

PROSPECTUS SUPPLEMENT
To the Prospectus dated May 24, 2021



**920,000 Shares of Common Stock
Pre-Funded Warrants to Purchase up to 1,668,236 Shares of Common Stock
Up to 1,668,236 Shares of Common Stock Underlying the Pre-Funded Warrants**

We are offering 920,000 shares of our common stock, par value \$0.0001 per share (“Common Stock”), and pre-funded warrants (“Pre-funded Warrants”) to purchase up to 1,668,236 shares of our Common Stock directly to a single institutional investor pursuant to this prospectus supplement and the accompanying prospectus. Each Pre-funded Warrant will have an exercise price of \$0.001 per share and will be exercisable upon issuance until exercised in full, and is subject to adjustments in the event of stock splits, dividends, subsequent rights offerings, pro rata distributions, and certain fundamental transactions, as more fully described in the section of this prospectus supplement titled “*Description of Securities We are Offering*.” The offering price per share of Common Stock and per Pre-funded Warrant is \$1.700 and \$1.699, respectively.

In a concurrent private placement, we are also selling to the same institutional investor that received shares of Common Stock and Pre-funded Warrants pursuant to this prospectus supplement and the accompanying prospectus, unregistered warrants to purchase up to 2,588,236 shares of Common Stock (the “Warrants”). The Warrants are being sold for \$0.125 per Warrant (which is included in the offering price per share and Pre-funded Warrant), have an exercise price of \$1.58 per share and are exercisable for a period of five and one-half (5.5) years from the date of the issuance. The Warrants, and the shares of Common Stock issuable upon exercise of the Warrants, are being offered pursuant to the exemption provided in Section 4(a)(2) under the Securities Act of 1933, as amended (the “Securities Act”), and Rule 506(b) promulgated thereunder and are not being registered under the Securities Act at this time or offered pursuant to this prospectus supplement and the accompanying prospectus. The Warrants are more fully described in the section of this prospectus supplement titled “*Private Placement Transaction*.”

Our Common Stock is listed on the Nasdaq Capital Market under the symbol “MBIO.” On October 25, 2023, the last trading day before our entry into the securities purchase agreement providing for the sale of the shares of Common Stock and Pre-funded Warrants, the last reported sale price of our Common Stock on the Nasdaq Capital Market was \$1.70 per share. There is no established public trading market for the Pre-funded Warrants being offered in this offering and the Warrants being sold in a concurrent private placement, and we do not expect a market to develop. In addition, we do not intend to apply for listing of the Pre-funded Warrants or the Warrants on any national securities exchange or other trading market. Without an active market, the liquidity of the Pre-funded Warrants and the Warrants will be limited.

As of October 25, 2023, the aggregate market value of our outstanding Common Stock held by non-affiliates, or public float, was approximately \$21,465,170 million, based on 8,296,361 shares of outstanding Common Stock, of which approximately 1,791,764 shares were held by affiliates, and a price of \$3.30 per share, which was the price at which our Common Stock was last sold on the Nasdaq Capital Market on August 30, 2023. We have sold approximately \$0.16 million of securities pursuant to General Instruction I.B.6 of Form S-3 during the prior 12-calendar month period that ends on and includes the date of this prospectus supplement (excluding this offering). Accordingly, based on the foregoing, we are currently eligible under General Instruction I.B.6 of Form S-3 to offer and sell shares of our Common Stock having an aggregate offering price of up to approximately \$7.155 million. Pursuant to General Instruction I.B.6 of Form S-3, in no event will we sell securities in a public primary offering with a value exceeding one-third of our public float in any 12-month period so long as our public float remains below \$75.0 million.

We have engaged H.C. Wainwright & Co., LLC (the “Placement Agent”) as our exclusive placement agent in connection with this offering. The Placement Agent has no obligation to buy any of the securities from us or to arrange for the purchase or sale of any specific number or dollar amount of the securities. We have agreed to pay the Placement Agent the fees set forth in the table below. We have not made any arrangements to place the funds from the investors in an escrow, trust or similar account. See “*Plan of Distribution*” beginning on page S-22 of this prospectus supplement for more information regarding these arrangements.

Investing in our securities involves a high degree of risk. See “Risk Factors” beginning on page S-10 of this prospectus supplement as well as the information under the caption “Risk Factors” in our Annual Report on Form 10-K for the year ended December 31, 2022 and in our Quarterly Report on Form 10-Q for the quarter ended June 30, 2023, and in the other documents incorporated by reference into this prospectus supplement and the accompanying prospectus for a discussion of the factors you should carefully consider before investing in our securities.

