arising after the date thereof which represent, individually or in the aggregate, a fundamental change in the information set forth therein is required to be filed with the Commission. There are no documents required to be filed with the Commission in connection with the transaction contemplated hereby that (x) have not been filed as required pursuant to the Securities Act or (y) will not be filed within the requisite time period. There are no contracts or other documents required to be described in the Prospectus or any Prospectus Supplement, or to be filed as exhibits or schedules to the Registration Statement, which have not been described or filed as required.

(z) No Integrated Offering. Neither the Company, nor any of its Affiliates, nor any Person acting on its or their behalf has, directly or indirectly, made any offers or sales of any security or solicited any offers to buy any security, under circumstances that would cause this offering of the Securities to be integrated with prior offerings by the Company for purposes of any applicable shareholder approval provisions of any Trading Market on which any of the securities of the Company are listed or designated.

(aa) Solvency. Based on the consolidated financial condition of the Company as of the Closing Date, after giving effect to the receipt by the Company of the proceeds from the sale of the Securities hereunder, (i) the fair saleable value of the Company's assets exceeds the amount that will be required to be paid on or in respect of the Company's existing debts and other liabilities (including known contingent liabilities) as they mature, (ii) the Company's assets do not constitute unreasonably small capital to carry on its business as now conducted and as proposed to be conducted including its capital needs taking into account the particular capital

requirements of the business conducted by the Company, consolidated and projected capital requirements and capital availability thereof, and (iii) the current cash flow of the Company, together with the proceeds the Company would receive, were it to liquidate all of its assets, after taking into account all anticipated uses of the cash, would be sufficient to pay all amounts on or in respect of its liabilities when such amounts are required to be paid. The Company does not intend to incur debts beyond its ability to pay such debts as they mature (taking into account the timing and amounts of cash to be payable on or in respect of its debt). The Company has no knowledge of any facts or circumstances which lead it to believe that it will file for reorganization or liquidation under the bankruptcy or reorganization laws of any jurisdiction within six months from the Closing Date. The SEC Reports sets forth as of the date hereof all outstanding secured and unsecured Indebtedness of the Company or any Subsidiary, or for which the Company or any Subsidiary has commitments.

(bb) Tax Status. Except for matters that would not, individually or in the aggregate, have or reasonably be expected to result in a Material Adverse Effect, the Company and its Subsidiaries each (i) has made or filed, or secured all extensions for the filing of all applicable United States federal, state and local income and all foreign income and franchise tax returns, reports and declarations required by any jurisdiction to which it is subject, (ii) has paid all taxes and other governmental assessments and charges that are material in amount, shown or determined to be due on such returns, reports and declarations and (iii) has set aside on its books provision reasonably adequate for the payment of all material taxes for periods subsequent to the periods to which such returns, reports or declarations apply. There are no unpaid taxes in any material amount claimed to be due by the taxing authority of any jurisdiction, and the officers of the Company or of any Subsidiary know of no basis for any such claim. The provisions for taxes payable, if any, shown on the financial statements filed with or as part of the Registration Statement are sufficient for all accrued and unpaid taxes, whether or not disputed, and for all periods to and including the dates of such consolidated financial statements. The term “taxes” means all federal, state, local, foreign, and other net income, gross income, gross receipts, sales, use, ad valorem, transfer, franchise, profits, license, lease, service, service use, withholding, payroll, employment, excise, severance, stamp, occupation, premium, property, windfall profits, customs, duties or other taxes, fees, assessments, or charges of any kind whatsoever, together with any interest and any penalties, additions to tax, or additional amounts with respect thereto. The term “returns” means all returns, declarations, reports, statements, and other documents required to be filed in respect to taxes.

(cc) Foreign Corrupt Practices. Neither the Company nor any Subsidiary, nor to the knowledge of the Company or any Subsidiary, any agent or other person acting on behalf of the Company or any Subsidiary, has (i) directly or indirectly, used any funds for unlawful contributions, gifts, entertainment or other unlawful expenses related to foreign or domestic political activity, (ii) made any unlawful

payment to foreign or domestic government officials or employees or to any foreign or domestic political parties or campaigns from corporate funds, (iii) failed to disclose fully any contribution made by the Company or any Subsidiary (or made by any person acting on its behalf of which the Company is aware) which is in violation of law, or (iv) violated in any material respect any provision of FCPA. The Company has taken reasonable steps to ensure that its accounting controls and procedures are sufficient to cause the Company to comply in all material respects with the FCPA.

(dd) Accountants. To the knowledge and belief of the Company, the Company Auditor (i) is an independent registered public accounting firm as required by the Exchange Act and (ii) shall express its opinion with respect to the financial statements to be included in the Company's Annual Report on Form 10-K for the fiscal year ending December 31, 2019. The Company Auditor has not, during the periods covered by the financial statements included in the Prospectus, provided to the Company any non-audit services, as such term is used in Section 10A(g) of the Exchange Act.

(ee) Office of Foreign Assets Control. Neither the Company nor any Subsidiary nor, to the Company's knowledge, any director, officer, agent, employee or affiliate of the Company or any Subsidiary is currently subject to any U.S. sanctions administered by the Office of Foreign Assets Control of the U.S. Treasury Department.

(ff) U.S. Real Property Holding Corporation. The Company is not and has never been a U.S. real property holding corporation within the meaning of Section 897 of the Internal Revenue Code of 1986, as amended, and the Company shall so certify upon the Representative's request.

(gg) Bank Holding Company Act. Neither the Company nor any of its Subsidiaries or Affiliates is subject to the Bank Holding Company Act of 1956, as amended (the "BHCA") and to regulation by the Board of Governors of the Federal Reserve System (the "Federal Reserve"). Neither the Company nor any of its Subsidiaries or Affiliates owns or controls, directly or indirectly, five percent (5%) or more of the outstanding shares of any class of voting securities or twenty-five percent (25%) or more of the total equity of a bank or any entity that is subject to the BHCA and to regulation by the Federal Reserve. Neither the Company nor any of its Subsidiaries or Affiliates exercises a controlling influence over the management or policies of a bank or any entity that is subject to the BHCA and to regulation by the Federal Reserve.

(hh) Money Laundering. The operations of the Company and its Subsidiaries are and have been conducted at all times in material compliance with applicable financial record-keeping and reporting requirements of the Currency and Foreign Transactions Reporting Act of 1970, as amended, applicable money laundering statutes and applicable rules and regulations thereunder (collectively, the "Money Laundering Laws"), and no action, suit or proceeding by or before any court

or governmental agency, authority or body or any arbitrator involving the Company or any Subsidiary with respect to the Money Laundering Laws is pending or, to the knowledge of the Company or any Subsidiary, threatened.

(ii) D&O Questionnaires. To the Company's knowledge, all information contained in the questionnaires completed by each of the Company's directors and officers immediately prior to the Offering as well as in the Lock-Up Agreement provided to the Underwriters is true and correct in all material respects and the Company has not become aware of any information which would cause the information disclosed in such questionnaires become inaccurate and incorrect.

(jj) FINRA Affiliation. To the Company's knowledge, no officer, director or any beneficial owner of 5% or more of the Company's unregistered securities has any direct or indirect affiliation or association with any FINRA member (as determined in accordance with the rules and regulations of FINRA) that is participating in the Offering. The Company will advise the Representative and EGS if it learns that any officer, director or owner of 5% or more of the Company's outstanding shares of Common Stock or Common Stock Equivalents is or becomes an affiliate or associated person of a FINRA member firm.

(kk) Officers' Certificate. Any certificate signed by any duly authorized officer of the Company and delivered to the Representative or EGS shall be deemed a representation and warranty by the Company to the Underwriters as to the matters covered thereby.

(ll) Board of Directors. The Board of Directors is comprised of the persons set forth under the heading of the Prospectus captioned "Management." The qualifications of the persons serving as board members and the overall composition of the Board of Directors comply with the Sarbanes-Oxley Act of 2002 and the rules promulgated thereunder applicable to the Company and the rules of the Trading Market. At least one member of the Board of Directors qualifies as a "financial expert" as such term is defined under the Sarbanes-Oxley Act of 2002 and the rules promulgated thereunder and the rules of the Trading Market. In addition, at least a majority of the persons serving on the Board of Directors qualify as "independent" as defined under the rules of the Trading Market.

ARTICLE IV. OTHER AGREEMENTS OF THE PARTIES

4.1 Amendments to Registration Statement. The Company has delivered, or will as promptly as practicable deliver, to the Underwriters complete conformed copies of the Registration Statement and of each consent and certificate of experts, as applicable, filed as a part thereof, and conformed copies of the Registration Statement (without exhibits), the Prospectus and any Prospectus Supplement, as amended or supplemented, in such quantities and at such places as an Underwriter reasonably requests. Neither the Company

nor any of its directors and officers has distributed and none of them will distribute, prior to the Closing Date, any offering material in connection with the offering and sale of the Securities other than the Prospectus, any Prospectus Supplement, the Registration Statement, and copies of the documents incorporated by reference therein. The Company shall not file any such amendment or supplement to which the Representative shall reasonably object in writing.

4.2 Federal Securities Laws.

(a) Compliance. During the time when a Prospectus is required to be delivered under the Securities Act, the Company will use its best efforts to comply with all requirements imposed upon it by the Securities Act and the rules and regulations thereunder and the Exchange Act and the rules and regulations thereunder, as from time to time in force, so far as necessary to permit the continuance of sales of or dealings in the Securities in accordance with the provisions hereof and the Prospectus. If at any time when a Prospectus relating to the Securities is required to be delivered under the Securities Act, any event shall have occurred as a result of which, in the opinion of counsel for the Company or counsel for the Underwriters, the Prospectus, as then amended or supplemented, includes an untrue statement of a material fact or omits to state any material fact required to be stated therein or necessary to make the statements therein, in light of the circumstances under which they were made, not misleading, or if it is necessary at any time to amend the Prospectus to comply with the Securities Act, the Company will notify the Underwriters promptly and prepare and file with the Commission, subject to Section 4.1 hereof, an appropriate amendment or supplement in accordance with Section 10 of the Securities Act.

(b) Filing of Final Prospectus. The Company will file the Prospectus (in form and substance satisfactory to the Representative) with the Commission pursuant to the requirements of Rule 424.

(c) Exchange Act Registration. For a period of two years from the Execution Date, the Company will use its reasonable best efforts to maintain the registration of the Common Stock under the Exchange Act. The Company will not deregister the Common Stock under the Exchange Act without the prior written consent of the Representative, subject to the exercise of fiduciary duties.

(d) Free Writing Prospectuses. The Company represents and agrees that it has not made and will not make any offer relating to the Securities using a document that would constitute an issuer free writing prospectus, as defined in Rule 433 of the rules and regulations under the Securities Act, without the prior written consent of the Representative. Any such free writing prospectus consented to by the Representative is herein referred to as a “Permitted Free Writing Prospectus.” The Company represents that it will treat each Permitted Free Writing Prospectus as an “issuer free writing prospectus” as defined in rules and regulations under the Securities Act, and has complied and will comply with the applicable requirements of Rule 433 of the Securities Act, including timely Commission filing where required, legending and record keeping.

4.3 Delivery to the Underwriters of Prospectuses. The Company will deliver to the Underwriters, without charge, from time to time during the period when the Prospectus is required to be delivered under the Securities Act or the Exchange Act such number of copies of each Prospectus as the Underwriters may reasonably request.

4.4 Effectiveness and Events Requiring Notice to the Underwriters. The Company will use its reasonable best efforts to cause the Registration Statement to remain effective with a current prospectus until the later of nine (9) months from the Execution Date and the date on which the Warrants are no longer outstanding, and will notify the Underwriters and holders of the Warrants immediately and confirm the notice in writing: (i) of the effectiveness of the Registration Statement and any amendment thereto; (ii) of the issuance by the Commission of any stop order or of the initiation, or the threatening, of any proceeding for that purpose; (iii) of the issuance by any state securities commission of any proceedings for the suspension of the qualification of the Securities for offering or sale in any jurisdiction or of the initiation, or the threatening, of any proceeding for that purpose; (iv) of the mailing and delivery to the Commission for filing of any amendment or supplement to the Registration Statement or Prospectus; (v) of the receipt of any comments or request for any additional information from the Commission; and (vi) of the happening of any event during the period described in this Section 4.4 that, in the judgment of the Company, makes any statement of a material fact made in the Registration Statement or the Prospectus untrue or that requires the making of any changes in the Registration Statement or the Prospectus in order to make the statements therein, in light of the circumstances under which they were made, not misleading. If the Commission or any state securities commission shall enter a stop order or suspend such qualification at any time, the Company will make every reasonable effort to obtain promptly the lifting of such order.

4.5 Expenses of the Offering.

(a) General Expenses Related to the Offering. The Company hereby agrees to pay on each of the Closing Date and each Option Closing Date, if any, to the extent not paid at the Closing Date, all expenses incident to the performance of the obligations of the Company under this Agreement, including, but not limited to: (a) all filing fees and communication expenses relating to the registration of the Securities to be sold in the Offering (including the Option Securities) with the Commission; (b) all FINRA Public Offering Filing System fees associated with the review of the Offering by FINRA; all fees and expenses relating to the listing of such Closing Shares, Option Shares and Underlying Shares on the Trading Market and such other stock exchanges as the Company and the Representative together determine; (c) all fees, expenses and disbursements relating to the registration or qualification of such Securities under the “blue sky” securities laws of such states and any foreign jurisdictions as the Representative may reasonably designate; (d) the costs of all mailing and printing of the underwriting documents (including, without limitation, the Underwriting Agreement, any Blue Sky Surveys and, if appropriate, any Agreement Among Underwriters, Selected Dealers’ Agreement, Underwriters’ Questionnaire and Power of Attorney), Registration Statements,

Prospectuses and all amendments, supplements and exhibits thereto and as many preliminary and final Prospectuses as the Representative may reasonably deem necessary; (e) the costs and expenses of the Company's public relations firm; (f) the costs of preparing, printing and delivering the Securities; (g) fees and expenses of the Transfer Agent for the Securities (including, without limitation, any fees required for same-day processing of any instruction letter delivered by the Company and fees and expenses pursuant to the Warrant Agency Agreement and the Preferred Stock Agency Agreement); (h) stock transfer and/or stamp taxes, if any, payable upon the transfer of securities from the Company to the Underwriters; (i) the fees and expenses of the Company's accountants; (j) the fees and expenses of the Company's legal counsel and other agents and representatives; and (k) the Underwriters' costs of mailing prospectuses to prospective investors. The Underwriters may also deduct from the net proceeds of the Offering payable to the Company on the Closing Date, or each Option Closing Date, if any, the expenses set forth herein to be paid by the Company to the Underwriters.

(b) Expenses. The Company further agrees that, in addition to the expenses payable pursuant to Section 4.5(a), on the Closing Date it will reimburse the Representative for its out-of-pocket expenses related to the Offering in an amount up to \$90,000, and the remainder of which shall be paid by deduction from the proceeds of the Offering contemplated herein.

4.6 Application of Net Proceeds. The Company will apply the net proceeds from the Offering received by it in a manner consistent with the application described under the caption "Use of Proceeds" in the Prospectus.

4.7 Delivery of Earnings Statements to Security Holders. The Company will make generally available to its security holders as soon as practicable, but not later than the first day of the fifteenth full calendar month following the Execution Date, an earnings statement (which need not be certified by independent public or independent certified public accountants unless required by the Securities Act or the Rules and Regulations under the Securities Act, but which shall satisfy the provisions of Rule 158(a) under Section 11(a) of the Securities Act) covering a period of at least twelve consecutive months beginning after the Execution Date.

4.8 Stabilization. Neither the Company, nor, to its knowledge, any of its employees, directors or shareholders (without the consent of the Representative) has taken or will take, directly or indirectly, any action designed to or that has constituted or that might reasonably be expected to cause or result in, under the Exchange Act, or otherwise, stabilization or manipulation of the price of any security of the Company to facilitate the sale or resale of the Securities.

4.9 Internal Controls. The Company will maintain a system of internal accounting controls sufficient to provide reasonable assurances that: (i) transactions are executed in accordance with management's general or specific authorization; (ii) transactions are recorded as necessary in order to permit preparation of financial

statements in accordance with GAAP and to maintain accountability for assets; (iii) access to assets is permitted only in accordance with management's general or specific authorization; and (iv) the recorded accountability for assets is compared with existing assets at reasonable intervals and appropriate action is taken with respect to any differences.

4.10 Accountants. The Company shall continue to retain a nationally recognized independent certified public accounting firm for a period of at least three years after the Execution Date. The Underwriters acknowledge that the Company Auditor is acceptable to the Underwriters.

4.11 FINRA. The Company shall advise the Underwriters (who shall make an appropriate filing with FINRA) if it is aware that any 5% or greater shareholder of the Company becomes an affiliate or associated person of an Underwriter.

4.12 No Fiduciary Duties. The Company acknowledges and agrees that the Underwriters' responsibility to the Company is solely contractual and commercial in nature, based on arms-length negotiations and that neither the Underwriters nor their affiliates or any selected dealer shall be deemed to be acting in a fiduciary capacity, or otherwise owes any fiduciary duty to the Company or any of its affiliates in connection with the Offering and the other transactions contemplated by this Agreement. Notwithstanding anything in this Agreement to the contrary, the Company acknowledges that the Underwriters may have financial interests in the success of the Offering that are not limited to the difference between the price to the public and the purchase price paid to the Company by the Underwriters for the shares and the Underwriters have no obligation to disclose, or account to the Company for, any of such additional financial interests. The Company hereby waives and releases, to the fullest extent permitted by law, any claims that the Company may have against the Underwriters with respect to any breach or alleged breach of fiduciary duty.

4.13 Underlying Shares. The shares of Common Stock underlying the Preferred Stock shall be issued free of legends. If all or any portion of a Warrant is exercised at a time when there is an effective registration statement to cover the issuance of the Warrant Shares or if the Warrant is exercised via cashless exercise at a time when such Warrant Shares would be eligible for resale under Rule 144 by a non-affiliate of the Company, the Warrant Shares issued pursuant to any such exercise shall be issued free of all restrictive legends. If at any time following the date hereof the Registration Statement (or any subsequent registration statement registering the sale or resale of the Warrant Shares) is not effective or is not otherwise available for the sale of the Warrant Shares, the Company shall promptly notify the holders of the Warrants in writing that such registration statement is not then effective and thereafter shall promptly notify such holders when the registration statement is effective again and available for the sale of the Warrant Shares (it being understood and agreed that the foregoing shall not limit the ability of the Company to issue, or any holder thereof to sell, any of the Warrant Shares in compliance with applicable federal and state securities laws).

4.14 Board Composition and Board Designations. The Company shall use its reasonable best efforts to ensure that: (i) the qualifications of the persons serving as board

members and the overall composition of the Board of Directors comply with the Sarbanes-Oxley Act of 2002 and the rules promulgated thereunder and with the listing requirements of the Trading Market and (ii) if applicable, at least one member of the Board of Directors qualifies as a “financial expert” as such term is defined under the Sarbanes-Oxley Act of 2002 and the rules promulgated thereunder.

4.15 Securities Laws Disclosure; Publicity. By 9:00 a.m. (New York City time) on the date hereof, the Company shall issue a press release disclosing the material terms of the Offering. The Company and the Representative shall consult with each other in issuing any other press releases with respect to the Offering, and neither the Company nor any Underwriter shall issue any such press release nor otherwise make any such public statement without the prior consent of the Company, with respect to any press release of such Underwriter, or without the prior consent of such Underwriter, with respect to any press release of the Company, which consent shall not unreasonably be withheld or delayed, except if such disclosure is required by law, in which case the disclosing party shall promptly provide the other party with prior notice of such public statement or communication. The Company will not issue press releases or engage in any other publicity, without the Representative’s prior written consent, for a period ending at 5:00 p.m. (New York City time) on the first business day following the 40th day following the Closing Date, other than normal and customary releases issued in the ordinary course of the Company’s business.

4.16 Shareholder Rights Plan. No claim will be made or enforced by the Company or, with the consent of the Company, any other Person, that any Underwriter of the Securities is an “Acquiring Person” under any control share acquisition, business combination, poison pill (including any distribution under a rights agreement) or similar anti-takeover plan or arrangement in effect or hereafter adopted by the Company, or that any Underwriter of Securities could be deemed to trigger the provisions of any such plan or arrangement, by virtue of receiving Securities.

4.17 Reservation of Common Stock. As of the date hereof, the Company has reserved and the Company shall continue to reserve and keep available at all times, free of preemptive rights, a sufficient number of shares of Common Stock for the purpose of enabling the Company to issue the Required Minimum other than the Warrant Shares. From and after the effective date of the Amendment, the Company will reserve and keep available at all times, free of preemptive rights, a sufficient number of shares of Common Stock for the purpose of enabling the Company to issue the Warrant Shares.

4.18 Listing of Common Stock. The Company hereby agrees to use best efforts to maintain the listing or quotation of the Common Stock on the Trading Market on which it is currently listed, and concurrently with the Closing, the Company shall apply to list or quote all of the Closing Shares, Option Shares, Conversion Shares and Warrant Shares on such Trading Market and promptly secure the listing of all of the Closing Shares, Option Shares, Conversion Shares and Warrant Shares on such Trading Market. The Company further agrees, if the Company applies to have the Common Stock traded on any other Trading Market, it will then include in such application all of the Closing Shares, Option Shares, Conversion Shares and Warrant Shares, and will take such other action as is necessary to cause all of the Closing Shares, Option Shares, Conversion Shares and Warrant

Shares to be listed or quoted on such other Trading Market as promptly as possible. The Company will then take all action reasonably necessary to continue the listing and trading of its Common Stock on a Trading Market and to comply in all respects with the Company's reporting, filing and other obligations under the bylaws or rules of the Trading Market. The Company agrees to use its reasonable best efforts to maintain the eligibility of the Common Stock for electronic transfer through the Depository Trust Company or another established clearing corporation, including, without limitation, by timely payment of fees to the Depository Trust Company or such other established clearing corporation in connection with such electronic transfer.

4.19 Subsequent Equity Sales/Authorized Share Approval.

(a) The Company shall hold an annual or special meeting of stockholders within 60 calendar days of the date hereof for the purpose of obtaining Authorized Share Approval, with the recommendation of the Company's Board of Directors that such proposal is approved, and the Company shall solicit proxies from its stockholders in connection therewith in the same manner as all other management proposals in such proxy statement and all management-appointed proxyholders shall vote their proxies in favor of such proposal. If the Company does not obtain Authorized Share Approval at the first meeting, the Company shall call a meeting every four (4) months thereafter to seek Authorized Share Approval until the earlier of the date on which Authorized Share Approval is obtained or the Warrants are no longer outstanding.

(b) From the date hereof until 90 days following the Closing Date, neither the Company nor any Subsidiary shall issue, enter into any agreement to issue or announce the issuance or proposed issuance of any shares of Common Stock or Common Stock Equivalents, provided, however, that this restriction shall terminate if the closing price of the Common Stock on the Trading Market exceeds \$_____¹ (subject to the adjustment for forward and reverse stock splits and the like that occur after the date hereof) in this Offering for three (3) consecutive Trading Days following 45 days from the Closing. In addition, until the Authorized Share Approval is effective, neither the Company nor any Subsidiary shall issue, enter into any agreement to issue or announce the issuance or proposed issuance of any shares of Common Stock or Common Stock Equivalents.

(c) From the date hereof until the one year anniversary of the Closing Date, the Company shall be prohibited from effecting or entering into an agreement to effect any issuance by the Company or any of its Subsidiaries of Common Stock or Common Stock Equivalents (or a combination of units thereof) involving a Variable Rate Transaction. "Variable Rate Transaction" means a transaction in which the Company (i) issues or sells any debt or equity securities that are convertible into, exchangeable or exercisable for, or include the right to receive, additional shares of Common Stock either (A) at a conversion price, exercise price or exchange rate or other price that is based upon, and/or varies with, the trading prices of or quotations for the shares of Common Stock at any time after the initial issuance of such debt or equity securities or (B) with a conversion, exercise or exchange price that is subject to being reset at some future date after the initial issuance of such debt or equity security or upon the occurrence of specified or contingent events directly or indirectly related to the business of the Company or the market for the Common Stock

or (ii) enters into, or effects a transaction under, any agreement, including, but not limited to, an equity line of credit, whereby the Company may issue securities at a future determined price. Notwithstanding the foregoing, the Company shall be permitted to enter into, or effect a transaction under, an at-the-market offering with the Representative after the 180 day anniversary of the Closing Date. Any Underwriter shall be entitled to obtain injunctive relief against the Company to preclude any such issuance, which remedy shall be in addition to any right to collect damages.

(d) Notwithstanding the foregoing, this Section 4.19 shall not apply in respect of an Exempt Issuance, except that no Variable Rate Transaction shall be an Exempt Issuance.

4.20 Research Independence. The Company acknowledges that each Underwriter's research analysts and research departments, if any, are required to be independent from their respective investment banking divisions and are subject to certain regulations and internal policies, and that such Underwriter's research analysts may hold and make statements or investment recommendations and/or publish research reports with respect to the Company and/or the offering that differ from the views of its investment bankers. The Company hereby waives and releases, to the fullest extent permitted by law, any claims that the Company may have against such Underwriter with respect to any conflict of interest that may arise from the fact that the views expressed by their independent research analysts and research departments may be different from or inconsistent with the views or advice communicated to the Company by such Underwriter's investment banking divisions. The Company acknowledges that the Representative is a full service securities firm and as such from time to time, subject to applicable securities laws, may effect transactions for its own

account or the account of its customers and hold long or short position in debt or equity securities of the Company.

¹ Insert public offering price per Class A Unit

**ARTICLE V.
DEFAULT BY UNDERWRITERS**

If on the Closing Date or any Option Closing Date, if any, any Underwriter shall fail to purchase and pay for the portion of the Closing Securities or Option Securities, as the case may be, which such Underwriter has agreed to purchase and pay for on such date (otherwise than by reason of any default on the part of the Company), the Representative, or if the Representative is the defaulting Underwriter, the non-defaulting Underwriters, shall use their reasonable efforts to procure within 36 hours thereafter one or more of the other Underwriters, or any others, to purchase from the Company such amounts as may be agreed upon and upon the terms set forth herein, the Closing Securities or Option Securities, as the case may be, which the defaulting Underwriter or Underwriters failed to purchase. If during such 36 hours the Representative shall not have procured such other Underwriters, or any others, to purchase the Closing Securities or Option Securities, as the case may be, agreed to be purchased by the defaulting Underwriter or Underwriters, then (a) if the aggregate number of Closing Securities or Option Securities, as the case may be, with respect to which such default shall occur does not exceed 10% of the Closing Securities or Option Securities, as the case may be, covered hereby, the other Underwriters shall be obligated, severally, in proportion to the respective numbers of Closing Securities or Option Securities, as the case may be, which they are obligated to purchase hereunder, to purchase the Closing Securities or Option Securities, as the case may be, which such defaulting Underwriter or Underwriters failed to purchase, or (b) if the aggregate number of Closing Securities or Option Securities, as the case may be, with respect to which such default shall occur exceeds 10% of the Closing Securities or Option Securities, as the case may be, covered hereby, the Company or the Representative will have the right to terminate this Agreement without liability on the part of the non-defaulting Underwriters or of the Company except to the extent provided in Article VI hereof. In the event of a default by any Underwriter or Underwriters, as set forth in this Article V, the applicable Closing Date may be postponed for such period, not exceeding seven days, as the Representative, or if the Representative is the defaulting Underwriter, the non-defaulting Underwriters, may determine in order that the required changes in the Prospectus or in any other documents or arrangements may be effected. The term "Underwriter" includes any person substituted for a defaulting Underwriter. Any action taken under this Section shall not relieve any defaulting Underwriter from liability in respect of any default of such Underwriter under this Agreement.

**ARTICLE VI.
INDEMNIFICATION**

6.1 Indemnification of the Underwriters. Subject to the conditions set forth below, the Company agrees to indemnify and hold harmless the Underwriters, and each dealer selected by each Underwriter that participates in the offer and sale of the Securities (each a "Selected Dealer") and each of their respective directors, officers and employees and each Person, if any, who controls such Underwriter or any Selected Dealer ("Controlling Person") within the meaning of Section 15 of the Securities Act or Section 20 of the Exchange Act, against any and all loss, liability, claim, damage and expense whatsoever (including but not limited to any and all legal or other expenses reasonably incurred in investigating, preparing or defending against any litigation, commenced or

threatened, or any claim whatsoever, whether arising out of any action between such Underwriter and the Company or between such Underwriter and any third party or otherwise) to which they or any of them may become subject under the Securities Act, the Exchange Act or any other statute or at common law or otherwise or under the laws of foreign countries, arising out of or based upon any untrue statement or alleged untrue statement of a material fact contained in (i) any Preliminary Prospectus, if any, the Registration Statement or the Prospectus (as from time to time each may be amended and supplemented); (ii) any materials or information provided to investors by, or with the approval of, the Company in connection with the marketing of the offering of the Securities, including any “road show” or investor presentations made to investors by the Company (whether in person or electronically); or (iii) any application or other document or written communication (in this Article VI, collectively called “application”) executed by the Company or based upon written information furnished by the Company in any jurisdiction in order to qualify the Securities under the securities laws thereof or filed with the Commission, any state securities commission or agency, Trading Market or any securities exchange; or the omission or alleged omission therefrom of a material fact required to be stated therein or necessary to make the statements therein, in light of the circumstances under which they were made, not misleading, unless such statement or omission was made in reliance upon and in conformity with written information furnished to the Company with respect to the applicable Underwriter by or on behalf of such Underwriter expressly for use in any Preliminary Prospectus, if any, the Registration Statement or Prospectus, or any amendment or supplement thereto, or in any application, as the case may be. With respect to any untrue statement or omission or alleged untrue statement or omission made in the Preliminary Prospectus, if any, the indemnity agreement contained in this Section 6.1 shall not inure to the benefit of an Underwriter to the extent that any loss, liability, claim, damage or expense of such Underwriter results from the fact that a copy of the Prospectus was not given or sent to the Person asserting any such loss, liability, claim or damage at or prior to the written confirmation of sale of the Securities to such Person as required by the Securities Act and the rules and regulations thereunder, and if the untrue statement or omission has been corrected in the Prospectus, unless such failure to deliver the Prospectus was a result of non-compliance by the Company with its obligations under this Agreement. The Company agrees promptly to notify each Underwriter of the commencement of any litigation or proceedings against the Company or any of its officers, directors or Controlling Persons in connection with the issue and sale of the Public Securities or in connection with the Registration Statement or Prospectus.

6.2 Procedure. If any action is brought against an Underwriter, a Selected Dealer or a Controlling Person in respect of which indemnity may be sought against the Company pursuant to Section 6.1, such Underwriter, such Selected Dealer or Controlling Person, as the case may be, shall promptly notify the Company in writing of the institution of such action and the Company shall assume the defense of such action, including the employment and fees of counsel (subject to the reasonable approval of such Underwriter or such Selected Dealer, as the case may be) and payment of actual expenses. Such Underwriter, such Selected Dealer or Controlling Person shall have the right to employ its or their own counsel in any such case, but the fees and expenses of such counsel shall be at the expense of such Underwriter, such Selected Dealer or Controlling Person unless (i) the employment of such counsel at the expense of the Company shall have been authorized in writing by the Company in connection with the defense of such action, or (ii) the Company shall not have employed counsel to have charge of the defense of such action, or (iii) such indemnified party or parties shall have reasonably concluded that there may be defenses available to it or them which

are different from or additional to those available to the Company (in which case the Company shall not have the right to direct the defense of such action on behalf of the indemnified party or parties), in any of which events the reasonable fees and expenses of not more than one additional firm of attorneys selected by such Underwriter (in addition to local counsel), Selected Dealer and/or Controlling Person shall be borne by the Company. Notwithstanding anything to the contrary contained herein, if any Underwriter, Selected Dealer or Controlling Person shall assume the defense of such action as provided above, the Company shall have the right to approve the terms of any settlement of such action which approval shall not be unreasonably withheld.

6.3 Indemnification of the Company. Each Underwriter severally and not jointly agrees to indemnify and hold harmless the Company, its directors, officers and employees and agents who control the Company within the meaning of Section 15 of the Securities Act or Section 20 of the Exchange Act against any and all loss, liability, claim, damage and expense described in the foregoing indemnity from the Company to such Underwriter, as incurred, but only with respect to untrue statements or omissions, or alleged untrue statements or omissions made in any Preliminary Prospectus, if any, the Registration Statement or Prospectus or any amendment or supplement thereto or in any application, in reliance upon, and in strict conformity with, written information furnished to the Company with respect to such Underwriter by or on behalf of such Underwriter expressly for use in such Preliminary Prospectus, if any, the Registration Statement or Prospectus or any amendment or supplement thereto or in any such application. In case any action shall be brought against the Company or any other Person so indemnified based on any Preliminary Prospectus, if any, the Registration Statement or Prospectus or any amendment or supplement thereto or any application, and in respect of which indemnity may be sought against such Underwriter, such Underwriter shall have the rights and duties given to the Company, and the Company and each other Person so indemnified shall have the rights and duties given to such Underwriter by the provisions of this Article VI. Notwithstanding the provisions of this Section 6.3, no Underwriter shall be required to indemnify the Company for any amount in excess of the underwriting discounts and commissions applicable to the Securities purchased by such Underwriter. The Underwriters' obligations in this Section 6.3 to indemnify the Company are several in proportion to their respective underwriting obligations and not joint.

6.4 Contribution.

(a) Contribution Rights. In order to provide for just and equitable contribution under the Securities Act in any case in which (i) any Person entitled to indemnification under this Article VI makes a claim for indemnification pursuant hereto but it is judicially determined (by the entry of a final judgment or decree by a court of competent jurisdiction and the expiration of time to appeal or the denial of the last right of appeal) that such indemnification may not be enforced in such case notwithstanding the fact that this Article VI provides for indemnification in such case, or (ii) contribution under the Securities Act, the Exchange Act or otherwise may be required on the part of any such Person in circumstances for which indemnification is provided under this Article VI, then, and in each such case, the Company and each Underwriter, severally and not jointly, shall contribute to the aggregate losses, liabilities, claims, damages and expenses of the nature contemplated by said indemnity agreement incurred by the Company and such Underwriter, as incurred,

in such proportions that such Underwriter is responsible for that portion represented by the percentage that the underwriting discount appearing on the cover page of the Prospectus bears to the initial offering price appearing thereon and the Company is responsible for the balance; provided, that, no Person guilty of a fraudulent misrepresentation (within the meaning of Section 11(f) of the Securities Act) shall be entitled to contribution from any Person who was not guilty of such fraudulent misrepresentation. For purposes of this Section, each director, officer and employee of such Underwriter or the Company, as applicable, and each Person, if any, who controls such Underwriter or the Company, as applicable, within the meaning of Section 15 of the Securities Act shall have the same rights to contribution as such Underwriter or the Company, as applicable. Notwithstanding the provisions of this Section 6.4, no Underwriter shall be required to contribute any amount in excess of the underwriting discounts and commissions applicable to the Securities purchased by such Underwriter. The Underwriters' obligations in this Section 6.4 to contribute are several in proportion to their respective underwriting obligations and not joint.

(b) Contribution Procedure. Within fifteen days after receipt by any party to this Agreement (or its representative) of notice of the commencement of any action, suit or proceeding, such party will, if a claim for contribution in respect thereof is to be made against another party ("contributing party"), notify the contributing party of the commencement thereof, but the failure to so notify the contributing party will not relieve it from any liability which it may have to any other party other than for contribution hereunder. In case any such action, suit or proceeding is brought against any party, and such party notifies a contributing party or its representative of the commencement thereof within the aforesaid fifteen days, the contributing party will be entitled to participate therein with the notifying party and any other contributing party similarly notified. Any such contributing party shall not be liable to any party seeking contribution on account of any settlement of any claim, action or proceeding effected by such party seeking contribution without the written consent of such contributing party. The contribution provisions contained in this Section 6.4 are intended to supersede, to the extent permitted by law, any right to contribution under the Securities Act, the Exchange Act or otherwise available.

ARTICLE VII. MISCELLANEOUS

7.1 Termination.

(a) Termination Right. The Representative shall have the right to terminate this Agreement at any time prior to any Closing Date, (i) if any domestic or international event or act or occurrence has materially disrupted, or in its opinion will in the immediate future materially disrupt, general securities markets in the United States, or (ii) if trading on any Trading Market shall have been suspended or materially limited, or minimum or maximum prices for trading shall have been fixed, or maximum ranges for prices for securities shall have been required by FINRA or by order of the Commission or any other government authority having jurisdiction, or (iii) if the United States shall have become involved in a new war or an increase in major hostilities, or (iv) if a banking moratorium has been declared

by a New York State or federal authority, or (v) if a moratorium on foreign exchange trading has been declared which materially adversely impacts the United States securities markets, or (vi) if the Company shall have sustained a material loss by fire, flood, accident, hurricane, earthquake, theft, sabotage or other calamity or malicious act which, whether or not such loss shall have been insured, will, in the Representative's opinion, make it inadvisable to proceed with the delivery of the Securities, or (vii) if the Company is in material breach of any of its representations, warranties or covenants hereunder, or (viii) if the Representative shall have become aware after the date hereof of such a material adverse change in the conditions or prospects of the Company, or such adverse material change in general market conditions as in the Representative's judgment would make it impracticable to proceed with the offering, sale and/or delivery of the Securities or to enforce contracts made by the Underwriters for the sale of the Securities.

(b) Expenses. In the event this Agreement shall be terminated pursuant to Section 7.1(a), within the time specified herein or any extensions thereof pursuant to the terms herein, the Company shall be obligated to pay to the Representative its actual and accountable out of pocket expenses related to the transactions contemplated herein then due and payable, including the fees and disbursements of EGS up to \$50,000 (provided, however, that such expense cap in no way limits or impairs the indemnification and contribution provisions of this Agreement).

(c) Indemnification. Notwithstanding any contrary provision contained in this Agreement, any election hereunder or any termination of this Agreement, and whether or not this Agreement is otherwise carried out, the provisions of Article VI shall not be in any way affected by such election or termination or failure to carry out the terms of this Agreement or any part hereof.

7.2 Entire Agreement. The Transaction Documents, together with the exhibits and schedules thereto, the Prospectus and any Prospectus Supplement, contain the entire understanding of the parties with respect to the subject matter hereof and thereof and supersede all prior agreements and understandings, oral or written, with respect to such matters, which the parties acknowledge have been merged into such documents, exhibits and schedules. Notwithstanding anything herein to the contrary, the Engagement Agreement, dated August 30, 2019 ("Engagement Agreement"), by and between the Company and Ladenburg Thalmann & Co. Inc., shall continue to be effective and the terms therein, including, without limitation, Section 4(b) and Section 5 with respect to any future offerings, shall continue to survive and be enforceable by the Representative in accordance with its terms, provided that, in the event of a conflict between the terms of the Engagement Agreement and this Agreement, the terms of this Agreement shall prevail.