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

	Per Share	Per Share Underlying Pre-funded Warrant	Total
Offering price	\$ 1.700	\$ 1.699	\$ 4,398,332.96
Placement agent fees ⁽¹⁾	\$ 0.119	\$ 0.119	\$ 308,000.08
Proceeds, before expenses, to us ⁽²⁾	\$ 1.581	\$ 1.580	\$ 4,090,332.88

(1) We have also agreed to (i) issue warrants to purchase up to 155,294 shares of Common Stock to the Placement Agent, or its designees and (ii) pay the Placement Agent for certain expenses. See “*Plan of Distribution*” beginning on page S-22 for additional information regarding the compensation to be paid to the Placement Agent.

(2) The amount of the offering proceeds to us presented in this table does not include proceeds from the exercise of any of the Warrants being issued in the concurrent private placement.

Delivery of shares of Common Stock and Pre-funded Warrants is expected to be made on or about October 30, 2023, subject to the satisfaction of certain closing conditions.

H.C. Wainwright & Co.

The date of this prospectus supplement is October 26, 2023.

TABLE OF CONTENTS

Prospectus Supplement	Page
ABOUT THIS PROSPECTUS SUPPLEMENT	S-1
SPECIAL CAUTIONARY NOTICE REGARDING FORWARD LOOKING STATEMENTS	S-2
PROSPECTUS SUPPLEMENT SUMMARY	S-4
THE OFFERING	S-8

RISK FACTORS	S-10
CAPITALIZATION	S-12
DILUTION	S-14
USE OF PROCEEDS	S-16
DIVIDEND POLICY	S-17
DESCRIPTION OF THE SECURITIES WE ARE OFFERING	S-18
PRIVATE PLACEMENT TRANSACTION	S-20
PLAN OF DISTRIBUTION	S-22
LEGAL MATTERS	S-25
EXPERTS	S-25
WHERE YOU CAN FIND MORE INFORMATION	S-25
INCORPORATION OF CERTAIN INFORMATION BY REFERENCE	S-26

Prospectus	Page
SUMMARY	1
ABOUT THIS PROSPECTUS	3
DESCRIPTION OF CAPITAL STOCK	4
DESCRIPTION OF WARRANTS	6
DESCRIPTION OF DEBT SECURITIES	7
DESCRIPTION OF UNITS	10
PLAN OF DISTRIBUTION	11
LEGAL MATTERS	12
EXPERTS	12
WHERE YOU CAN FIND MORE INFORMATION	12
INCORPORATION OF CERTAIN DOCUMENTS BY REFERENCE	12

ABOUT THIS PROSPECTUS SUPPLEMENT

This document is in two parts. The first part is this prospectus supplement, which describes the specific terms of this offering and also adds to and updates information contained in the accompanying prospectus and the documents incorporated by reference in this prospectus supplement and the accompanying prospectus. The second part, the accompanying prospectus dated May 24, 2021, including the documents incorporated by reference, provides more general information, some of which may not apply to this offering. Generally, when we refer to this prospectus supplement, we are referring to both parts of this document combined.

To the extent there is a conflict between the information contained in this prospectus supplement and the information contained in the accompanying prospectus or any document incorporated by reference that was filed with the U.S. Securities and Exchange Commission (the “SEC”) prior to the date of this prospectus supplement, you should rely on the information in this prospectus supplement; provided that, if any statement in one of these documents is inconsistent with a statement in another document having a later date—for example, a document incorporated by reference in the accompanying prospectus—the statement in the document having the later date modifies or supersedes the earlier statement.

We have not, and the Placement Agent has not, authorized anyone to provide you with information that is in addition to or different from that contained or incorporated by reference in this prospectus supplement and the accompanying prospectus. We take no responsibility for, and can provide no assurance as to the reliability of, any other information that others may give to you. Neither the delivery of this prospectus supplement or the accompanying prospectus, including any free writing prospectus that we have authorized for use in this offering, nor the sale of our securities means that information contained in this prospectus supplement and the accompanying prospectus, including any free writing prospectus that we have authorized for use in this offering, is correct after their respective dates. It is important for you to read and consider all information contained in this prospectus supplement and the accompanying prospectus, including the information incorporated by reference into this prospectus supplement and the accompanying prospectus, and any free writing prospectus that we have authorized for use in connection with this offering, in making your investment decision. You should also read and consider the information in the documents to which we have referred you in the sections titled “*Where You Can Find More Information*” and “*Incorporation of Certain Information By Reference*” in this prospectus supplement.