7.3 Notices. Any and all notices or other communications or deliveries required or permitted to be provided hereunder shall be in writing and shall be deemed given and effective on the earliest of: (a) the date of transmission, if such notice or communication is delivered via facsimile at the facsimile number or e-mail attachment at the email address set forth on the signature pages attached hereto at or prior to 5:30 p.m. (New York City time) on a Trading Day, (b) the next Trading Day after the date of transmission, if such notice or communication is delivered via facsimile at the

facsimile number or e-mail attachment at the e-mail address as set forth on the signature pages attached hereto on a day that is not a Trading Day or later than 5:30 p.m. (New York City time) on any Trading Day, (c) the second (2nd) Trading Day following the date of mailing, if sent by U.S. nationally recognized overnight courier service or (d) upon actual receipt by the party to whom such notice is required to be given. The address for such notices and communications shall be as set forth on the signature pages attached hereto.

7.4 Amendments; Waivers. No provision of this Agreement may be waived, modified, supplemented or amended except in a written instrument signed, in the case of an amendment, by the Company and the Representative. No waiver of any default with respect to any provision, condition or requirement of this Agreement shall be deemed to be a continuing waiver in the future or a waiver of any subsequent default or a waiver of any other provision, condition or requirement hereof, nor shall any delay or omission of any party to exercise any right hereunder in any manner impair the exercise of any such right.

7.5 Headings. The headings herein are for convenience only, do not constitute a part of this Agreement and shall not be deemed to limit or affect any of the provisions hereof.

7.6 Successors and Assigns. This Agreement shall be binding upon and inure to the benefit of the parties and their successors and permitted assigns.

7.7 Governing Law. All questions concerning the construction, validity, enforcement and interpretation of the Transaction Documents shall be governed by and construed and enforced in accordance with the internal laws of the State of New York, without regard to the principles of conflicts of law thereof. Each party agrees that all legal proceedings concerning the interpretations, enforcement and defense of the transactions contemplated by this Agreement and any other Transaction Documents (whether brought against a party hereto or its respective affiliates, directors, officers, shareholders, partners, members, employees or agents) shall be commenced exclusively in the state and federal courts sitting in the City of New York. Each party hereby irrevocably submits to the exclusive jurisdiction of the state and federal courts sitting in the City of New York, Borough of Manhattan for the adjudication of any dispute hereunder or in connection herewith or with any transaction contemplated hereby or discussed herein (including with respect to the enforcement of any of the Transaction Documents), and hereby irrevocably waives, and agrees not to assert in any action, suit or proceeding, any claim that it is not personally subject to the jurisdiction of any such court, that such suit, action or proceeding is improper or is an inconvenient venue for such proceeding. Each party hereby irrevocably waives personal service of process and consents to process being served in any such suit, action or proceeding by mailing a copy thereof via registered or certified mail or overnight delivery (with evidence of delivery) to such party at the address in effect for notices to it under this Agreement and agrees that such service shall constitute good and sufficient service of process and notice thereof. Nothing contained herein shall be deemed to limit in any way any right to serve process in any other manner permitted by law. If either party shall commence an action or proceeding to enforce any provisions of the Transaction Documents, then, in addition to the obligations of the Company under Article VI, the prevailing party in such action, suit or proceeding shall be reimbursed by the other party for its reasonable attorneys' fees and other

costs and expenses incurred with the investigation, preparation and prosecution of such action or proceeding.

7.8 Survival. The representations and warranties contained herein shall survive the Closing and the Option Closing, if any, and the delivery of the Securities.

7.9 Execution. This Agreement may be executed in two or more counterparts, all of which when taken together shall be considered one and the same agreement and shall become effective when counterparts have been signed by each party and delivered to each other party, it being understood that the parties need not sign the same counterpart. In the event that any signature is delivered by facsimile transmission or by e-mail delivery of a “.pdf” format data file, such signature shall create a valid and binding obligation of the party executing (or on whose behalf such signature is executed) with the same force and effect as if such facsimile or “.pdf” signature page were an original thereof.

7.10 Severability. If any term, provision, covenant or restriction of this Agreement is held by a court of competent jurisdiction to be invalid, illegal, void or unenforceable, the remainder of the terms, provisions, covenants and restrictions set forth herein shall remain in full force and effect and shall in no way be affected, impaired or invalidated, and the parties hereto shall use their commercially reasonable efforts to find and employ an alternative means to achieve the same or substantially the same result as that contemplated by such term, provision, covenant or restriction. It is hereby stipulated and declared to be the intention of the parties that they would have executed the remaining terms, provisions, covenants and restrictions without including any of such that may be hereafter declared invalid, illegal, void or unenforceable.

7.11 Remedies. In addition to being entitled to exercise all rights provided herein or granted by law, including recovery of damages, the Underwriters and the Company will be entitled to specific performance under the Transaction Documents. The parties agree that monetary damages may not be adequate compensation for any loss incurred by reason of any breach of obligations contained in the Transaction Documents and hereby agree to waive and not to assert in any action for specific performance of any such obligation the defense that a remedy at law would be adequate.

7.12 Saturdays, Sundays, Holidays, etc. If the last or appointed day for the taking of any action or the expiration of any right required or granted herein shall not be a Business Day, then such action may be taken or such right may be exercised on the next succeeding Business Day.

7.13 Construction. The parties agree that each of them and/or their respective counsel have reviewed and had an opportunity to revise the Transaction Documents and, therefore, the normal rule of construction to the effect that any ambiguities are to be resolved against the drafting party shall not be employed in the interpretation of the Transaction Documents or any amendments thereto. In addition, each and every reference to share prices and shares of Common Stock in any Transaction Document shall be subject to adjustment for reverse and forward stock splits, stock dividends, stock combinations and other similar transactions of the Common Stock that occur after the date of this Agreement.

7.14 **WAIVER OF JURY TRIAL. IN ANY ACTION, SUIT, OR PROCEEDING IN ANY JURISDICTION BROUGHT BY ANY PARTY AGAINST ANY OTHER PARTY ARISING OUT OF OR RELATING TO THIS AGREEMENT OR THE TRANSACTIONS CONTEMPLATED HEREBY, THE PARTIES EACH KNOWINGLY AND INTENTIONALLY, TO THE GREATEST EXTENT PERMITTED BY APPLICABLE LAW, HEREBY ABSOLUTELY, UNCONDITIONALLY, IRREVOCABLY AND EXPRESSLY WAIVE FOREVER ANY RIGHT TO TRIAL BY JURY.**

(Signature Pages Follow)

If the foregoing correctly sets forth the understanding between the Underwriters and the Company, please so indicate in the space provided below for that purpose, whereupon this letter shall constitute a binding agreement among the Company and the several Underwriters in accordance with its terms.

Very truly yours,

YIELD10 BIOSCIENCE, INC.

By: _____

Name: Oliver P. Peoples
Title: President & Chief Executive Officer

Address for Notice:
19 Presidential Way
Woburn, Massachusetts 01801
Attn: Chief Executive Officer

Copy to:
Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C.
One Financial Center
Boston, Massachusetts 02111
Facsimile: (617) 542-2241
Attn: Megan Gates

Accepted on the date first above written.
LADENBURG THALMANN & CO. INC.
As the Representative of the several
Underwriters listed on Schedule I
By: Ladenburg Thalmann & Co. Inc.

By: _____
Name: Nicholas Stergis
Title: Managing Director

Address for Notice:
4400 Biscayne Boulevard, 14th Floor
Miami, Florida 33137
Attn: General Counsel

Copy to:
Ellenoff Grossman & Schole LLP
1345 Avenue of the Americas
New York, New York 10105

Facsimile: (212) 401-4741
Attn: Michael Nertney

SCHEDULE I

SCHEDULE OF UNDERWRITERS

<u>Underwriters</u>	<u>Closing Shares</u>	<u>Closing Preferred Shares</u>	<u>Closing Warrants</u>	<u>Closing Purchase Price</u>
Ladenburg Thalmann & Co. Inc.				
Ladenburg Thalmann & Co. Inc. (Securities sold to Company insiders)				
Total				

YIELD10 BIOSCIENCE, INC.
**CERTIFICATE OF DESIGNATION OF PREFERENCES,
RIGHTS AND LIMITATIONS
OF
SERIES A CONVERTIBLE PREFERRED STOCK**

PURSUANT TO SECTION 151 OF THE
DELAWARE GENERAL CORPORATION LAW

The undersigned, Oliver P. Peoples and Lynne H. Brum, do hereby certify that:

1. They are the President and Secretary, respectively, of Yield10 Bioscience, Inc., a Delaware corporation (the "Corporation").
2. The Corporation is authorized to issue 5,000,000 shares of preferred stock, none of which have been issued.
3. The following resolutions were duly adopted by the board of directors of the Corporation (the "Board of Directors"):

WHEREAS, the certificate of incorporation of the Corporation provides for a class of its authorized stock known as preferred stock, consisting of 5,000,000 shares, \$0.01 par value per share, issuable from time to time in one or more series;

WHEREAS, the Board of Directors is authorized to fix the dividend rights, dividend rate, voting rights, conversion rights, rights and terms of redemption and liquidation preferences of any wholly unissued series of preferred stock and the number of shares constituting any series and the designation thereof, of any of them; and

WHEREAS, it is the desire of the Board of Directors, pursuant to its authority as aforesaid, to fix the rights, preferences, restrictions and other matters relating to a series of the preferred stock, which shall consist of, except as otherwise set forth in the Underwriting Agreement, up to _____ shares of the preferred stock which the Corporation has the authority to issue, as follows:

NOW, THEREFORE, BE IT RESOLVED, that the Board of Directors does hereby provide for the issuance of a series of preferred stock for cash or exchange of other securities, rights or property and does hereby fix and determine the rights, preferences, restrictions and other matters relating to such series of preferred stock as follows:

TERMS OF PREFERRED STOCK

Section 1. Definitions. For the purposes hereof, the following terms shall have the following meanings:

“Affiliate” means any Person that, directly or indirectly through one or more intermediaries, controls or is controlled by or is under common control with a Person, as such terms are used in and construed under Rule 405 of the Securities Act.

“Alternate Consideration” shall have the meaning set forth in Section 7(d).

“Beneficial Ownership Limitation” shall have the meaning set forth in Section 6(d).

“Business Day” means any day except any Saturday, any Sunday, any day which is a federal legal holiday in the United States or any day on which banking institutions in the State of New York are authorized or required by law or other governmental action to close.

“Buy-In” shall have the meaning set forth in Section 6(c)(iv).

“Commission” means the United States Securities and Exchange Commission.

“Common Stock” means the Corporation’s common stock, par value \$0.01 per share, and stock of any other class of securities into which such securities may hereafter be reclassified or changed.

“Common Stock Equivalents” means any securities of the Corporation or the Subsidiaries which would entitle the holder thereof to acquire at any time Common Stock, including, without limitation, any debt, preferred stock, rights, options, warrants or other instrument that is at any time convertible into or exercisable or exchangeable for, or otherwise entitles the holder thereof to receive, Common Stock.

“Conversion Amount” means the sum of the Stated Value at issue.

“Conversion Date” shall have the meaning set forth in Section 6(a).

“Conversion Price” shall have the meaning set forth in Section 6(b).

“Conversion Shares” means, collectively, the shares of Common Stock issuable upon conversion of the shares of Preferred Stock in accordance with the terms hereof.

“Equity Conditions” means, during the period in question, (a) the Corporation shall have duly honored all conversions scheduled to occur or occurring by virtue of one or more Notices of Conversion of the applicable Holder on or prior to the dates so requested or required, if any, (b) the Corporation shall have paid all liquidated damages and other amounts

owing to the applicable Holder in respect of the Preferred Stock, (c)(i) there is an effective registration statement pursuant to which either (A) the Corporation may issue Conversion Shares or (B) the Holders are permitted to utilize the prospectus thereunder to resell all of the shares of Common Stock issuable pursuant to the Transaction Documents (and the Corporation believes, in good faith, that such effectiveness will continue uninterrupted for the foreseeable future) or (ii) all of the Conversion Shares may be issued to the Holder pursuant to Section 3(a)(9) of the Securities Act and immediately resold without restriction, (d) the Common Stock is trading on a Trading Market and all of the shares issuable pursuant to the Transaction Documents are listed or quoted for trading on such Trading Market (and the Corporation believes, in good faith, that trading of the Common Stock on a Trading Market will continue uninterrupted for the foreseeable future), (e) there is a sufficient number of authorized, but unissued and otherwise unreserved, shares of Common Stock for the issuance of all of the shares then issuable pursuant to the Transaction Documents, (f) the issuance of the shares in question to the applicable Holder would not violate the limitations set forth in Section 6(d) herein and (g) the applicable Holder is not in possession of any information provided by the Corporation, any of its Subsidiaries, or any of their officers, directors, employees, agents or Affiliates, that constitutes, or may constitute, material non-public information.

“Exchange Act” means the Securities Exchange Act of 1934, as amended, and the rules and regulations promulgated thereunder.

“Forced Conversion Date” shall have the meaning set forth in Section 6(e).

“Forced Conversion Notice” shall have the meaning set forth in Section 6(e).

“Forced Conversion Notice Date” shall have the meaning set forth in Section 6(e).

“Fundamental Transaction” shall have the meaning set forth in Section 7(d).

“GAAP” means United States generally accepted accounting principles.

“Holder” shall have the meaning given such term in Section 2.

“Liquidation” shall have the meaning set forth in Section 5.

“New York Courts” shall have the meaning set forth in Section 8(d).

“Notice of Conversion” shall have the meaning set forth in Section 6(a).

“Original Issue Date” means the date of the first issuance of any shares of the Preferred Stock regardless of the number of transfers of any particular shares of Preferred Stock and regardless of the number of certificates which may be issued to evidence such Preferred Stock.

“Person” means an individual or corporation, partnership, trust, incorporated or unincorporated association, joint venture, limited liability company, joint stock company, government (or an agency or subdivision thereof) or other entity of any kind.

“Preferred Stock” shall have the meaning set forth in Section 2.

“Representative” means Ladenburg Thalmann & Co. Inc.

“Securities Act” means the Securities Act of 1933, as amended, and the rules and regulations promulgated thereunder.

“Share Delivery Date” shall have the meaning set forth in Section 6(c).

“Stated Value” shall have the meaning set forth in Section 2, as the same may be increased pursuant to Section 3.

“Successor Entity” shall have the meaning set forth in Section 7(d).

“Trading Day” means a day on which the principal Trading Market is open for business.

“Trading Market” means any of the following markets or exchanges on which the Common Stock is listed or quoted for trading on the date in question: the NYSE American, the Nasdaq Capital Market, the Nasdaq Global Market, the Nasdaq Global Select Market, or the New York Stock Exchange (or any successors to any of the foregoing).

“Transfer Agent” means American Stock Transfer & Trust Company, LLC, the current transfer agent of the Corporation with a mailing address of 6201 15th Avenue, Brooklyn, New York 11219, and a facsimile number of (718) 765-8712, and any successor transfer agent of the Corporation.

“Underwriting Agreement” means the underwriting agreement, dated as of _____, 2019, among the Corporation and the Representative, as representative of the underwriters named therein, as amended, modified or supplemented from time to time in accordance with its terms.

“VWAP” means, for any date, the price determined by the first of the following clauses that applies: (a) if the Common Stock is then listed or quoted on a Trading Market, the daily volume weighted average price of the Common Stock for such date (or the nearest preceding date) on the Trading Market on which the Common Stock is then listed or quoted as reported by Bloomberg L.P. (based on a Trading Day from 9:30 a.m. (New York City time) to 4:02 p.m. (New York City time)), (b) if OTCQB or OTCQX is not a Trading Market, the volume weighted average price of the Common Stock for such date (or the nearest preceding date) on OTCQB or OTCQX as applicable, (c) if the Common Stock is not then

listed or quoted for trading on OTCQB or OTCQX and if prices for the Common Stock are then reported in the “Pink Sheets” published by OTC Markets, Inc. (or a similar organization or agency succeeding to its functions of reporting prices), the most recent bid price per share of the Common Stock so reported, or (d) in all other cases, the fair market value of a share of Common Stock as determined by an independent appraiser selected in good faith by the Holders of a majority in interest of the Preferred Stock then outstanding and reasonably acceptable to the Corporation, the fees and expenses of which shall be paid by the Corporation.

Section 2. Designation, Amount and Par Value. The series of preferred stock shall be designated as the Corporation’s Series A Convertible Preferred Stock (the “Preferred Stock”) and the number of shares so designated shall be up to ___ (which shall not be subject to increase without the written consent of all of the holders of the then-outstanding shares of Preferred Stock (each, a “Holder” and collectively, the “Holders”). Each share of Preferred Stock shall have a par value of \$0.01 per share and a stated value equal to \$1,000, subject to increase set forth in Section 3 below (the “Stated Value”). The Preferred Stock will initially be issued in book-entry form and shall initially be represented only by one or more global certificates deposited with the Depository Trust Company (“DTC”) and registered in the name of Cede & Co., a nominee of DTC, or as otherwise directed by DTC. In addition, a beneficial owner of Preferred Stock has the right, upon written notice by such beneficial owner to the Corporation, to request the exchange of some or all of such beneficial owner’s interest in Preferred Stock represented by one or more global Preferred Stock certificates deposited with Cede & Co. (or its successor) for a physical Preferred Stock certificate (a “Preferred Stock Certificate Request Notice” and the date of delivery of such Preferred Stock Certificate Request Notice by a beneficial owner, the “Preferred Stock Certificate Request Notice Date” and the deemed surrender upon delivery by the beneficial owner of a number of global shares of Preferred Stock for the same number of shares of Preferred Stock represented by a physical stock certificate, a “Preferred Stock Exchange”, and such physical certificate(s), a “Preferred Stock Certificate”). Upon delivery of a Preferred Stock Certificate Request Notice, the Corporation shall promptly effect the Preferred Stock Exchange and shall promptly issue and deliver to the beneficial owner a physical Preferred Stock Certificate for such number of shares of Preferred Stock represented by its interest in such global certificates in the name of the beneficial owner. Such Preferred Stock Certificate shall be dated the original issue date and shall be executed by an authorized signatory of the Corporation. In connection with a Preferred Stock Exchange, the Corporation agrees to deliver the Preferred Stock Certificate to the Holder within two (2) Business Days of the delivery of a properly completed and executed Preferred Stock Certificate Request Notice pursuant to the delivery instructions in the Preferred Stock Certificate Request Notice. The Corporation covenants and agrees that, upon the date of delivery of the properly completed and executed Preferred Stock Certificate Request Notice, the Holder shall be deemed to be the holder of the Preferred Stock Certificate and further, for purposes of Regulation SHO, a Holder whose interest in this Preferred Stock is a beneficial interest in certificate(s) representing this Preferred Stock held in book-entry form through DTC shall be deemed to have converted its interest in this Preferred Stock upon instructing its broker that is a DTC participant to convert its interest in this Preferred Stock, and, notwithstanding anything to the contrary set forth herein, the Preferred Stock Certificate shall be deemed for all purposes to represent all of the terms and conditions of the Preferred Stock evidenced by such global Preferred Stock certificates and the terms hereof.

Section 3. Dividends. Except for stock dividends or distributions for which adjustments are to be made pursuant to Section 7, Holders shall be entitled to receive, and the Corporation shall pay, dividends on shares of Preferred Stock equal (on an as-if-converted-to-Common-Stock basis, disregarding for such purpose any conversion limitations hereunder) to and in the same form as dividends actually paid on shares of the Common Stock when, as and if such dividends are paid on shares of the Common Stock. No other dividends shall be paid on shares of Preferred Stock. The Corporation shall not pay any dividends on the Common Stock unless the Corporation simultaneously complies with this provision.

Section 4. Voting Rights. Except as otherwise provided herein or as otherwise required by law, the Preferred Stock shall have no voting rights. However, as long as any shares of Preferred Stock are outstanding, the Corporation shall not, without the affirmative vote of the Holders of a majority of the then outstanding shares of the Preferred Stock, (a) alter or change adversely the powers, preferences or rights given to the Preferred Stock or alter or amend this Certificate of Designation, (b) amend its certificate of incorporation or other charter documents in any manner that adversely affects any rights of the Holders, (c) increase the number of authorized shares of Preferred Stock, or (d) enter into any agreement with respect to any of the foregoing.

Section 5. Liquidation. Upon any liquidation, dissolution or winding-up of the Corporation, whether voluntary or involuntary (a "Liquidation"), the Holders shall be entitled to receive out of the assets, whether capital or surplus, of the Corporation the same amount that a holder of Common Stock would receive if the Preferred Stock were fully converted (disregarding for such purposes any conversion limitations hereunder) to Common Stock which amounts shall be paid pari passu with all holders of Common Stock. The Corporation shall mail written notice of any such Liquidation, not less than 45 days prior to the payment date stated therein, to each Holder.

Section 6. Conversion.

a) Conversions at Option of Holder. Each share of Preferred Stock shall be convertible, at any time and from time to time from and after the Original Issue Date at the option of the Holder thereof, into that number of shares of Common Stock (subject to the limitations set forth in Section 6(d)) determined by dividing the Stated Value of such share of Preferred Stock by the Conversion Price. Holders shall effect conversions by providing the Corporation with the form of conversion notice attached hereto as Annex A (a "Notice of Conversion"). Each Notice of Conversion shall specify the number of shares of Preferred Stock to be converted, the number of shares of Preferred Stock owned prior to the conversion at issue, the number of shares of Preferred Stock owned subsequent to the conversion at issue and the date on which such conversion is to be effected, which date may not be prior to the date the applicable Holder delivers by facsimile or e-mail such Notice of Conversion to the Corporation (such date, the "Conversion Date"). If no Conversion Date is specified in a Notice of Conversion, the Conversion Date shall be the date that such Notice of Conversion to the Corporation is deemed delivered hereunder. No ink-original Notice of Conversion shall be required, nor shall any medallion guarantee (or other type of guarantee or notarization) of any Notice of Conversion form be required. The calculations and entries

set forth in the Notice of Conversion shall control in the absence of manifest or mathematical error. To effect conversions of shares of Preferred Stock, a Holder shall not be required to surrender the certificate(s) representing the shares of Preferred Stock to the Corporation unless all of the shares of Preferred Stock represented thereby are so converted, in which case such Holder shall deliver the certificate representing such shares of Preferred Stock promptly following the Conversion Date at issue. Shares of Preferred Stock converted into Common Stock or redeemed in accordance with the terms hereof shall be canceled and shall not be reissued. Notwithstanding the foregoing in this Section 6(a), a holder whose interest in the Preferred Stock is a beneficial interest in certificate(s) representing the Preferred Stock held in book-entry form through DTC (or another established clearing corporation performing similar functions), shall effect conversions made pursuant to this Section 6(a) by delivering to DTC (or such other clearing corporation, as applicable) the appropriate instruction form for conversion, complying with the procedures to effect conversions that are required by DTC (or such other clearing corporation, as applicable), subject to a Holder's right to elect to receive Preferred Stock in certificated form pursuant to Section 2, in which case this sentence shall not apply, and, provided, however, as between the Corporation and a beneficial owner of Preferred Stock held in book-entry form through DTC (or another established clearing corporation performing similar functions) shall have all of the rights and remedies of a "Holder" hereunder.

b) Conversion Price. The conversion price for the Preferred Stock shall equal \$_____, subject to adjustment as provided for herein (the "Conversion Price").

c) Mechanics of Conversion

i. Delivery of Conversion Shares Upon Conversion. Not later than the earlier of (i) two (2) Trading Days and (ii) the number of Trading Days comprising the Standard Settlement Period (as defined below) after each Conversion Date (the "Share Delivery Date"), the Corporation shall deliver, or cause to be delivered, to the converting Holder (A) the number of Conversion Shares being acquired upon the conversion of the Preferred Stock, which Conversion Shares shall be free of restrictive legends and trading restrictions, and (B) a bank check in the amount of accrued and unpaid dividends, if any. The Corporation shall use its best efforts to deliver the Conversion Shares required to be delivered by the Corporation under this Section 6 electronically through the Depository Trust Company or another established clearing corporation performing similar functions. As used herein, "Standard Settlement Period" means the standard settlement period, expressed in a number of Trading Days, on the Corporation's primary Trading Market with respect to the Common Stock as in effect on the date of delivery of the Notice of Conversion. Notwithstanding the foregoing, with respect to any Notice(s) of Conversion delivered by 12:00 p.m. (New York City time) on the Original Issue Date, the Corporation agrees to deliver the Conversion Shares subject to such notice(s) by 4:00 p.m. (New York City time) on the Original Issue Date.

ii. Failure to Deliver Conversion Shares. If, in the case of any Notice of Conversion, such Conversion Shares are not delivered to or as directed by the applicable Holder by the Share Delivery Date, the Holder shall be entitled to elect by written notice to the Corporation at any time on or before its receipt of such Conversion Shares, to rescind such Conversion, in which event the Corporation shall promptly return to the Holder any original Preferred Stock certificate delivered to the Corporation and the Holder shall promptly return to the Corporation the Conversion Shares issued to such Holder pursuant to the rescinded Notice of Conversion.

iii. Obligation Absolute; Partial Liquidated Damages. The Corporation's obligation to issue and deliver the Conversion Shares upon conversion of Preferred Stock in accordance with the terms hereof are absolute and unconditional, irrespective of any action or inaction by a Holder to enforce the same, any waiver or consent with respect to any provision hereof, the recovery of any judgment against any Person or any action to enforce the same, or any setoff, counterclaim, recoupment, limitation or termination, or any breach or alleged breach by such Holder or any other Person of any obligation to the Corporation or any violation or alleged violation of law by such Holder or any other person, and irrespective of any other circumstance which might otherwise limit such obligation of the Corporation to such Holder in connection with the issuance of such Conversion Shares; provided, however, that such delivery shall not operate as a waiver by the Corporation of any such action that the Corporation may have against such Holder. In the event a Holder shall elect to convert any or all of the Stated Value of its Preferred Stock, the Corporation may not refuse conversion based on any claim that such Holder or any one associated or affiliated with such Holder has been engaged in any violation of law, agreement or for any other reason, unless an injunction from a court, on notice to Holder, restraining and/or enjoining conversion of all or part of the Preferred Stock of such Holder shall have been sought and obtained, and the Corporation posts a surety bond for the benefit of such Holder in the amount of 110% of the Stated Value of Preferred Stock which is subject to the injunction, which bond shall remain in effect until the completion of arbitration/litigation of the underlying dispute and the proceeds of which shall be payable to such Holder to the extent it obtains judgment. In the absence of such injunction, the Corporation shall issue Conversion Shares and, if applicable, cash, upon a properly noticed conversion. If the Corporation fails to deliver to a Holder such Conversion Shares pursuant to Section 6(c)(i) by the Share Delivery Date applicable to such conversion, the Corporation shall pay to such Holder, in cash, as liquidated damages and not as a penalty, for each \$5,000 of Stated Value of Preferred Stock being converted, \$25 per Trading Day (increasing to \$50 per Trading Day on the third Trading Day and increasing to \$100 per Trading Day on the sixth Trading Day after such damages begin to accrue) for each Trading Day after the Share Delivery Date until such Conversion Shares are delivered or Holder rescinds such conversion. Nothing herein shall limit a Holder's right to pursue actual damages for the Corporation's failure to deliver Conversion Shares within the period specified herein and such Holder shall

have the right to pursue all remedies available to it hereunder, at law or in equity including, without limitation, a decree of specific performance and/or injunctive relief. The exercise of any such rights shall not prohibit a Holder from seeking to enforce damages pursuant to any other Section hereof or under applicable law.

iv. Compensation for Buy-In on Failure to Timely Deliver Conversion Shares Upon Conversion. In addition to any other rights available to the Holder, if the Corporation fails for any reason to deliver to a Holder the applicable Conversion Shares by the Share Delivery Date pursuant to Section 6(c)(i), and if after such Share Delivery Date such Holder is required by its brokerage firm to purchase (in an open market transaction or otherwise), or the Holder's brokerage firm otherwise purchases, shares of Common Stock to deliver in satisfaction of a sale by such Holder of the Conversion Shares which such Holder was entitled to receive upon the conversion relating to such Share Delivery Date (a "Buy-In"), then the Corporation shall (A) pay in cash to such Holder (in addition to any other remedies available to or elected by such Holder) the amount, if any, by which (x) such Holder's total purchase price (including any brokerage commissions) for the Common Stock so purchased exceeds (y) the product of (1) the aggregate number of shares of Common Stock that such Holder was entitled to receive from the conversion at issue multiplied by (2) the actual sale price at which the sell order giving rise to such purchase obligation was executed (including any brokerage commissions) and (B) at the option of such Holder, either reissue (if surrendered) the shares of Preferred Stock equal to the number of shares of Preferred Stock submitted for conversion (in which case, such conversion shall be deemed rescinded) or deliver to such Holder the number of shares of Common Stock that would have been issued if the Corporation had timely complied with its delivery requirements under Section 6(c)(i). For example, if a Holder purchases shares of Common Stock having a total purchase price of \$11,000 to cover a Buy-In with respect to an attempted conversion of shares of Preferred Stock with respect to which the actual sale price of the Conversion Shares (including any brokerage commissions) giving rise to such purchase obligation was a total of \$10,000 under clause (A) of the immediately preceding sentence, the Corporation shall be required to pay such Holder \$1,000. The Holder shall provide the Corporation written notice indicating the amounts payable to such Holder in respect of the Buy-In and, upon request of the Corporation, evidence of the amount of such loss. Nothing herein shall limit a Holder's right to pursue any other remedies available to it hereunder, at law or in equity including, without limitation, a decree of specific performance and/or injunctive relief with respect to the Corporation's failure to timely deliver the Conversion Shares upon conversion of the shares of Preferred Stock as required pursuant to the terms hereof.

v. Reservation of Shares Issuable Upon Conversion. The Corporation covenants that it will at all times reserve and keep available out of its authorized and unissued shares of Common Stock for the sole purpose of issuance upon conversion of the Preferred Stock as herein provided, free from preemptive rights or any other actual contingent purchase rights of Persons other than the Holder (and the other

holders of the Preferred Stock), not less than such aggregate number of shares of the Common Stock as shall be issuable (taking into account the adjustments and restrictions of Section 7) upon the conversion of the then outstanding shares of Preferred Stock. The Corporation covenants that all shares of Common Stock that shall be so issuable shall, upon issue, be duly authorized, validly issued, fully paid and nonassessable.

vi. Fractional Shares. No fractional shares or scrip representing fractional shares shall be issued upon the conversion of the Preferred Stock. As to any fraction of a share which the Holder would otherwise be entitled to purchase upon such conversion, the Corporation shall round up to the next whole share.

vii. Transfer Taxes and Expenses. The issuance of Conversion Shares on conversion of this Preferred Stock shall be made without charge to any Holder for any documentary stamp or similar taxes that may be payable in respect of the issue or delivery of such Conversion Shares, provided that the Corporation shall not be required to pay any tax that may be payable in respect of any transfer involved in the issuance and delivery of any such Conversion Shares upon conversion in a name other than that of the Holders of such shares of Preferred Stock and the Corporation shall not be required to issue or deliver such Conversion Shares unless or until the Person or Persons requesting the issuance thereof shall have paid to the Corporation the amount of such tax or shall have established to the satisfaction of the Corporation that such tax has been paid. The Corporation shall pay all Transfer Agent fees required for same-day processing of any Notice of Conversion and all fees to the Depository Trust Company (or another established clearing corporation performing similar functions) required for same-day electronic delivery of the Conversion Shares.

d) Beneficial Ownership Limitation. The Corporation shall not effect any conversion of the Preferred Stock, and a Holder shall not have the right to convert any portion of the Preferred Stock, to the extent that, after giving effect to the conversion set forth on the applicable Notice of Conversion, such Holder (together with such Holder's Affiliates, and any Persons acting as a group together with such Holder or any of such Holder's Affiliates (such Persons, "Attribution Parties")) would beneficially own in excess of the Beneficial Ownership Limitation (as defined below). For purposes of the foregoing sentence, the number of shares of Common Stock beneficially owned by such Holder and its Affiliates and Attribution Parties shall include the number of shares of Common Stock issuable upon conversion of the Preferred Stock with respect to which such determination is being made, but shall exclude the number of shares of Common Stock which are issuable upon (i) conversion of the remaining, unconverted Stated Value of Preferred Stock beneficially owned by such Holder or any of its Affiliates or Attribution Parties and (ii) exercise or conversion of the unexercised or unconverted portion of any other securities of the Corporation subject to a limitation on conversion or exercise analogous to the limitation contained herein (including, without limitation, the Preferred Stock) beneficially owned by such Holder or any of its Affiliates or Attribution Parties. Except as set forth in the preceding

sentence, for purposes of this Section 6(d), beneficial ownership shall be calculated in accordance with Section 13(d) of the Exchange Act and the rules and regulations promulgated thereunder. Subject to a Holder's right to rely on the number of outstanding shares of Common Stock as set forth below, the Corporation makes no representation to the Holder that its calculations are in compliance with Section 13(d) of the Exchange Act and that the Holder is solely responsible for any schedules required to be filed in accordance therewith. To the extent that the limitation contained in this Section 6(d) applies, the determination of whether the Preferred Stock is convertible (in relation to other securities owned by such Holder together with any Affiliates and Attribution Parties) and of how many shares of Preferred Stock are convertible shall be in the sole discretion of such Holder, and the submission of a Notice of Conversion shall be deemed to be such Holder's determination of whether the shares of Preferred Stock may be converted (in relation to other securities owned by such Holder together with any Affiliates and Attribution Parties) and how many shares of the Preferred Stock are convertible, in each case subject to the Beneficial Ownership Limitation. To ensure compliance with this restriction, each Holder will be deemed to represent to the Corporation each time it delivers a Notice of Conversion that such Notice of Conversion has not violated the restrictions set forth in this paragraph and the Corporation shall have no obligation to verify or confirm the accuracy of such determination. In addition, a determination as to any group status as contemplated above shall be determined in accordance with Section 13(d) of the Exchange Act and the rules and regulations promulgated thereunder. For purposes of this Section 6(d), in determining the number of outstanding shares of Common Stock, a Holder may rely on the number of outstanding shares of Common Stock as stated in the most recent of the following: (i) the Corporation's most recent periodic or annual report filed with the Commission, as the case may be, (ii) a more recent public announcement by the Corporation or (iii) a more recent written notice by the Corporation or the Transfer Agent setting forth the number of shares of Common Stock outstanding. Upon the written or oral request (which may be via email) of a Holder, the Corporation shall within one Trading Day confirm orally and in writing to such Holder the number of shares of Common Stock then outstanding. In any case, the number of outstanding shares of Common Stock shall be determined after giving effect to the conversion or exercise of securities of the Corporation, including the Preferred Stock, by such Holder or its Affiliates or Attribution Parties since the date as of which such number of outstanding shares of Common Stock was reported. The "Beneficial Ownership Limitation" shall be 4.99% (or, upon election by a Holder prior to the issuance of any shares of Preferred Stock, 9.99%) of the number of shares of the Common Stock outstanding immediately after giving effect to the issuance of shares of Common Stock issuable upon conversion of Preferred Stock held by the applicable Holder. A Holder, upon notice to the Corporation, may increase or decrease the Beneficial Ownership Limitation provisions of this Section 6(d) applicable to its Preferred Stock provided that the Beneficial Ownership Limitation in no event exceeds 9.99% of the number of shares of the Common Stock outstanding immediately after giving effect to the issuance of shares of Common Stock upon conversion of this Preferred Stock held by the Holder and the provisions of this Section 6(d) shall continue to apply. Any such increase in the Beneficial Ownership Limitation will not be effective until the 61st day after such notice is delivered to the Corporation and shall only apply to such Holder and no other Holder. The provisions of this paragraph shall be construed and implemented in a manner

otherwise than in strict conformity with the terms of this Section 6(d) to correct this paragraph (or any portion hereof) which may be defective or inconsistent with the intended Beneficial Ownership Limitation contained herein or to make changes or supplements necessary or desirable to properly give effect to such limitation. The limitations contained in this paragraph shall apply to a successor holder of Preferred Stock.

e) Forced Conversion. Notwithstanding anything herein to the contrary, if after the Original Issue Date, the VWAP during any 30 consecutive Trading Day period, which thirty (30) consecutive Trading Day period shall have commenced only after the Original Issue Date (the “Threshold Period”), exceeds \$_____¹ (subject to adjustment for forward and reverse stock splits, recapitalizations, stock dividends and the like after the Original Issue Date) and (ii) the daily dollar trading volume for such Threshold Period exceeds \$175,000 per Trading Day, the Corporation may, within one (1) Trading Day after the end of any such Threshold Period, deliver a written notice to all Holders (a “Forced Conversion Notice” and the date such notice is delivered to all Holders, the “Forced Conversion Notice Date”) to cause each Holder to convert all or part of such Holder’s Preferred Stock (as specified in such Forced Conversion Notice) pursuant to Section 6, it being agreed that the “Conversion Date” for purposes of Section 6 shall be deemed to occur on the third Trading Day following the Forced Conversion Notice Date (such third Trading Day, the “Forced Conversion Date”). The Corporation may not deliver a Forced Conversion Notice, and any Forced Conversion Notice delivered by the Corporation shall not be effective, unless all of the Equity Conditions have been met on each Trading Day during the applicable Threshold Period through and including the later of the Forced Conversion Date and the Trading Day after the date that the Conversion Shares issuable pursuant to such conversion are actually delivered to the Holders pursuant to the Forced Conversion Notice. Any Forced Conversion Notices shall be applied ratably to all of the Holders based on the then outstanding shares of Preferred Stock. For purposes of clarification, a Forced Conversion shall be subject to all of the provisions of Section 6, including, without limitation, the provisions requiring payment of liquidated damages and limitations on conversions.

Section 7. Certain Adjustments.

a) Stock Dividends and Stock Splits. If the Corporation, at any time while this Preferred Stock is outstanding: (i) pays a stock dividend or otherwise makes a distribution or distributions payable in shares of Common Stock on shares of Common Stock or any other Common Stock Equivalents (which, for avoidance of doubt, shall not include any shares of Common Stock issued by the Corporation upon conversion of, or payment of a dividend on, this Preferred Stock), (ii) subdivides outstanding shares of Common Stock into a larger number of shares, (iii) combines (including by way of a reverse stock split) outstanding shares of Common Stock into a smaller number of shares, or (iv) issues, in the event of a reclassification of shares of the Common Stock, any shares of capital stock of the Corporation, then the Conversion Price shall be multiplied by a fraction of which the

¹ 300% of Conversion Price

numerator shall be the number of shares of Common Stock (excluding any treasury shares of the Corporation) outstanding immediately before such event, and of which the denominator shall be the number of shares of Common Stock outstanding immediately after such event. Any adjustment made pursuant to this Section 7(a) shall become effective immediately after the record date for the determination of stockholders entitled to receive such dividend or distribution and shall become effective immediately after the effective date in the case of a subdivision, combination or re-classification.

b) Subsequent Rights Offerings. In addition to any adjustments pursuant to Section 7(a) above, if at any time the Corporation grants, issues or sells any Common Stock Equivalents or rights to purchase stock, warrants, securities or other property pro rata to the record holders of any class of shares of Common Stock (the "Purchase Rights"), then the Holder will be entitled to acquire, upon the terms applicable to such Purchase Rights, the aggregate Purchase Rights which the Holder could have acquired if the Holder had held the number of shares of Common Stock acquirable upon complete conversion of such Holder's Preferred Stock (without regard to any limitations on exercise hereof, including without limitation, the Beneficial Ownership Limitation) immediately before the date on which a record is taken for the grant, issuance or sale of such Purchase Rights, or, if no such record is taken, the date as of which the record holders of shares of Common Stock are to be determined for the grant, issue or sale of such Purchase Rights (provided, however, to the extent that the Holder's right to participate in any such Purchase Right would result in the Holder exceeding the Beneficial Ownership Limitation, then the Holder shall not be entitled to participate in such Purchase Right to such extent (or beneficial ownership of such shares of Common Stock as a result of such Purchase Right to such extent) and such Purchase Right to such extent shall be held in abeyance for the Holder until such time, if ever, as its right thereto would not result in the Holder exceeding the Beneficial Ownership Limitation).