We further note that the representations, warranties and covenants made by us in any agreement that is filed as an exhibit to any document that is incorporated by reference herein, were made solely for the benefit of the parties to such agreement, including, in some cases, for the purpose of allocating risk among the parties to such

agreements, and should not be deemed to be a representation, warranty or covenant to you. Moreover, such representations, warranties or covenants were accurate only as of the date when made. Accordingly, such representations, warranties and covenants should not be relied on as accurately representing the current state of our affairs.

Unless otherwise stated, all references in this prospectus supplement to “we,” “us,” “our,” “Mustang,” the “Company” and similar designations refer to Mustang Bio, Inc. and its consolidated subsidiaries.

S-1

SPECIAL CAUTIONARY NOTICE REGARDING FORWARD-LOOKING STATEMENTS

This prospectus supplement contains predictive or “forward-looking statements” for purposes of the Securities Act and the Securities Exchange Act of 1934, as amended (the “Exchange Act”), and involve known and unknown risks, uncertainties and other factors that may cause our actual results, performance or achievements to be materially different from the future results, performance or achievements expressed or implied by such forward-looking statements. The words “anticipate,” “believe,” “estimate,” “may,” “expect” and similar expressions are generally intended to identify forward-looking statements. Such forward-looking statements include, but are not limited to, statements about our:

- expectations for increases or decreases in expenses;
- expectations for the clinical and pre-clinical development, manufacturing, regulatory approval, and commercialization of our product candidates or any other products we may acquire or in-license;
- our use of clinical research centers and other contractors;
- expectations for incurring capital expenditures to expand our research and development and manufacturing capabilities;
- expectations for generating revenue or becoming profitable on a sustained basis;
- expectations or ability to enter into marketing and other partnership agreements;
- expectations or ability to enter into product acquisition and in-licensing transactions;
- expectations or ability to build our own commercial infrastructure to manufacture, market and sell our product candidates;
- acceptance of our products by doctors, patients or payors;
- our ability to compete against other companies and research institutions;
- our ability to secure adequate protection for our intellectual property;
- our ability to attract and retain key personnel;
- availability of reimbursement for our products;
- estimates of the sufficiency of our existing cash and cash equivalents and investments to finance our operating requirements, including expectations regarding the value and liquidity of our investments;
- the volatility of our stock price;
- expected losses;
- expectations for future capital requirements;
- statements about the Company’s expectations with respect to the consummation of the sale of its manufacturing facility and its ability to fund its operations, including continued investment in its research and development pipeline;
- the Company’s anticipated savings and expenses relating to the consummation of the sale of the Facility;
- the discontinuance of its MB-102, its CD123-targeted CAR T cell therapy, as well as its HER2-, CS1- and PSCA-targeted CAR T cell therapy programs;
- the postponing of the XSCID (formerly MB-107 and MB-207; going forward MB-117 and MB-217) pivotal trials and the related reduction in the Company’s workforce;
- and the Company’s plans and timeline regarding its XSCID program.

Our actual results may differ materially from the results anticipated in these forward-looking statements due to a variety of factors, including among other things, risks related to the satisfaction of the conditions to closing the sale of the Company’s manufacturing facility in the anticipated timeframe or at all; whether the prospective purchaser of the Company’s manufacturing facility is able to successfully perform its obligation to produce the Company’s products under the manufacturing services agreement on a timely basis and to acceptable standards; disruption from the sale of the Company’s manufacturing facility making it more difficult to maintain business and operational relationships; negative effects of the announcement or the consummation of the transaction on the market price of the Company’s Common Stock; significant transaction costs; the development stage of the Company’s primary product candidates, our ability to obtain, perform under, and maintain financing and strategic agreements and relationships; risks relating to the results of research and development activities; risks relating to the timing of starting and completing clinical trials; uncertainties relating to preclinical and clinical testing; our dependence on third-party suppliers; our ability to attract, integrate and retain key personnel; the early stage of products under development; our need for substantial additional funds; government regulation; patent and intellectual property matters; competition and those factors described in the section titled “*Risk Factors*” beginning on page S-10 of this prospectus supplement. All written or oral forward-looking statements attributable to us are expressly qualified in their entirety by these cautionary statements.

S-2

The forward-looking statements contained in this prospectus supplement reflect our views and assumptions as of the date of this prospectus supplement. Except as required by law, we assume no responsibility for updating any forward-looking statements.

We qualify all of our forward-looking statements by these cautionary statements.

S-3

PROSPECTUS SUPPLEMENT SUMMARY

This summary highlights certain information about us, this offering and information appearing elsewhere in this prospectus supplement, in the accompanying prospectus and in the documents we incorporate by reference. This summary is not complete and does not contain all of the information that you should consider before making an investment decision. To fully understand this offering and its consequences to you, you should read this entire prospectus supplement and the accompanying prospectus carefully, including the factors described under the heading “Risk Factors” in this prospectus supplement beginning on page S-10, together with any free writing prospectus we have authorized for use in connection with this offering and the financial statements and all other information incorporated by reference in this prospectus supplement and the accompanying prospectus.

CORPORATE SUMMARY

We are a clinical-stage biopharmaceutical company focused on translating today's medical breakthroughs in cell and gene therapies into potential cures for hematologic cancers, solid tumors and rare genetic diseases. We have acquired rights to these technologies by licensing or otherwise acquiring an ownership interest in the technologies, funding their research and development and eventually will seek either to out-license or bring the technologies to market.

Our pipeline is currently focused in three core areas: chimeric antigen receptor ("CAR") engineered T cell ("CAR T") therapies for hematologic malignancies, CAR T therapies for solid tumors, and gene therapies for rare genetic disorders. For our CAR T therapies, we have partnered with the City of Hope National Medical Center ("COH"), Fred Hutchinson Cancer Center ("Fred Hutch"), Nationwide Children's Hospital ("Nationwide") and the Mayo Clinic ("Mayo Clinic"). For our gene therapies, we have partnered with St. Jude Children's Research Hospital ("St. Jude") in the development of a first-in-class ex vivo lentiviral ("LV") gene therapy treatment of X-linked severe combined immunodeficiency ("XSCID") and with Leiden University Medical Center ("LUMC") in the development of a first-in-class ex vivo LV gene therapy treatment of RAG1-SCID.

CAR T Therapies

Our pipeline of CAR T therapies is being developed under exclusive licenses from several world class research institutions. Our strategy is to license these technologies, support preclinical and clinical research activities by our academic partners and transfer the underlying technology to our contract manufacturer's cell processing facility, in order to conduct our own clinical trials. We are developing CAR T therapies for hematologic malignancies in partnership with Fred Hutch targeting CD20 (MB-106).

MB-106 (CD20-targeted CAR T cell therapy for Non-Hodgkin Lymphoma and Chronic Lymphocytic Leukemia)

MB-106 continues to generate promising preliminary safety and efficacy data in patients with B-cell malignancies, and the product profile of this autologous CD20-directed CAR T suggests a favorable profile to date compared to the currently-approved autologous CD19-directed CAR Ts.

In June 2023, the Company announced that updated data from the ongoing Phase 1/2 Fred Hutch-sponsored clinical trial of MB-106 were presented at the European Hematology Association 2023 Hybrid Congress and such data showed a favorable safety and efficacy profile in patients with Waldenstrom macroglobulinemia ("WM"), a rare form of blood cancer for which the U.S. Food and Drug Administration (the "FDA") has granted MB-106 Orphan Drug Designation. All six patients in the study had been previously treated with Bruton's tyrosine kinase inhibitors ("BTKi"), and their disease had continued to progress while on BTKi's. Overall, 83% (5/6) of the patients treated with MB-106 responded to treatment, including 2 complete responses, 1 very good partial response, 1 partial response, and 1 minor response. In addition, 1 patient experienced stable disease. One of the patients who achieved a complete response was in ongoing remission at 22 months, with an immunoglobulin M ("IgM") level that had decreased rapidly to the normal range after treatment with MB-106 and remained normal since. No patient had started additional anti-WM treatment after being treated with MB-106. From a safety perspective, cytokine release syndrome ("CRS") occurred in five patients: two patients with grade 1 and three patients with grade 2. One patient experienced grade 1 immune effector cell-associated neurotoxicity syndrome ("ICANS"). No grade 3 or 4 CRS or grade 2, 3 or 4 ICANS was observed.