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c) Pro Rata Distributions. During such time as this Preferred Stock is outstanding, if the Corporation declares or makes any dividend or other distribution of its assets (or rights to acquire its assets) to holders of shares of Common Stock, by way of return of capital or otherwise (including, without limitation, any distribution of cash, stock or other securities, property or options by way of a dividend, spin off, reclassification, corporate rearrangement, scheme of arrangement or other similar transaction) (a "Distribution"), at any time after the issuance of this Preferred Stock, then, in each such case, the Holder shall be entitled to participate in such Distribution to the same extent that the Holder would have participated therein if the Holder had held the number of shares of Common Stock acquirable upon complete conversion of this Preferred Stock (without regard to any limitations on conversion hereof, including without limitation, the Beneficial Ownership Limitation) immediately before the date of which a record is taken for such Distribution, or, if no such record is taken, the date as of which the record holders of shares of Common Stock are to be determined for the participation in such Distribution (provided, however, to the extent that the Holder's right to participate in any such Distribution would result in the Holder exceeding the Beneficial Ownership Limitation, then the Holder shall not be entitled to participate in such Distribution to such extent (or in the beneficial ownership of any shares of Common Stock as a result of such Distribution to such extent) and the

portion of such Distribution shall be held in abeyance for the benefit of the Holder until such time, if ever, as its right thereto would not result in the Holder exceeding the Beneficial Ownership Limitation).

d) Fundamental Transaction. If, at any time while this Preferred Stock is outstanding, (i) the Corporation, directly or indirectly, in one or more related transactions effects any merger or consolidation of the Corporation with or into another Person, (ii) the Corporation, directly or indirectly, effects any sale, lease, license, assignment, transfer, conveyance or other disposition of all or substantially all of its assets in one or a series of related transactions, (iii) any, direct or indirect, purchase offer, tender offer or exchange offer (whether by the Corporation or another Person) is completed pursuant to which holders of Common Stock are permitted to sell, tender or exchange their shares for other securities, cash or property and has been accepted by the holders of 50% or more of the outstanding Common Stock, (iv) the Corporation, directly or indirectly, in one or more related transactions effects any reclassification, reorganization or recapitalization of the Common Stock or any compulsory share exchange pursuant to which the Common Stock is effectively converted into or exchanged for other securities, cash or property, or (v) the Corporation, directly or indirectly, in one or more related transactions consummates a stock or share purchase agreement or other business combination (including, without limitation, a reorganization, recapitalization, spin-off or scheme of arrangement) with another Person whereby such other Person acquires more than 50% of the outstanding shares of Common Stock (not including any shares of Common Stock held by the other Person or other Persons making or party to, or associated or affiliated with the other Persons making or party to, such stock or share purchase agreement or other business combination) (each a "Fundamental Transaction"), then, upon any subsequent conversion of this Preferred Stock, the Holder shall have the right to receive, for each Conversion Share that would have been issuable upon such conversion immediately prior to the occurrence of such Fundamental Transaction (without regard to any limitation in Section 6(d) on the conversion of this Preferred Stock), the number of shares of Common Stock of the successor or acquiring corporation or of the Corporation, if it is the surviving corporation, and any additional consideration (the "Alternate Consideration") receivable as a result of such Fundamental Transaction by a holder of the number of shares of Common Stock for which this Preferred Stock is convertible immediately prior to such Fundamental Transaction (without regard to any limitation in Section 6(d) on the conversion of this Preferred Stock). For purposes of any such conversion, the determination of the Conversion Price shall be appropriately adjusted to apply to such Alternate Consideration based on the amount of Alternate Consideration issuable in respect of one share of Common Stock in such Fundamental Transaction, and the Corporation shall apportion the Conversion Price among the Alternate Consideration in a reasonable manner reflecting the relative value of any different components of the Alternate Consideration. If holders of Common Stock are given any choice as to the securities, cash or property to be received in a Fundamental Transaction, then the Holder shall be given the same choice as to the Alternate Consideration it receives upon any conversion of this Preferred Stock following such Fundamental Transaction. To the extent necessary to effectuate the foregoing provisions, any successor to the Corporation or surviving entity in such Fundamental Transaction shall file a new Certificate of Designation with the same terms and conditions

and issue to the Holders new preferred stock consistent with the foregoing provisions and evidencing the Holders' right to convert such preferred stock into Alternate Consideration. The Corporation shall cause any successor entity in a Fundamental Transaction in which the Corporation is not the survivor (the "Successor Entity") to assume in writing all of the obligations of the Corporation under this Certificate of Designation in accordance with the provisions of this Section 7(d) pursuant to written agreements in form and substance reasonably satisfactory to the Holder and approved by the Holder (without unreasonable delay) prior to such Fundamental Transaction and shall, at the option of the Holder, deliver to the Holder in exchange for this Preferred Stock a security of the Successor Entity evidenced by a written instrument substantially similar in form and substance to this Preferred Stock which is convertible for a corresponding number of shares of capital stock of such Successor Entity (or its parent entity) equivalent to the shares of Common Stock acquirable and receivable upon conversion of this Preferred Stock (without regard to any limitations on the conversion of this Preferred Stock) prior to such Fundamental Transaction, and with a conversion price which applies the conversion price hereunder to such shares of capital stock (but taking into account the relative value of the shares of Common Stock pursuant to such Fundamental Transaction and the value of such shares of capital stock, such number of shares of capital stock and such conversion price being for the purpose of protecting the economic value of this Preferred Stock immediately prior to the consummation of such Fundamental Transaction), and which is reasonably satisfactory in form and substance to the Holder. Upon the occurrence of any such Fundamental Transaction, the Successor Entity shall succeed to, and be substituted for (so that from and after the date of such Fundamental Transaction, the provisions of this Certificate of Designation referring to the "Corporation" shall refer instead to the Successor Entity), and may exercise every right and power of the Corporation and shall assume all of the obligations of the Corporation under this Certificate of Designation with the same effect as if such Successor Entity had been named as the Corporation herein.

e) Calculations. All calculations under this Section 7 shall be made to the nearest cent or the nearest 1/100th of a share, as the case may be. For purposes of this Section 7, the number of shares of Common Stock deemed to be issued and outstanding as of a given date shall be the sum of the number of shares of Common Stock (excluding any treasury shares of the Corporation) issued and outstanding.

f) Notice to the Holders.

i. Adjustment to Conversion Price. Whenever the Conversion Price is adjusted pursuant to any provision of this Section 7, the Corporation shall promptly deliver to each Holder by facsimile or email a notice setting forth the Conversion Price after such adjustment and setting forth a brief statement of the facts requiring such adjustment.

ii. Notice to Allow Conversion by Holder. If (A) the Corporation shall declare a dividend (or any other distribution in whatever form) on the Common Stock, (B) the Corporation shall declare a special nonrecurring cash dividend on or

a redemption of the Common Stock, (C) the Corporation shall authorize the granting to all holders of the Common Stock of rights or warrants to subscribe for or purchase any shares of capital stock of any class or of any rights, (D) the approval of any stockholders of the Corporation shall be required in connection with any reclassification of the Common Stock, any consolidation or merger to which the Corporation is a party, any sale or transfer of all or substantially all of the assets of the Corporation, or any compulsory share exchange whereby the Common Stock is converted into other securities, cash or property or (E) the Corporation shall authorize the voluntary or involuntary dissolution, liquidation or winding up of the affairs of the Corporation, then, in each case, the Corporation shall cause to be filed at each office or agency maintained for the purpose of conversion of this Preferred Stock, and shall cause to be delivered by facsimile or email to each Holder at its last facsimile number or email address as it shall appear upon the stock books of the Corporation, at least twenty (20) calendar days prior to the applicable record or effective date hereinafter specified, a notice stating (x) the date on which a record is to be taken for the purpose of such dividend, distribution, redemption, rights or warrants, or if a record is not to be taken, the date as of which the holders of the Common Stock of record to be entitled to such dividend, distributions, redemption, rights or warrants are to be determined or (y) the date on which such reclassification, consolidation, merger, sale, transfer or share exchange is expected to become effective or close, and the date as of which it is expected that holders of the Common Stock of record shall be entitled to exchange their shares of the Common Stock for securities, cash or other property deliverable upon such reclassification, consolidation, merger, sale, transfer or share exchange, provided that the failure to deliver such notice or any defect therein or in the delivery thereof shall not affect the validity of the corporate action required to be specified in such notice. To the extent that any notice provided hereunder constitutes, or contains, material, non-public information regarding the Corporation or any of the Subsidiaries, the Corporation shall simultaneously file such notice with the Commission pursuant to a Current Report on Form 8-K. The Holder shall remain entitled to convert the Conversion Amount of this Preferred Stock (or any part hereof) during the 20-day period commencing on the date of such notice through the effective date of the event triggering such notice except as may otherwise be expressly set forth herein.

Section 8. Miscellaneous.

a) Notices. Any and all notices or other communications or deliveries to be provided by the Holders hereunder including, without limitation, any Notice of Conversion, shall be in writing and delivered personally, by facsimile or e-mail, or sent by a nationally recognized overnight courier service, addressed to the Corporation, at 19 Presidential Way, Woburn, Massachusetts 01801, Attention: Chief Executive Officer, facsimile number [_____], e-mail address peoples@yield10bio.com, or such other facsimile number, e-mail address or address as the Corporation may specify for such purposes by notice to the Holders delivered in accordance with this Section 8. Any and all notices or other communications or deliveries to be provided by the Corporation hereunder shall be

in writing and delivered personally, by facsimile, or by e-mail, or sent by a nationally recognized overnight courier service addressed to each Holder at the facsimile number, e-mail address or address of such Holder appearing on the books of the Corporation. Any notice or other communication or deliveries hereunder shall be deemed given and effective on the earliest of (i) the time of transmission, if such notice or communication is delivered via facsimile at the facsimile number or e-mail at the e-mail address set forth in this Section 8 prior to 5:30 p.m. (New York City time) on any date, (ii) the next Trading Day after the time of transmission, if such notice or communication is delivered via facsimile at the facsimile number or e-mail at the e-mail address set forth in this Section on a day that is not a Trading Day or later than 5:30 p.m. (New York City time) on any Trading Day, (iii) the second Trading Day following the date of mailing, if sent by U.S. nationally recognized overnight courier service, or (iv) upon actual receipt by the party to whom such notice is required to be given.

b) Absolute Obligation. Except as expressly provided herein, no provision of this Certificate of Designation shall alter or impair the obligation of the Corporation, which is absolute and unconditional, to pay liquidated damages, and accrued dividends, as applicable, on the shares of Preferred Stock at the time, place, and rate, and in the coin or currency, herein prescribed.

c) Lost or Mutilated Preferred Stock Certificate. If a Holder's Preferred Stock certificate shall be mutilated, lost, stolen or destroyed, the Corporation shall execute and deliver, in exchange and substitution for and upon cancellation of a mutilated certificate, or in lieu of or in substitution for a lost, stolen or destroyed certificate, a new certificate for the shares of Preferred Stock so mutilated, lost, stolen or destroyed, but only upon receipt of evidence of such loss, theft or destruction of such certificate, and of the ownership thereof reasonably satisfactory to the Corporation.

d) Governing Law. All questions concerning the construction, validity, enforcement and interpretation of this Certificate of Designation shall be governed by and construed and enforced in accordance with the internal laws of the State of Delaware, without regard to the principles of conflict of laws thereof. All legal proceedings concerning the interpretation, enforcement and defense of the transactions contemplated by this Certificate of Designation (whether brought against a party hereto or its respective Affiliates, directors, officers, shareholders, employees or agents) shall be commenced in the state and federal courts sitting in the City of New York, Borough of Manhattan (the "New York Courts"). The Corporation and each Holder hereby irrevocably submit to the exclusive jurisdiction of the New York Courts for the adjudication of any dispute hereunder or in connection herewith or with any transaction contemplated hereby or discussed herein, and hereby irrevocably waive, and agree not to assert in any suit, action or proceeding, any claim that they are not personally subject to the jurisdiction of such New York Courts, or such New York Courts are improper or inconvenient venue for such proceeding. The Corporation and each Holder hereby irrevocably waive personal service of process and consent to process being served in any such suit, action or proceeding by mailing a copy thereof via registered or certified mail or overnight delivery (with evidence of delivery) to such party at the address

in effect for notices to it under this Certificate of Designation and agree that such service shall constitute good and sufficient service of process and notice thereof. Nothing contained herein shall be deemed to limit in any way any right to serve process in any other manner permitted by applicable law. The Corporation and each Holder hereto hereby irrevocably waive, to the fullest extent permitted by applicable law, any and all right to trial by jury in any legal proceeding arising out of or relating to this Certificate of Designation or the transactions contemplated hereby. If the Corporation or any Holder shall commence an action or proceeding to enforce any provisions of this Certificate of Designation, then the prevailing party in such action or proceeding shall be reimbursed by the other party for its attorneys' fees and other costs and expenses incurred in the investigation, preparation and prosecution of such action or proceeding.

e) Waiver. Any waiver by the Corporation or a Holder of a breach of any provision of this Certificate of Designation shall not operate as or be construed to be a waiver of any other breach of such provision or of any breach of any other provision of this Certificate of Designation or a waiver by any other Holders. The failure of the Corporation or a Holder to insist upon strict adherence to any term of this Certificate of Designation on one or more occasions shall not be considered a waiver or deprive that party (or any other Holder) of the right thereafter to insist upon strict adherence to that term or any other term of this Certificate of Designation on any other occasion. Any waiver by the Corporation or a Holder must be in writing.

f) Severability. If any provision of this Certificate of Designation is invalid, illegal or unenforceable, the balance of this Certificate of Designation shall remain in effect, and if any provision is inapplicable to any Person or circumstance, it shall nevertheless remain applicable to all other Persons and circumstances. If it shall be found that any interest or other amount deemed interest due hereunder violates the applicable law governing usury, the applicable rate of interest due hereunder shall automatically be lowered to equal the maximum rate of interest permitted under applicable law.

g) Next Business Day. Whenever any payment or other obligation hereunder shall be due on a day other than a Business Day, such payment shall be made on the next succeeding Business Day.

h) Headings. The headings contained herein are for convenience only, do not constitute a part of this Certificate of Designation and shall not be deemed to limit or affect any of the provisions hereof.

i) Status of Converted or Redeemed Preferred Stock. If any shares of Preferred Stock shall be converted, redeemed or reacquired by the Corporation, such shares shall resume the status of authorized but unissued shares of preferred stock and shall no longer be designated as Series A Convertible Preferred Stock.

RESOLVED, FURTHER, that the Chairman, the president or any vice-president, and the secretary or any assistant secretary, of the Corporation be and they hereby are authorized and directed to prepare and file this Certificate of Designation of Preferences, Rights and Limitations in accordance with the foregoing resolution and the provisions of Delaware law.

IN WITNESS WHEREOF, the undersigned have executed this Certificate this ____ day of _____ 2019.

Name:
Title:

Name:
Title:

ANNEX A

NOTICE OF CONVERSION

(TO BE EXECUTED BY THE REGISTERED HOLDER IN ORDER TO CONVERT SHARES OF PREFERRED STOCK)

The undersigned hereby elects to convert the number of shares of Series A Convertible Preferred Stock indicated below into shares of common stock, par value \$0.01 per share (the "Common Stock"), of Yield10 Bioscience, Inc., a Delaware corporation (the "Corporation"), according to the conditions hereof, as of the date written below. If shares of Common Stock are to be issued in the name of a Person other than the undersigned, the undersigned will pay all transfer taxes payable with respect thereto. No fee will be charged to the Holders for any conversion, except for any such transfer taxes.

Conversion calculations:

Date to Effect Conversion: _____

Number of shares of Preferred Stock owned prior to Conversion: _____

Number of shares of Preferred Stock to be Converted: _____

Stated Value of shares of Preferred Stock to be Converted: _____

Number of shares of Common Stock to be Issued: _____

Applicable Conversion Price: _____

Number of shares of Preferred Stock subsequent to Conversion: _____

Address for Delivery: _____

or

DWAC Instructions:

Broker no: _____

Account no: _____

[HOLDER

By: _____

Name:

Title:

[Form of Preferred Stock Certificate]

UNLESS THIS CERTIFICATE IS PRESENTED BY AN AUTHORIZED REPRESENTATIVE OF THE DEPOSITORY TRUST COMPANY, A NEW YORK CORPORATION (“DTC”), TO THE CORPORATION OR THE TRANSFER AGENT, AND ANY CERTIFICATE ISSUED IS REGISTERED IN THE NAME OF THE HOLDER OR IN SUCH OTHER NAME AS IS REQUESTED BY AN AUTHORIZED REPRESENTATIVE OF DTC (AND ANY PAYMENT IS MADE TO THE HOLDER, OR TO SUCH OTHER ENTITY AS IS REQUESTED BY AN AUTHORIZED REPRESENTATIVE OF DTC), ANY TRANSFER, PLEDGE OR OTHER USE HEREOF FOR VALUE OR OTHERWISE BY OR TO ANY PERSON IS WRONGFUL INASMUCH AS THE REGISTERED OWNER HEREOF HAS AN INTEREST HEREIN. TRANSFERS OF THIS GLOBAL SECURITY SHALL BE LIMITED TO TRANSFERS IN WHOLE, BUT NOT IN PART, TO NOMINEES OF DTC OR TO A SUCCESSOR THEREOF OR SUCH SUCCESSOR’S NOMINEE.

THE CORPORATION IS AUTHORIZED TO ISSUE MORE THAN ONE CLASS OF STOCK AND MORE THAN ONE SERIES OF ITS CLASS OF PREFERRED STOCK. THE CORPORATION WILL FURNISH WITHOUT CHARGE TO EACH STOCKHOLDER WHO SO REQUESTS THE POWERS, DESIGNATIONS, PREFERENCES AND RELATIVE PARTICIPATING, OPTIONAL OR OTHER SPECIAL RIGHTS OF EACH CLASS OF STOCK OR SERIES THEREOF AND THE QUALIFICATIONS, LIMITATIONS OR RESTRICTIONS OF SUCH PREFERENCES AND/OR RIGHTS.

Incorporated under the laws of the State of Delaware, September 1998

Certificate Number: []

Initial Number of Shares of Series A Convertible Preferred Stock: []

CUSIP []
ISIN []

YIELD10 BIOSCIENCE, INC.

Yield10 Bioscience, Inc. (the “**Corporation**”) hereby certifies that [] (the “**Holder**”) is the registered owner of [] fully paid and non-assessable shares of the Corporation’s designated Series A Convertible Preferred Stock, par value \$0.01 per share (the “**Series A Preferred Stock**”), transferable on the books and records of the Transfer Agent, in person or by a duly authorized attorney, upon surrender of this certificate duly endorsed or assigned and in proper form for transfer.