S-4

Also in June 2023, Mustang Bio announced that updated data from the same Phase 1/2 Fred Hutch-sponsored clinical trial of MB-106 were presented at the 1st International Conference on Malignant Lymphoma and showed a favorable safety and efficacy profile in patients with follicular lymphoma (FL). A total of 20 patients with relapsed FL with confirmed CD20 expression participated in the study and had day 28 assessment. The median age of the patients was 63 years (ranging from 44 – 81), and the median prior lines of treatment was 4 (ranging from 1 – 12). High-risk features included patients with progression of disease within 24 months of first-line chemoimmunotherapy (n=15, 75%), history of histologic transformation (n=4, 20%), and prior treatment with a CD19-directed target CAR T (n=1, 5%). The overall response rate ("ORR") was 95% (19/20), and the complete response ("CR") rate was 80% (16/20). Patients who received higher dose levels (3.3×10^6 and 1.0×10^7 cells/kg) had an ORR of 100% and a CR rate of 91%. Ten patients were in remission over one year, seven of whom were over two years. One patient, previously treated with a CD19-targeted CAR T-cell therapy, achieved a CR and remained in remission after 18 months. From a safety profile perspective, all CRS events were grade 1 (n=5; 25%) or grade 2 (n=1; 5%), with no grade ≥ 3 CRS events. There was no occurrence of ICANS of any grade.

In October 2022, Mustang Bio announced that the first patient had been treated in its multicenter, open-label, non-randomized Phase 1/2 clinical trial evaluating the safety and efficacy of MB-106 for the treatment of relapsed or refractory B-cell non-Hodgkin lymphomas ("B-NHL") and chronic lymphocytic leukemia ("CLL"). This six-center Phase 1/2 clinical trial is a three-arm study targeting CLL, indolent B-NHL including FL and WM, and aggressive lymphoma including diffuse large B-cell lymphoma and mantle cell lymphoma. Included in the eligibility criteria for the trial are patients who have relapsed after treatment with CD19-directed CAR-T cell therapy. Since the Mustang-sponsored multicenter clinical trial is using the same lentiviral vector as the Company's Fred Hutch-sponsored single-center trial, the FDA allowed dose escalation to begin at a higher dose than the starting dose in the Fred Hutch trial.

In August 2023, Mustang Bio announced the first data from the indolent lymphoma cohort of this Mustang-sponsored multicenter clinical trial, demonstrating clinical responses as well as safety and efficacy consistent with the ongoing Phase 1/2 Fred Hutch-sponsored clinical trial. The multicenter study data showed clinical responses in four of four patients with relapsed or refractory indolent NHL at the starting dose of 3.3×10^6 CAR-T cells/kg, a dose comparable to that employed for the majority of the indolent lymphoma patients in the Fred Hutch trial. The multicenter data also showed persistence of CAR-T cells at 6+ months and favorable safety data, with only Grade 1 CRS reported to date. Two patients with follicular lymphoma had CR by both PET-CT and bone marrow, one of whom had been previously treated with a CD19-directed CAR-T. A third patient, with a diagnosis of WM, who had nine prior treatments and high disease burden, achieved complete metabolic response by PET-CT, morphologic clearance of lymphoma in bone marrow, and resolution of the IgM monoclonal protein. The fourth patient, with a diagnosis of hairy cell leukemia variant, who had been heavily transfusion dependent, continued to have stable disease with decreased disease in his bone marrow and achieved complete transfusion independence, which was ongoing at six plus months. Following treatment of these four indolent NHL patients, the Safety Review Committee unanimously approved dose escalation to 1.0×10^7 CAR-T cells/kg.

In the remainder of 2023, Mustang Bio anticipates continuing dose escalation in its multicenter, 3-arm Phase 1 trial and reporting updated response data from the Phase 1 indolent arm of this trial in the fourth quarter of the year. In mid-2024, the Company expects to treat the first patient in a non-randomized pivotal multicenter trial in WM, with top-line data anticipated from this trial in 2026.