This Certificate and the shares represented hereby are issued and shall be held subject to all the provisions of the Amended and Restated Certificate of Incorporation and the Amended and Restated Bylaws of the Corporation and any amendments thereto, including the provisions of the Certificate of Designation of Preferences, Rights and Limitations, dated [], as the same may be amended from time to time (the “**Certificate of Designations**”). Capitalized terms used herein but not defined shall have the meaning given them in the Certificate of Designations.

The shares of the Series A Preferred Stock shall be convertible in the manner and accordance with the terms set forth in the Certificate of Designations.

Reference is hereby made to the provisions of the Series A Preferred Stock set forth in the Certificate of Designations, which provisions shall for all purposes have the same effect as if set forth at this place.

Upon receipt of this executed certificate, the Holder is bound by the Certificate of Designations and is entitled to the benefits thereunder.

Unless the Transfer Agent has properly countersigned, these shares of the Series A Preferred Stock shall not be entitled to any benefit under the Certificate of Designations or be valid or obligatory for any purpose.

IN WITNESS WHEREOF the said Corporation has caused this Certificate to be signed by its duly authorized officers as of [].

By: _____
Name:
Title:

By: _____
Name:
Title:

COUNTERSIGNATURE

These are shares of the Series A Convertible Preferred Stock referred to in the within-mentioned Certificate of Designations.

Dated: _____

American Stock Trust & Transfer Company,
as Transfer Agent

By: _____
Name:
Title:

COMMON STOCK PURCHASE WARRANT

YIELD10 BIOSCIENCE, INC.

Warrant Shares: _____ Issue Date: _____, 2019

CUSIP:

ISIN:

THIS COMMON STOCK PURCHASE WARRANT (the “Warrant”) certifies that, for value received, CEDE & CO. or its assigns (the “Holder”) is entitled, upon the terms and subject to the limitations on exercise and the conditions hereinafter set forth, at any time on or after the Authorized Share Increase Date (the “Initial Exercise Date”) and on or prior to 5:00 p.m. (New York City time) on the five and one-half year anniversary of the date hereof (the “Termination Date”) but not thereafter, to subscribe for and purchase from Yield10 Bioscience, Inc., a Delaware corporation (the “Company”), up to _____ shares (as subject to adjustment hereunder, the “Warrant Shares”) of Common Stock. The purchase price of one share of Common Stock under this Warrant shall be equal to the Exercise Price, as defined in Section 2(b). This Warrant shall initially be issued and maintained in the form of a security held in book-entry form and the Depository Trust Company or its nominee (“DTC”) shall initially be the sole registered holder of this Warrant, subject to a Holder’s right to elect to receive a Warrant in certificated form pursuant to the terms of the Warrant Agency Agreement, in which case this sentence shall not apply.

Section 1. Definitions. In addition to the terms defined elsewhere in this Warrant, the following terms have the meanings indicated in this Section 1:

“Affiliate” means any Person that, directly or indirectly through one or more intermediaries, controls or is controlled by or is under common control with a Person, as such terms are used in and construed under Rule 405 under the Securities Act.

“Amendment” means the amendment to the Company’s articles of incorporation that either effects a reverse stock split or increases the number of authorized shares of Common Stock such that all of the Warrants may be exercised in full by the holders of the Warrants.

“Authorized Share Increase Date” means, subject to Authorized Share Approval, the date on which the Amendment is filed and accepted with the State of Delaware

“Authorized Share Approval” means approval of the Amendment by the shareholders of the Company.

“Bid Price” means, for any date, the price determined by the first of the following clauses that applies: (a) if the Common Stock is then listed or quoted on a Trading Market, the bid price of the Common Stock for the time in question (or the nearest preceding date) on the Trading Market on which the Common Stock is then listed or quoted as reported by

Bloomberg L.P. (based on a Trading Day from 9:30 a.m. (New York City time) to 4:02 p.m. (New York City time)), (b) if OTCQB or OTCQX is not a Trading Market, the volume weighted average price of the Common Stock for such date (or the nearest preceding date) on OTCQB or OTCQX as applicable, (c) if the Common Stock is not then listed or quoted for trading on OTCQB or OTCQX and if prices for the Common Stock are then reported in the “Pink Sheets” published by OTC Markets Group, Inc. (or a similar organization or agency succeeding to its functions of reporting prices), the most recent bid price per share of the Common Stock so reported, or (d) in all other cases, the fair market value of a share of Common Stock as determined by an independent appraiser selected in good faith by the Holders of a majority in interest of the Warrants then outstanding and reasonably acceptable to the Company, the fees and expenses of which shall be paid by the Company.

“Board of Directors” means the board of directors of the Company.

“Business Day” means any day except any Saturday, any Sunday, any day which is a federal legal holiday in the United States or any day on which banking institutions in the State of New York are authorized or required by law or other governmental action to close.

“Commission” means the United States Securities and Exchange Commission.

“Common Stock” means the common stock of the Company, par value \$0.01 per share, and any other class of securities into which such securities may hereafter be reclassified or changed.

“Common Stock Equivalents” means any securities of the Company or the Subsidiaries which would entitle the holder thereof to acquire at any time Common Stock, including, without limitation, any debt, preferred stock, right, option, warrant or other instrument that is at any time convertible into or exercisable or exchangeable for, or otherwise entitles the holder thereof to receive, Common Stock.

“Exchange Act” means the Securities Exchange Act of 1934, as amended, and the rules and regulations promulgated thereunder.

“Person” means an individual or corporation, partnership, trust, incorporated or unincorporated association, joint venture, limited liability company, joint stock company, government (or an agency or subdivision thereof) or other entity of any kind.

“Registration Statement” means the Company’s registration statement on Form S-1 (File No. 333-233683).

“Securities Act” means the Securities Act of 1933, as amended, and the rules and regulations promulgated thereunder.

“Trading Day” means a day on which the Common Stock is traded on a Trading Market.

“Trading Market” means any of the following markets or exchanges on which the Common Stock is listed or quoted for trading on the date in question: the NYSE American, the Nasdaq Capital Market, the Nasdaq Global Market, the Nasdaq Global Select Market, or the New York Stock Exchange (or any successors to any of the foregoing).

“Transfer Agent” means American Stock Transfer & Trust Company, LLC, with offices located at 6201 15th Avenue, Brooklyn, New York 11219 and a facsimile number of (718) 765-8712, and any successor transfer agent of the Company.

“VWAP” means, for any date, the price determined by the first of the following clauses that applies: (a) if the Common Stock is then listed or quoted on a Trading Market, the daily volume weighted average price of the Common Stock for such date (or the nearest preceding date) on the Trading Market on which the Common Stock is then listed or quoted as reported by Bloomberg L.P. (based on a Trading Day from 9:30 a.m. (New York City time) to 4:02 p.m. (New York City time)), (b) if OTCQB or OTCQX is not a Trading Market, the volume weighted average price of the Common Stock for such date (or the nearest preceding date) on OTCQB or OTCQX as applicable, (c) if the Common Stock is not then listed or quoted for trading on OTCQB or OTCQX and if prices for the Common Stock are then reported in the “Pink Sheets” published by OTC Markets Group, Inc. (or a similar organization or agency succeeding to its functions of reporting prices), the most recent bid price per share of the Common Stock so reported, or (d) in all other cases, the fair market value of a share of Common Stock as determined by an independent appraiser selected in good faith by the holders of a majority in interest of the Warrants then outstanding and reasonably acceptable to the Company, the fees and expenses of which shall be paid by the Company.

“Warrant Agency Agreement” means that certain warrant agency agreement, dated on or about the Initial Exercise Date, between the Company and the Warrant Agent.

“Warrant Agent” means the Transfer Agent and any successor warrant agent of the Company.

“Warrants” means this Warrant and other Common Stock purchase warrants issued by the Company pursuant to the Registration Statement.

Section 2. Exercise.

a) Exercise of Warrant. Exercise of the purchase rights represented by this Warrant may be made, in whole or in part, at any time or times on or after the Initial Exercise Date and on or before the Termination Date by delivery to the Company of a duly executed facsimile copy (or PDF copy submitted by e-mail attachment) of the Notice of Exercise in the form annexed hereto (the “Notice of Exercise”). Within the earlier of (i) two (2) Trading Days and (ii) the number of Trading Days comprising the Standard Settlement Period (as defined in Section 2(d)(i) herein) following the date of exercise as aforesaid, the Holder shall deliver the aggregate Exercise Price for the shares specified in the applicable Notice of Exercise by wire transfer or cashier’s check drawn on a United States bank unless the

cashless exercise procedure specified in Section 2(c) below is specified in the applicable Notice of Exercise. No ink-original Notice of Exercise shall be required, nor shall any medallion guarantee (or other type of guarantee or notarization) of any Notice of Exercise form be required. Notwithstanding anything herein to the contrary, the Holder shall not be required to physically surrender this Warrant to the Company until the Holder has purchased all of the Warrant Shares available hereunder and the Warrant has been exercised in full, in which case, the Holder shall surrender this Warrant to the Company for cancellation within three (3) Trading Days of the date on which the final Notice of Exercise is delivered to the Company. Partial exercises of this Warrant resulting in purchases of a portion of the total number of Warrant Shares available hereunder shall have the effect of lowering the outstanding number of Warrant Shares purchasable hereunder in an amount equal to the applicable number of Warrant Shares purchased. The Holder and the Company shall maintain records showing the number of Warrant Shares purchased and the date of such purchases. The Company shall deliver any objection to any Notice of Exercise within one (1) Business Day of receipt of such notice. **The Holder and any assignee, by acceptance of this Warrant, acknowledge and agree that, by reason of the provisions of this paragraph, following the purchase of a portion of the Warrant Shares hereunder, the number of Warrant Shares available for purchase hereunder at any given time may be less than the amount stated on the face hereof.**

Notwithstanding the foregoing in this Section 2(a), a holder whose interest in this Warrant is a beneficial interest in certificate(s) representing this Warrant held in book-entry form through DTC (or another established clearing corporation performing similar functions), shall effect exercises made pursuant to this Section 2(a) by delivering to DTC (or such other clearing corporation, as applicable) the appropriate instruction form for exercise, complying with the procedures to effect exercise that are required by DTC (or such other clearing corporation, as applicable), subject to a Holder's right to elect to receive a Warrant in certificated form pursuant to the terms of the Warrant Agency Agreement, in which case this sentence shall not apply.

b) Exercise Price. The exercise price per share of Common Stock under this Warrant shall be \$_____, subject to adjustment hereunder (the "Exercise Price").

c) Cashless Exercise. If at the time of exercise hereof there is no effective registration statement registering, or the prospectus contained therein is not available for the issuance of the Warrant Shares to the Holder, then this Warrant may also be exercised, in whole or in part, at such time by means of a "cashless exercise" in which the Holder shall be entitled to receive a number of Warrant Shares equal to the quotient obtained by dividing [(A-B) (X)] by (A), where:

(A) = as applicable: (i) the VWAP on the Trading Day immediately preceding the date of the applicable Notice of Exercise if such Notice of Exercise is (1) both executed and delivered pursuant to Section 2(a) hereof on a day that is not a Trading Day or (2) both executed and delivered pursuant to Section 2(a) hereof on a Trading Day prior to the opening of "regular trading hours" (as defined

in Rule 600(b)(64) of Regulation NMS promulgated under the federal securities laws) on such Trading Day, (ii) at the option of the Holder, either (y) the VWAP on the Trading Day immediately preceding the date of the applicable Notice of Exercise or (z) the Bid Price of the Common Stock on the principal Trading Market as reported by Bloomberg L.P. as of the time of the Holder's execution of the applicable Notice of Exercise if such Notice of Exercise is executed during "regular trading hours" on a Trading Day and is delivered within two (2) hours thereafter (including until two (2) hours after the close of "regular trading hours" on a Trading Day) pursuant to Section 2(a) hereof or (iii) the VWAP on the date of the applicable Notice of Exercise if the date of such Notice of Exercise is a Trading Day and such Notice of Exercise is both executed and delivered pursuant to Section 2(a) hereof after the close of "regular trading hours" on such Trading Day;

(B) = the Exercise Price of this Warrant, as adjusted hereunder; and

(X) = the number of Warrant Shares that would be issuable upon exercise of this Warrant in accordance with the terms of this Warrant if such exercise were by means of a cash exercise rather than a cashless exercise.

If Warrant Shares are issued in such a cashless exercise, the parties acknowledge and agree that in accordance with Section 3(a)(9) of the Securities Act, the Warrant Shares shall take on the registered characteristics of the Warrants being exercised. The Company agrees not to take any position contrary to this Section 2(c).

Notwithstanding anything herein to the contrary, on the Termination Date, this Warrant shall be automatically exercised via cashless exercise pursuant to this Section 2(c).

Notwithstanding the foregoing, and without limiting the rights of the Holder under Sections 2(d)(i) and 2(d)(iv), in no event will the Company be required to net cash settle an exercise of this Warrant.

d) Mechanics of Exercise.

i. Delivery of Warrant Shares Upon Exercise. Warrant Shares purchased hereunder shall be transmitted by the Transfer Agent to the Holder by crediting the account of the Holder's or its designee's balance account with The Depository Trust Company through its Deposit or Withdrawal at Custodian system ("DWAC") if the Company is then a participant in such system and either (A) there is an effective registration statement permitting the issuance of the Warrant Shares to or resale of the Warrant Shares by Holder or (B) this Warrant is being exercised via cashless exercise, and otherwise by physical delivery of a certificate, registered in the Company's share register in the name of the Holder or its designee, for the number of Warrant Shares to which the Holder is entitled pursuant to such exercise to

the address specified by the Holder in the Notice of Exercise by the date that is the earliest of (i) two (2) Trading Days after the delivery to the Company of the Notice of Exercise, (ii) one (1) Trading Day after delivery of the aggregate Exercise Price to the Company and (iii) the number of Trading Days comprising the Standard Settlement Period after the delivery to the Company of the Notice of Exercise (such date, the “Warrant Share Delivery Date”). Upon delivery of the Notice of Exercise, the Holder shall be deemed for all corporate purposes to have become the holder of record of the Warrant Shares with respect to which this Warrant has been exercised, irrespective of the date of delivery of the Warrant Shares, provided that payment of the aggregate Exercise Price (other than in the case of a cashless exercise) is received within the earlier of (i) two (2) Trading Days and (ii) the number of Trading Days comprising the Standard Settlement Period following delivery of the Notice of Exercise. If the Company fails for any reason to deliver to the Holder the Warrant Shares subject to a Notice of Exercise by the Warrant Share Delivery Date, the Company shall pay to the Holder, in cash, as liquidated damages and not as a penalty, for each \$1,000 of Warrant Shares subject to such exercise (based on the VWAP of the Common Stock on the date of the applicable Notice of Exercise), \$5 per Trading Day (increasing to \$10 per Trading Day on the fifth Trading Day after such liquidated damages begin to accrue) for each Trading Day after such Warrant Share Delivery Date until such Warrant Shares are delivered or Holder rescinds such exercise. The Company agrees to maintain a transfer agent that is a participant in the FAST program so long as this Warrant remains outstanding and exercisable. As used herein, “Standard Settlement Period” means the standard settlement period, expressed in a number of Trading Days, on the Company’s primary Trading Market with respect to the Common Stock as in effect on the date of delivery of the Notice of Exercise.

ii. Delivery of New Warrants Upon Exercise. If this Warrant shall have been exercised in part, the Company shall, at the request of a Holder and upon surrender of this Warrant, at the time of delivery of the Warrant Shares, deliver to the Holder a new Warrant evidencing the rights of the Holder to purchase the unpurchased Warrant Shares called for by this Warrant, which new Warrant shall in all other respects be identical with this Warrant.

iii. Rescission Rights. If the Company fails to cause the Transfer Agent to transmit to the Holder the Warrant Shares pursuant to Section 2(d)(i) by the Warrant Share Delivery Date, then the Holder will have the right to rescind such exercise.

iv. Compensation for Buy-In on Failure to Timely Deliver Warrant Shares Upon Exercise. In addition to any other rights available to the Holder, if the Company fails to cause the Transfer Agent to transmit to the Holder

the Warrant Shares in accordance with the provisions of Section 2(d)(i) above pursuant to an exercise on or before the Warrant Share Delivery Date, and if after such date the Holder is required by its broker to purchase (in an open market transaction or otherwise) or the Holder's brokerage firm otherwise purchases, shares of Common Stock to deliver in satisfaction of a sale by the Holder of the Warrant Shares which the Holder anticipated receiving upon such exercise (a "Buy-In"), then the Company shall (A) pay in cash to the Holder the amount, if any, by which (x) the Holder's total purchase price (including brokerage commissions, if any) for the shares of Common Stock so purchased exceeds (y) the amount obtained by multiplying (1) the number of Warrant Shares that the Company was required to deliver to the Holder in connection with the exercise at issue times (2) the price at which the sell order giving rise to such purchase obligation was executed, and (B) at the option of the Holder, either reinstate the portion of the Warrant and equivalent number of Warrant Shares for which such exercise was not honored (in which case such exercise shall be deemed rescinded) or deliver to the Holder the number of shares of Common Stock that would have been issued had the Company timely complied with its exercise and delivery obligations hereunder. For example, if the Holder purchases Common Stock having a total purchase price of \$11,000 to cover a Buy-In with respect to an attempted exercise of shares of Common Stock with an aggregate sale price giving rise to such purchase obligation of \$10,000, under clause (A) of the immediately preceding sentence the Company shall be required to pay the Holder \$1,000. The Holder shall provide the Company written notice indicating the amounts payable to the Holder in respect of the Buy-In and, upon request of the Company, evidence of the amount of such loss. Nothing herein shall limit a Holder's right to pursue any other remedies available to it hereunder, at law or in equity including, without limitation, a decree of specific performance and/or injunctive relief with respect to the Company's failure to timely deliver shares of Common Stock upon exercise of the Warrant as required pursuant to the terms hereof.

v. No Fractional Shares or Scrip. No fractional shares or scrip representing fractional shares shall be issued upon the exercise of this Warrant. As to any fraction of a share which the Holder would otherwise be entitled to purchase upon such exercise, the Company shall round up to the next whole share.

vi. Charges, Taxes and Expenses. Issuance of Warrant Shares shall be made without charge to the Holder for any issue or transfer tax or other incidental expense in respect of the issuance of such Warrant Shares, all of which taxes and expenses shall be paid by the Company, and such Warrant Shares shall be issued in the name of the Holder or in such name or names as may be directed by the Holder; provided, however, that in the event that Warrant Shares are to be issued in a name other than the name of the Holder,

this Warrant when surrendered for exercise shall be accompanied by the Assignment Form attached hereto duly executed by the Holder and the Company may require, as a condition thereto, the payment of a sum sufficient to reimburse it for any transfer tax incidental thereto. The Company shall pay all Transfer Agent fees required for same-day processing of any Notice of Exercise and all fees to the Depository Trust Company (or another established clearing corporation performing similar functions) required for same-day electronic delivery of the Warrant Shares.

vii. Closing of Books. The Company will not close its stockholder books or records in any manner which prevents the timely exercise of this Warrant, pursuant to the terms hereof.

e) Holder's Exercise Limitations. The Company shall not effect any exercise of this Warrant, and a Holder shall not have the right to exercise any portion of this Warrant, pursuant to Section 2 or otherwise, to the extent that after giving effect to such issuance after exercise as set forth on the applicable Notice of Exercise, the Holder (together with the Holder's Affiliates, and any other Persons acting as a group together with the Holder or any of the Holder's Affiliates (such Persons, "Attribution Parties")), would beneficially own in excess of the Beneficial Ownership Limitation (as defined below). For purposes of the foregoing sentence, the number of shares of Common Stock beneficially owned by the Holder and its Affiliates and Attribution Parties shall include the number of shares of Common Stock issuable upon exercise of this Warrant with respect to which such determination is being made, but shall exclude the number of shares of Common Stock which would be issuable upon (i) exercise of the remaining, nonexercised portion of this Warrant beneficially owned by the Holder or any of its Affiliates or Attribution Parties and (ii) exercise or conversion of the unexercised or nonconverted portion of any other securities of the Company (including, without limitation, any other Common Stock Equivalents) subject to a limitation on conversion or exercise analogous to the limitation contained herein beneficially owned by the Holder or any of its Affiliates or Attribution Parties. Except as set forth in the preceding sentence, for purposes of this Section 2(e), beneficial ownership shall be calculated in accordance with Section 13(d) of the Exchange Act and the rules and regulations promulgated thereunder. Subject to the Holder's right to rely on the number of outstanding shares of Common Stock set forth below, it being acknowledged by the Holder that the Company is not representing to the Holder that such calculation is in compliance with Section 13(d) of the Exchange Act and the Holder is solely responsible for any schedules required to be filed in accordance therewith. To the extent that the limitation contained in this Section 2(e) applies, the determination of whether this Warrant is exercisable (in relation to other securities owned by the Holder together with any Affiliates and Attribution Parties) and of which portion of this Warrant is exercisable shall be in the sole discretion of the Holder, and the submission of a Notice of Exercise shall be deemed to be the Holder's determination of whether this Warrant is exercisable (in relation to other securities owned by the Holder together with any Affiliates and Attribution Parties) and of which portion of this Warrant is exercisable, in each case subject to the Beneficial Ownership Limitation. To ensure compliance with this restriction, each Holder shall be deemed to represent to the

Company each time it delivers a Notice of Exercise that such Notice of Exercise has not violated the restrictions set forth in this paragraph, and the Company shall have no obligation to verify or confirm the accuracy of such determination. In addition, a determination as to any group status as contemplated above shall be determined in accordance with Section 13(d) of the Exchange Act and the rules and regulations promulgated thereunder. For purposes of this Section 2(e), in determining the number of outstanding shares of Common Stock, a Holder may rely on the number of outstanding shares of Common Stock as reflected in (A) the Company's most recent periodic or annual report filed with the Commission, as the case may be, (B) a more recent public announcement by the Company or (C) a more recent written notice by the Company or the Transfer Agent setting forth the number of shares of Common Stock outstanding. Upon the written or oral request of a Holder, the Company shall within two Trading Days confirm orally and in writing to the Holder the number of shares of Common Stock then outstanding. In any case, the number of outstanding shares of Common Stock shall be determined after giving effect to the conversion or exercise of securities of the Company, including this Warrant, by the Holder or its Affiliates or Attribution Parties since the date as of which such number of outstanding shares of Common Stock was reported. The "Beneficial Ownership Limitation" shall be 4.99% (or, upon election by a Holder prior to the issuance of any Warrants, 9.99%) of the number of shares of the Common Stock outstanding immediately after giving effect to the issuance of shares of Common Stock issuable upon exercise of this Warrant. The Holder, upon notice to the Company, may increase or decrease the Beneficial Ownership Limitation provisions of this Section 2(e), provided that the Beneficial Ownership Limitation in no event exceeds 9.99% of the number of shares of the Common Stock outstanding immediately after giving effect to the issuance of shares of Common Stock upon exercise of this Warrant held by the Holder and the provisions of this Section 2(e) shall continue to apply. Any increase in the Beneficial Ownership Limitation will not be effective until the 61st day after such notice is delivered to the Company. The provisions of this paragraph shall be construed and implemented in a manner otherwise than in strict conformity with the terms of this Section 2(e) to correct this paragraph (or any portion hereof) which may be defective or inconsistent with the intended Beneficial Ownership Limitation herein contained or to make changes or supplements necessary or desirable to properly give effect to such limitation. The limitations contained in this paragraph shall apply to a successor holder of this Warrant.

f) Call Provision. Subject to the provisions of Section 2(e) and this Section 2(f), if, after the Initial Exercise Date (i) the VWAP for each of 20 consecutive Trading Days (the "Measurement Period," which 20 consecutive Trading Day period shall not have commenced until after the Initial Exercise Date) exceeds \$[]¹ (subject to adjustment for forward and reverse stock splits, recapitalizations, stock dividends and the like after the Initial Exercise Date), (ii) the daily dollar volume for such Measurement Period exceeds \$175,000 per Trading Day, (iii) the Holder is not in possession of any information that constitutes, or might constitute, material non-public information which was provided by the Company, any

¹ 300% of Exercise Price.

of its Subsidiaries, or any of their officers, directors, employees, agents or Affiliates and (iv) there is an effective registration statement and current prospectus thereunder to permit the issuance of all of the Warrant Shares to the Holder, then the Company may, within one Trading Day of the end of such Measurement Period, call for cancellation of all or any portion of this Warrant for which a Notice of Exercise has not yet been delivered (such right, a “Call”) for consideration equal to \$0.001 per Warrant Share. To exercise this right, the Company must deliver to the Holder an irrevocable written notice (a “Call Notice”),

indicating therein the portion of unexercised portion of this Warrant to which such notice applies. If the conditions set forth below for such Call are satisfied from the period from the date of the Call Notice through and including the Call Date (as defined below), then any portion of this Warrant subject to such Call Notice for which a Notice of Exercise shall not have been received by the Call Date will be cancelled at 6:30 p.m. (New York City time) on the tenth Trading Day after the date the Call Notice is received by the Holder (such date and time, the “Call Date”). Any unexercised portion of this Warrant to which the Call Notice does not pertain will be unaffected by such Call Notice. In furtherance thereof, the Company covenants and agrees that it will honor all Notices of Exercise with respect to Warrant Shares subject to a Call Notice that are tendered through 6:30 p.m. (New York City time) on the Call Date. The parties agree that any Notice of Exercise delivered following a Call Notice which calls less than all of the Warrants shall first reduce to zero the number of Warrant Shares subject to such Call Notice prior to reducing the remaining Warrant Shares available for purchase under this Warrant. For example, if (A) this Warrant then permits the Holder to acquire 100 Warrant Shares, (B) a Call Notice pertains to 75 Warrant Shares, and (C) prior to 6:30 p.m. (New York City time) on the Call Date the Holder tenders a Notice of Exercise in respect of 50 Warrant Shares, then (x) on the Call Date the right under this Warrant to acquire 25 Warrant Shares will be automatically cancelled, (y) the Company, in the time and manner required under this Warrant, will have issued and delivered to the Holder 50 Warrant Shares in respect of the exercises following receipt of the Call Notice, and (z) the Holder may, until the Termination Date, exercise this Warrant for 25 Warrant Shares (subject to adjustment as herein provided and subject to subsequent Call Notices). Subject again to the provisions of this Section 2(f), the Company may deliver subsequent Call Notices for any portion of this Warrant for which the Holder shall not have delivered a Notice of Exercise. Notwithstanding anything to the contrary set forth in this Warrant, the Company may not deliver a Call Notice or require the cancellation of this Warrant (and any such Call Notice shall be void), unless, from the beginning of the Measurement Period through the Call Date, (1) the Company shall have honored in accordance with the terms of this Warrant all Notices of Exercise delivered by 6:30 p.m. (New York City time) on the Call Date, and (2) the Registration Statement shall be effective as to all Warrant Shares and the prospectus thereunder available for use by the Holder for the issuance of all such Warrant Shares, (3) the Common Stock shall be listed or quoted for trading on the Trading Market, (4) there shall be a sufficient number of authorized shares of Common Stock for issuance of all Warrant Shares and all shares of Common Stock issuable upon conversion of the Company’s preferred stock issued pursuant to the Registration Statement, and (5) the issuance of the shares shall not cause a breach of any provision of Section 2(e) herein. The Company’s right to call the Warrants under this Section 2(f) shall be exercised ratably among the Holders based on each Holder’s initial purchase of Warrants.

Section 3. Certain Adjustments.

a) Stock Dividends and Splits. If the Company, at any time while this Warrant is outstanding: (i) pays a stock dividend or otherwise makes a distribution or distributions on shares of its Common Stock or any other equity or equity equivalent securities payable in shares of Common Stock (which, for avoidance of doubt, shall not include any shares of Common Stock issued by the Company upon exercise of this Warrant), (ii) subdivides outstanding shares of Common Stock into a larger number of shares, (iii) combines (including by way of reverse stock split) outstanding shares of Common Stock into a smaller number of shares, or (iv) issues by reclassification of shares of the Common Stock any shares of capital stock of the Company, then in each case the Exercise Price shall be multiplied by a fraction of which the numerator shall be the number of shares of Common Stock (excluding treasury shares, if any) outstanding immediately before such event and of which the denominator shall be the number of shares of Common Stock outstanding immediately after such event, and the number of shares issuable upon exercise of this Warrant shall be proportionately adjusted such that the aggregate Exercise Price of this Warrant shall remain unchanged. Any adjustment made pursuant to this Section 3(a) shall become effective immediately after the record date for the determination of stockholders entitled to receive such dividend or distribution and shall become effective immediately after the effective date in the case of a subdivision, combination or re-classification.

b) Subsequent Rights Offerings. In addition to any adjustments pursuant to Section 3(a) above, if at any time the Company grants, issues or sells any Common Stock Equivalents or rights to purchase stock, warrants, securities or other property pro rata to the record holders of any class of shares of Common Stock (the "Purchase Rights"), then the Holder will be entitled to acquire, upon the terms applicable to such Purchase Rights, the aggregate Purchase Rights which the Holder could have acquired if the Holder had held the number of shares of Common Stock acquirable upon complete exercise of this Warrant (without regard to any limitations on exercise hereof, including without limitation, the Beneficial Ownership Limitation) immediately before the date on which a record is taken for the grant, issuance or sale of such Purchase Rights, or, if no such record is taken, the date as of which the record holders of shares of Common Stock are to be determined for the grant, issue or sale of such Purchase Rights (provided, however, to the extent that the Holder's right to participate in any such Purchase Right would result in the Holder exceeding the Beneficial Ownership Limitation, then the Holder shall not be entitled to participate in such Purchase Right to such extent (or beneficial ownership of such shares of Common Stock as a result of such Purchase Right to such extent) and such Purchase Right to such extent shall be held in abeyance for the Holder until such time, if ever, as its right thereto would not result in the Holder exceeding the Beneficial Ownership Limitation).

c) Pro Rata Distributions. During such time as this Warrant is outstanding, if the Company shall declare or make any dividend or other distribution of its assets (or rights to acquire its assets) to holders of shares of Common Stock, by way of return of capital or otherwise (including, without limitation, any distribution of cash, stock or other securities, property or options by way of a dividend, spin off, reclassification, corporate rearrangement,

scheme of arrangement or other similar transaction) (a "Distribution"), at any time after the issuance of this Warrant, then, in each such case, the Holder shall be entitled to participate in such Distribution to the same extent that the Holder would have participated therein if the Holder had held the number of shares of Common Stock acquirable upon complete exercise of this Warrant (without regard to any limitations on exercise hereof, including without limitation, the Beneficial Ownership Limitation) immediately before the date of which a record is taken for such Distribution, or, if no such record is taken, the date as of which the record holders of shares of Common Stock are to be determined for the participation in such Distribution (provided, however, to the extent that the Holder's right to participate in any such Distribution would result in the Holder exceeding the Beneficial Ownership Limitation, then the Holder shall not be entitled to participate in such Distribution to such extent (or in the beneficial ownership of any shares of Common Stock as a result of such Distribution to such extent) and the portion of such Distribution shall be held in abeyance for the benefit of the Holder until such time, if ever, as its right thereto would not result in the Holder exceeding the Beneficial Ownership Limitation). To the extent that this Warrant has not been partially or completely exercised at the time of such Distribution, such portion of the Distribution shall be held in abeyance for the benefit of the Holder until the Holder has exercised this Warrant.

d) Fundamental Transaction. If, at any time while this Warrant is outstanding, (i) the Company, directly or indirectly, in one or more related transactions effects any merger or consolidation of the Company with or into another Person, (ii) the Company, directly or indirectly, effects any sale, lease, license, assignment, transfer, conveyance or other disposition of all or substantially all of its assets in one or a series of related transactions, (iii) any, direct or indirect, purchase offer, tender offer or exchange offer (whether by the Company or another Person) is completed pursuant to which holders of Common Stock are permitted to sell, tender or exchange their shares for other securities, cash or property and such offer has been accepted by the holders of 50% or more of the outstanding Common Stock, (iv) the Company, directly or indirectly, in one or more related transactions effects any reclassification, reorganization or recapitalization of the Common Stock or any compulsory share exchange pursuant to which the Common Stock is effectively converted into or exchanged for other securities, cash or property, or (v) the Company, directly or indirectly, in one or more related transactions consummates a stock or share purchase agreement or other business combination (including, without limitation, a reorganization, recapitalization, spin-off or scheme of arrangement) with another Person or group of Persons whereby such other Person or group acquires more than 50% of the outstanding shares of Common Stock (not including any shares of Common Stock held by the other Person or other Persons making or party to, or associated or affiliated with the other Persons making or party to, such stock or share purchase agreement or other business combination) (each a "Fundamental Transaction"), then, upon any subsequent exercise of this Warrant, the Holder shall have the right to receive, for each Warrant Share that would have been issuable upon such exercise immediately prior to the occurrence of such Fundamental Transaction, at the option of the Holder (without regard to any limitation in Section 2(e) on the exercise of this Warrant), the number of shares of Common Stock of the successor or acquiring corporation or of the Company, if it is the surviving corporation, and any additional consideration (the

“Alternate Consideration”) receivable as a result of such Fundamental Transaction by a holder of the number of shares of Common Stock for which this Warrant is exercisable immediately prior to such Fundamental Transaction (without regard to any limitation in Section 2(e) on the exercise of this Warrant). For purposes of any such exercise, the determination of the Exercise Price shall be appropriately adjusted to apply to such Alternate Consideration based on the amount of Alternate Consideration issuable in respect of one share of Common Stock in such Fundamental Transaction, and the Company shall apportion the Exercise Price among the Alternate Consideration in a reasonable manner reflecting the relative value of any different components of the Alternate Consideration. If holders of Common Stock are given any choice as to the securities, cash or property to be received in a Fundamental Transaction, then the Holder shall be given the same choice as to the Alternate Consideration it receives upon any exercise of this Warrant following such Fundamental Transaction. The Company shall cause any successor entity in a Fundamental Transaction in which the Company is not the survivor (the “Successor Entity”) to assume in writing all of the obligations of the Company under this Warrant in accordance with the provisions of this Section 3(d) pursuant to written agreements in form and substance reasonably satisfactory to the Holder and approved by the Holder (without unreasonable delay) prior to such Fundamental Transaction and shall, at the option of the Holder, deliver to the Holder in exchange for this Warrant a security of the Successor Entity evidenced by a written instrument substantially similar in form and substance to this Warrant which is exercisable for a corresponding number of shares of capital stock of such Successor Entity (or its parent entity) equivalent to the shares of Common Stock acquirable and receivable upon exercise of this Warrant (without regard to any limitations on the exercise of this Warrant) prior to such Fundamental Transaction, and with an exercise price which applies the exercise price hereunder to such shares of capital stock (but taking into account the relative value of the shares of Common Stock pursuant to such Fundamental Transaction and the value of such shares of capital stock, such number of shares of capital stock and such exercise price being for the purpose of protecting the economic value of this Warrant immediately prior to the consummation of such Fundamental Transaction), and which is reasonably satisfactory in form and substance to the Holder. Upon the occurrence of any such Fundamental Transaction, the Successor Entity shall succeed to, and be substituted for (so that from and after the date of such Fundamental Transaction, the provisions of this Warrant referring to the “Company” shall refer instead to the Successor Entity), and may exercise every right and power of the Company and shall assume all of the obligations of the Company under this Warrant with the same effect as if such Successor Entity had been named as the Company herein.

e) Calculations. All calculations under this Section 3 shall be made to the nearest cent or the nearest 1/100th of a share, as the case may be. For purposes of this Section 3, the number of shares of Common Stock deemed to be issued and outstanding as of a given date shall be the sum of the number of shares of Common Stock (excluding treasury shares, if any) issued and outstanding.

f) Notice to Holder.

i. Adjustment to Exercise Price. Whenever the Exercise Price is adjusted pursuant to any provision of this Section 3, the Company shall promptly deliver to the Holder by facsimile or email a notice setting forth the Exercise Price after such adjustment and any resulting adjustment to the number of Warrant Shares and setting forth a brief statement of the facts requiring such adjustment.

ii. Notice to Allow Exercise by Holder. If (A) the Company shall declare a dividend (or any other distribution in whatever form) on the Common Stock, (B) the Company shall declare a special nonrecurring cash dividend on or a redemption of the Common Stock, (C) the Company shall authorize the granting to all holders of the Common Stock rights or warrants to subscribe for or purchase any shares of capital stock of any class or of any rights, (D) the approval of any stockholders of the Company shall be required in connection with any reclassification of the Common Stock, any consolidation or merger to which the Company is a party, any sale or transfer of all or substantially all of the assets of the Company, or any compulsory share exchange whereby the Common Stock is converted into other securities, cash or property, or (E) the Company shall authorize the voluntary or involuntary dissolution, liquidation or winding up of the affairs of the Company, then, in each case, the Company shall cause to be delivered by facsimile or email to the Holder at its last facsimile number or email address as it shall appear upon the Warrant Register of the Company, at least 20 calendar days prior to the applicable record or effective date hereinafter specified, a notice stating (x) the date on which a record is to be taken for the purpose of such dividend, distribution, redemption, rights or warrants, or if a record is not to be taken, the date as of which the holders of the Common Stock of record to be entitled to such dividend, distributions, redemption, rights or warrants are to be determined or (y) the date on which such reclassification, consolidation, merger, sale, transfer or share exchange is expected to become effective or close, and the date as of which it is expected that holders of the Common Stock of record shall be entitled to exchange their shares of the Common Stock for securities, cash or other property deliverable upon such reclassification, consolidation, merger, sale, transfer or share exchange; provided that the failure to deliver such notice or any defect therein or in the delivery thereof shall not affect the validity of the corporate action required to be specified in such notice. To the extent that any notice provided in this Warrant constitutes, or contains, material, non-public information regarding the Company or any of the Subsidiaries, the Company shall simultaneously file such notice with the Commission pursuant to a Current Report on Form 8-K. The Holder shall remain entitled to exercise this Warrant during the period commencing on the date of such notice to the effective date of the event triggering such notice except as may otherwise be expressly set forth herein.

Section 4. Transfer of Warrant.

a) Transferability. Subject to compliance with any applicable securities laws, this Warrant and all rights hereunder (including, without limitation, any registration rights) are transferable, in whole or in part, upon surrender of this Warrant at the principal office of the Company or its designated agent, together with a written assignment of this Warrant substantially in the form attached hereto duly executed by the Holder or its agent or attorney and funds sufficient to pay any transfer taxes payable upon the making of such transfer. Upon such surrender and, if required, such payment, the Company shall execute and deliver a new Warrant or Warrants in the name of the assignee or assignees, as applicable, and in the denomination or denominations specified in such instrument of assignment, and shall issue to the assignor a new Warrant evidencing the portion of this Warrant not so assigned, and this Warrant shall promptly be cancelled. Notwithstanding anything herein to the contrary, the Holder shall not be required to physically surrender this Warrant to the Company unless the Holder has assigned this Warrant in full, in which case, the Holder shall surrender this Warrant to the Company within three (3) Trading Days of the date the Holder delivers an assignment form to the Company assigning this Warrant in full. The Warrant, if properly assigned in accordance herewith, may be exercised by a new holder for the purchase of Warrant Shares without having a new Warrant issued.

b) New Warrants. If this Warrant is not held in global form through DTC (or any successor depository), this Warrant may be divided or combined with other Warrants upon presentation hereof at the aforesaid office of the Company, together with a written notice specifying the names and denominations in which new Warrants are to be issued, signed by the Holder or its agent or attorney. Subject to compliance with Section 4(a), as to any transfer which may be involved in such division or combination, the Company shall execute and deliver a new Warrant or Warrants in exchange for the Warrant or Warrants to be divided or combined in accordance with such notice. All Warrants issued on transfers or exchanges shall be dated the initial issuance date of this Warrant and shall be identical with this Warrant except as to the number of Warrant Shares issuable pursuant thereto.

c) Warrant Register. The Company shall register this Warrant, upon records to be maintained by the Warrant Agent for that purpose (the “Warrant Register”), in the name of the record Holder hereof from time to time. The Company and the Warrant Agent may deem and treat the registered Holder of this Warrant as the absolute owner hereof for the purpose of any exercise hereof or any distribution to the Holder, and for all other purposes, absent actual notice to the contrary.

Section 5. Miscellaneous.

a) No Rights as Stockholder Until Exercise. This Warrant does not entitle the Holder to any voting rights, dividends or other rights as a stockholder of the Company prior to the exercise hereof as set forth in Section 2(d)(i), except as expressly set forth in Section 3. Without limiting any rights of a Holder to receive Warrant Shares on a “cashless exercise” pursuant to Section 2(c) or to receive cash payments pursuant to Section 2(d)(i) and Section

2(d)(iv) herein, in no event shall the Company be required to net cash settle an exercise of this Warrant.

b) Loss, Theft, Destruction or Mutilation of Warrant. The Company covenants that upon receipt by the Company or the Warrant Agent of evidence reasonably satisfactory to it of the loss, theft, destruction or mutilation of this Warrant or any stock certificate relating to the Warrant Shares, and in case of loss, theft or destruction, of indemnity or security reasonably satisfactory to it (which, in the case of the Warrant, shall not include the posting of any bond), and upon surrender and cancellation of such Warrant or stock certificate, if mutilated, the Company will make and deliver a new Warrant or stock certificate of like tenor and dated as of such cancellation, in lieu of such Warrant or stock certificate.

c) Saturdays, Sundays, Holidays, etc. If the last or appointed day for the taking of any action or the expiration of any right required or granted herein shall not be a Business Day, then, such action may be taken or such right may be exercised on the next succeeding Business Day.

d) Authorized Shares. The Company covenants that, from and after the authorized Share Increase Date, during the period the Warrant is outstanding, it will reserve from its authorized and unissued Common Stock a sufficient number of shares to provide for the issuance of the Warrant Shares upon the exercise of any purchase rights under this Warrant. The Company further covenants that its issuance of this Warrant shall constitute full authority to its officers who are charged with the duty of issuing the necessary Warrant Shares upon the exercise of the purchase rights under this Warrant. The Company will take all such reasonable action as may be necessary to assure that such Warrant Shares may be issued as provided herein without violation of any applicable law or regulation, or of any requirements of the Trading Market upon which the Common Stock may be listed. The Company covenants that all Warrant Shares which may be issued upon the exercise of the purchase rights represented by this Warrant will, upon exercise of the purchase rights represented by this Warrant and payment for such Warrant Shares in accordance herewith, be duly authorized, validly issued, fully paid and nonassessable and free from all taxes, liens and charges created by the Company in respect of the issue thereof (other than taxes in respect of any transfer occurring contemporaneously with such issue).

Except and to the extent as waived or consented to by the Holder, the Company shall not by any action, including, without limitation, amending its certificate of incorporation or through any reorganization, transfer of assets, consolidation, merger, dissolution, issue or sale of securities or any other voluntary action, avoid or seek to avoid the observance or performance of any of the terms of this Warrant, but will at all times in good faith assist in the carrying out of all such terms and in the taking of all such actions as may be necessary or appropriate to protect the rights of Holder as set forth in this Warrant against impairment. Without limiting the generality of the foregoing, the Company will (i) not increase the par value of any Warrant Shares above the amount payable therefor upon such exercise immediately prior to such increase in par value, (ii) take all such action as may be necessary or appropriate in order that the Company may validly and legally issue fully paid and

nonassessable Warrant Shares upon the exercise of this Warrant and (iii) use commercially reasonable efforts to obtain all such authorizations, exemptions or consents from any public regulatory body having jurisdiction thereof, as may be necessary to enable the Company to perform its obligations under this Warrant.

Before taking any action which would result in an adjustment in the number of Warrant Shares for which this Warrant is exercisable or in the Exercise Price, the Company shall obtain all such authorizations or exemptions thereof, or consents thereto, as may be necessary from any public regulatory body or bodies having jurisdiction thereof.

e) Governing Law. All questions concerning the construction, validity, enforcement and interpretation of this Warrant shall be governed by and construed and enforced in accordance with the internal laws of the State of New York, without regard to the principles of conflicts of law thereof. Each party agrees that all legal proceedings concerning the interpretations, enforcement and defense of the transactions contemplated by this Warrant (whether brought against a party hereto or their respective affiliates, directors, officers, shareholders, partners, members, employees or agents) shall be commenced exclusively in the state and federal courts sitting in the City of New York. Each party hereby irrevocably submits to the exclusive jurisdiction of the state and federal courts sitting in the City of New York, Borough of Manhattan for the adjudication of any dispute hereunder or in connection herewith or with any transaction contemplated hereby or discussed herein, and hereby irrevocably waives, and agrees not to assert in any suit, action or proceeding, any claim that it is not personally subject to the jurisdiction of any such court, that such suit, action or proceeding is improper or is an inconvenient venue for such proceeding. Each party hereby irrevocably waives personal service of process and consents to process being served in any such suit, action or proceeding by mailing a copy thereof via registered or certified mail or overnight delivery (with evidence of delivery) to such party at the address in effect for notices to it under this Warrant and agrees that such service shall constitute good and sufficient service of process and notice thereof. Nothing contained herein shall be deemed to limit in any way any right to serve process in any other manner permitted by law. If either party shall commence an action, suit or proceeding to enforce any provisions of this Warrant, the prevailing party in such action, suit or proceeding shall be reimbursed by the other party for their reasonable attorneys' fees and other costs and expenses incurred with the investigation, preparation and prosecution of such action or proceeding.

f) Restrictions. The Holder acknowledges that the Warrant Shares acquired upon the exercise of this Warrant, if not registered, and the Holder does not utilize cashless exercise, will have restrictions upon resale imposed by state and federal securities laws.

g) Nonwaiver and Expenses. No course of dealing or any delay or failure to exercise any right hereunder on the part of Holder shall operate as a waiver of such right or otherwise prejudice the Holder's rights, powers or remedies, notwithstanding the fact that all rights hereunder terminate on the Termination Date. Without limiting any other provision of this Warrant, if the Company willfully and knowingly fails to comply with any provision of this Warrant, which results in any material damages to the Holder, the Company shall

pay to the Holder such amounts as shall be sufficient to cover any costs and expenses including, but not limited to, reasonable attorneys' fees, including those of appellate proceedings, incurred by the Holder in collecting any amounts due pursuant hereto or in otherwise enforcing any of its rights, powers or remedies hereunder.

h) Notices. Any and all notices or other communications or deliveries to be provided by the Holders hereunder including, without limitation, any Notice of Exercise, shall be in writing and delivered personally, by facsimile or e-mail, or sent by a nationally recognized overnight courier service, addressed to the Company, at 19 Presidential Way, Woburn, Massachusetts 01801, Attention: Chief Executive Officer, email address: peoples@yield10bio.com, or such other facsimile number, email address or address as the Company may specify for such purposes by notice to the Holders. Any and all notices or other communications or deliveries to be provided by the Company hereunder shall be in writing and delivered personally, by facsimile or by e-mail, or sent by a nationally recognized overnight courier service addressed to each Holder at the facsimile number, e-mail address or address of such Holder appearing on the books of the Company. Any notice or other communication or deliveries hereunder shall be deemed given and effective on the earliest of (i) the date of transmission, if such notice or communication is delivered via facsimile at the facsimile number or via e-mail at the e-mail address set forth in this Section prior to 5:30 p.m. (New York City time) on any date, (ii) the next Trading Day after the date of transmission, if such notice or communication is delivered via facsimile at the facsimile number or via e-mail at the e-mail address set forth in this Section on a day that is not a Trading Day or later than 5:30 p.m. (New York City time) on any Trading Day, (iii) the second Trading Day following the date of mailing, if sent by U.S. nationally recognized overnight courier service, or (iv) upon actual receipt by the party to whom such notice is required to be given. To the extent that any notice provided hereunder constitutes, or contains, material, non-public information regarding the Company or any subsidiaries, the Company shall simultaneously file such notice with the Commission pursuant to a Current Report on Form 8-K.

i) Limitation of Liability. No provision hereof, in the absence of any affirmative action by the Holder to exercise this Warrant to purchase Warrant Shares, and no enumeration herein of the rights or privileges of the Holder, shall give rise to any liability of the Holder for the purchase price of any Common Stock or as a stockholder of the Company, whether such liability is asserted by the Company or by creditors of the Company.

j) Remedies. The Holder, in addition to being entitled to exercise all rights granted by law, including recovery of damages, will be entitled to specific performance of its rights under this Warrant. The Company agrees that monetary damages would not be adequate compensation for any loss incurred by reason of a breach by it of the provisions of this Warrant and hereby agrees to waive and not to assert the defense in any action for specific performance that a remedy at law would be adequate.

k) Successors and Assigns. Subject to applicable securities laws, this Warrant and the rights and obligations evidenced hereby shall inure to the benefit of and be binding

upon the successors and permitted assigns of the Company and the successors and permitted assigns of Holder. The provisions of this Warrant are intended to be for the benefit of any Holder from time to time of this Warrant and shall be enforceable by the Holder or holder of Warrant Shares.

l) Amendment. This Warrant may be modified or amended or the provisions hereof waived with the written consent of the Company, on the one hand, and the Holder or the beneficial owner of this Warrant, on the other hand. This Warrant also may be modified or amended or the provisions hereof waived with the written consent of the Company and the holders of Warrants representing 67% of the Warrant Shares issuable under Warrants then outstanding as of the date such consent is sought; provided, however, that (i) no such amendment shall adversely affect any Holder differently than it affects all other Holders, unless such Holder consents thereto and (ii) no amendment may increase the Exercise Price, decrease the number of shares or change the class of shares obtainable upon exercise of this Warrant or decrease the time period in which this Warrant can be exercised without the written consent of the Holder.

m) Severability. Wherever possible, each provision of this Warrant shall be interpreted in such manner as to be effective and valid under applicable law, but if any provision of this Warrant shall be prohibited by or invalid under applicable law, such provision shall be ineffective to the extent of such prohibition or invalidity, without invalidating the remainder of such provisions or the remaining provisions of this Warrant.

n) Headings. The headings used in this Warrant are for the convenience of reference only and shall not, for any purpose, be deemed a part of this Warrant.

o) Warrant Agency Agreement. If this Warrant is held in global form through DTC (or any successor depository), this Warrant is issued subject to the Warrant Agency Agreement. To the extent any provision of this Warrant conflicts with the express provisions of the Warrant Agency Agreement, the provisions of this Warrant shall govern and be controlling.

(Signature Page Follows)

IN WITNESS WHEREOF, the Company has caused this Warrant to be executed by its officer thereunto duly authorized as of the date first above indicated.

YIELD10 BIOSCIENCE, INC.

By: _____

Name: Oliver P. Peoples

Title: President & Chief Executive Officer

NOTICE OF EXERCISE

TO: YIELD10 BIOSCIENCE, INC.

(1) The undersigned hereby elects to purchase _____ Warrant Shares of the Company pursuant to the terms of the attached Warrant (only if exercised in full), and tenders herewith payment of the exercise price in full, together with all applicable transfer taxes, if any.

(2) Payment shall take the form of (check applicable box):

in lawful money of the United States; or

if permitted the cancellation of such number of Warrant Shares as is necessary, in accordance with the formula set forth in subsection 2(c), to exercise this Warrant with respect to the maximum number of Warrant Shares purchasable pursuant to the cashless exercise procedure set forth in subsection 2(c).

(3) Please issue said Warrant Shares in the name of the undersigned or in such other name as is specified below:

The Warrant Shares shall be delivered to the following DWAC Account Number:

[SIGNATURE OF HOLDER]

Name of Investing Entity: _____

Signature of Authorized Signatory of Investing Entity: _____

Name of Authorized Signatory: _____

Title of Authorized Signatory: _____

Date: _____

ASSIGNMENT FORM

(To assign the foregoing Warrant, execute this form and supply required information. Do not use this form to purchase shares.)

FOR VALUE RECEIVED, the foregoing Warrant and all rights evidenced thereby are hereby assigned to

Name:

(Please Print)

Address:

(Please Print)

Phone Number:

Email Address:

Dated: _____, _____

Holder's Signature:

Holder's Address:



October 11, 2019

Yield10 Bioscience, Inc.
19 Presidential Way
Woburn, Massachusetts 01801

Ladies and Gentlemen:

This opinion is furnished to you in connection with the sale and issuance by Yield10 Bioscience, Inc., a Delaware corporation (the “Company”), in a public offering pursuant to the Registration Statement on Form S-1 (Registration Statement No. 333-233683 initially filed with the Securities and Exchange Commission (the “Commission”) under the Securities Act of 1933, as amended (the “Act”), on September 9, 2019, as amended (the “Registration Statement”), of up to (i) \$5,200,000 in Class A Units (the “Class A Units”), with each Class A Unit consisting of one share of the Company’s common stock, par value \$0.01 per share (“Common Stock”), and a warrant to purchase one share of Common Stock, (ii) \$4,000,000 in Class B Units (the “Class B Units”, and collectively with the Class A Units, the “Units”), with each Class B Unit consisting of one share of the Company’s Series A convertible preferred stock, par value \$0.01 per share (“Series A Preferred Stock”) and warrants to purchase shares of Common Stock, (iii) shares of Common Stock issuable upon conversion of the shares of Series A Preferred Stock and (iv) shares of Common Stock issuable upon exercise of the warrants (the “Warrant Shares”) issued under each of the Class A Units and the Class B Units (each a “Warrant” and collectively, the “Warrants”) ((i) through (iv) collectively, the “Securities”). The Units are to be sold by the Company pursuant to an underwriting agreement (the “Underwriting Agreement”) to be entered into by and between the Company and Ladenburg Thalmann & Co., Inc. on behalf of themselves and as representative to the several underwriters to be named therein. The Securities are to be offered and sold in the manner described in the Registration Statement and the related prospectus included therein (the “Prospectus”).

In connection with this opinion, we have examined originals or copies, certified or otherwise identified to our satisfaction, of: (i) the Amended and Restated Certificate of Incorporation of the Company, as amended through the date hereof; (ii) the Amended and Restated Bylaws of the Company, as amended through the date hereof; (iii) the Certificate of Designation of Series A Convertible Preferred Stock to be filed with the Secretary of State of the State of Delaware; (iv) certain resolutions of the Board of Directors of the Company (the “Board”) relating to the issuance, sale and registration of the Securities; (v) the Registration Statement; (vi) the Prospectus; and (vii) the Underwriting Agreement. In addition, we have examined originals or copies, certified or otherwise identified to our satisfaction, of certain other corporate records, documents, instruments and certificates of public officials and of the Company, and we have made such inquiries of officers of the Company and public officials and considered such questions of law as we have deemed necessary for purposes of rendering the opinions set forth herein. Our opinions are limited to the matters stated herein and no opinion is implied or may be inferred beyond the matters expressly stated. As to certain factual matters, we have relied upon a certificate of an officer of the Company and have not sought to independently verify such matters.

In rendering our opinion set forth below, we have assumed that (i) each document submitted to us is accurate and complete; (ii) each such document that is an original is authentic; (iii) each such document that is a copy conforms to an authentic original; and (iv) all signatures (other than signatures on behalf of the Company) on each such document are genuine. We have further assumed the legal capacity of natural persons, and we have assumed that each party to the documents we have examined or relied on (other than the Company) has the legal capacity or

BOSTON LONDON LOS ANGELES NEW YORK SAN DIEGO SAN FRANCISCO WASHINGTON

MINTZ, LEVIN, COHN, FERRIS, GLOVSKY AND POPEO, P.C.

October 11, 2019

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authority and has satisfied all legal requirements that are applicable to that party to the extent necessary to make such documents enforceable against that party. We have further assumed that the Company will not in the future issue or otherwise make unavailable so many shares of Common Stock that there are insufficient remaining authorized but unissued shares of Common Stock for issuance pursuant to exercise of the Warrants. We have also assumed that all of the shares of Common Stock issuable or eligible for issuance pursuant to exercise of the Warrants following the date hereof will be issued for not less than par value. We have not verified any of those assumptions.

Based upon, subject to and limited by the foregoing, we are of the opinion that (i) the shares of Common Stock included in the Class A Units, when issued against payment therefor as set forth in the Registration Statement, will be validly issued, fully paid and non-assessable; (ii) the shares of Series A Preferred Stock included in the Class B Units, when issued against payment therefor as set forth in the Registration Statement, will be validly issued, fully paid and non-assessable; (iii) the shares of Common Stock, when issued upon conversion of the shares of Series A Preferred Stock, will be validly issued, fully paid and non-assessable; (iv) the Warrants, when issued as set forth in the Registration Statement will be legal, valid and binding obligations of the Company, enforceable against the Company in accordance with their terms; (v) the Warrant Shares, when issued upon exercise of the Warrants against payment therefor as set forth in the Registration Statement, will be validly issued, fully paid and non-assessable; (vi) the Class A Units, when duly delivered by the Company against the payment of consideration therefor and as contemplated in the Registration Statement, will constitute valid and legally binding obligations of the Company; and (vii) the Class B Units, when duly delivered by the Company against the payment of consideration therefor and as contemplated in the Registration Statement, will constitute valid and legally binding obligations of the Company.

We express no opinion as to matters governed by any laws other than the Delaware General Corporation Law and the federal laws of the United States of America, as in effect on the date hereof.

We hereby consent to the filing of this opinion as an exhibit to the Registration Statement and to the reference to our firm under the caption "Legal Matters" in the Prospectus. In giving such permission, we do not admit hereby that we come within the category of persons whose consent is required under Section 7 of the Act, or the rules and regulations of the Commission thereunder. This opinion is expressed as of the date hereof, and we disclaim any undertaking to advise you of any subsequent changes in the facts stated or assumed herein or of any subsequent changes in applicable law.

Very truly yours,

/s/ Mintz, Levin, Cohn, Ferris, Glovsky & Popeo, P.C.

Mintz, Levin, Cohn, Ferris, Glovsky & Popeo, P.C.

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We consent to the incorporation by reference in this Amendment No. 1 to the Registration Statement (No. 333-233683) on Form S-1 of Yield10 Bioscience, Inc. of our report dated March 28, 2019, except for the change in method of accounting for leasing transactions due to the adoption of Financial Accounting Standard Board's Accounting Standards Update 2016-02, *Leases*, described in the Change in Accounting Principle section of Note 2, and the New Lease Accounting section of Note 11, as to which the date is September 9, 2019, relating to the consolidated financial statements of Yield10 Bioscience, Inc. and its subsidiaries, appearing in the Current Report on Form 8-K of Yield10 Bioscience, Inc. filed on September 9, 2019.

We also consent to the reference to our firm under the heading "Experts" in such Registration Statement.

/s/ RSM US LLP
Boston, Massachusetts
October 11, 2019