MB-109 (Combination of MB-101 CAR T Therapy with MB-108 Oncolytic Virus Therapy for Malignant Brain Tumors)

In April 2022, in association with a poster presentation by COH at the American Association for Cancer Research Annual Meeting, Mustang announced interim data from two ongoing investigator-sponsored Phase 1 clinical trials evaluating two clinical candidates, MB-101 (IL13R α 2-targeted CAR T cell therapy licensed from COH) and MB-108 (herpes simplex virus type 1 oncolytic virus licensed from Nationwide) for the treatment of recurrent glioblastoma. At that time, Mustang noted that the two patients on the MB-101 Phase 1 trial with the highest levels of intratumoral CD3+ T cells pre-therapy had achieved the only 2 CRs observed among the 65 heavily pretreated patients who had been enrolled. These CRs lasted 7.5 and over 31 months, respectively. Preclinical data also presented at that time supported the safety of administering these two therapies sequentially in a combination regimen designated as MB-109. At the present time, all IND-enabling preclinical and manufacturing activities requested by the FDA to support the start of a Phase 1 trial of MB-109 have been completed.

In Vivo CAR T Platform Technology

Mustang is collaborating with the Mayo Clinic to develop a novel technology that may be able to transform the administration of CAR T therapies and potentially be used as an off-the-shelf therapy. In 2023, the Mayo Clinic expects to publish *in vivo* proof-of-concept data in a mouse model of cancer in a major scientific journal, and Mustang plans to file an IND application for a multicenter Phase 1 clinical trial once a lead construct has been identified.

Gene Therapies

MB-117 (Ex vivo LV Gene Therapy for Newly Diagnosed X-linked Severe Combined Immunodeficiency (XSCID)) and MB-217 (Ex vivo LV Gene Therapy for Previously Transplanted XSCID)

In partnership with St. Jude, our XSCID gene therapy programs (MB-117 and MB-217) are being conducted under an exclusive license to develop a potentially curative treatment for XSCID, a rare genetic immune system condition in which affected patients do not live beyond infancy without treatment. This first-in-class *ex vivo* LV gene therapy has been utilized in two Phase 1/2 clinical trials involving two different autologous cell products produced via transduction of patients' hematopoietic stem cells using a predecessor LV vector. These cell products were designated MB-107 and MB-207, and the respective Phase 1/2 clinical trials were: a multicenter trial of the MB-107 product in newly diagnosed infants sponsored by St. Jude (LVXSCID-ND) and a single-center trial of the MB-207 product in previously transplanted patients sponsored by the National Institutes of Health ("NIH") (LVXSCID-OC).

Going forward, this predecessor LV vector will be replaced by a modified LV vector which will be used to produce the MB-117 and MB-217 cell products. In 2023, St. Jude intends to initiate a new Phase 1 trial in newly diagnosed infants using MB-117, and the NIH intends to initiate a new Phase 1 trial in previously transplanted patients using MB-217.

LUMC License

MB-110, a first-in-class *ex vivo* treatment for RAG1 SCID, is currently being evaluated at LUMC in a Phase 1/2 multicenter clinical trial in Europe. In 2022 the first patient was treated without any complications, after which the patient developed a functioning immune system which responded well to the standard vaccinations for newborns. In 2023 we expect that additional centers will be added in Europe and that additional patients will be enrolled.

RECENT DEVELOPMENTS

In connection with the sale of its leasehold interest in its cell processing facility located in Worcester, Massachusetts (the "Facility") and associated assets relating to the manufacturing and production of cell and gene therapies at the Facility (the "Facility Transaction") to uBriGene (Boston) Biosciences, Inc., a Delaware corporation ("uBriGene") and an indirect, wholly owned subsidiary of UBriGene (Jiangsu) Biosciences Co., Ltd., a Chinese contract development and manufacturing organization, the Company and uBriGene previously submitted a voluntary notice with the U.S. Committee on Foreign Investment in the United States ("CFIUS"). CFIUS' initial 45-day review of the Facility Transaction was completed on September 28, 2023. Because CFIUS has not yet concluded its action, the proceeding has transitioned to a second 45-day phase as CFIUS investigates the Facility Transaction. CFIUS has advised counsel for the Company that its investigation will be completed no later than November 13, 2023.

In addition, on October 26, 2023 the Company announced the FDA's acceptance of its IND application for MB-109. The Company intends to initiate a Phase 1 multicenter clinical trial at COH and the University of Alabama at Birmingham to assess the safety, tolerability and efficacy of MB-109 in adult patients with recurrent glioblastoma and high-grade astrocytomas.

CORPORATE INFORMATION

Our principal executive offices are located at 377 Plantation Street, Worcester, Massachusetts 01605, and our telephone number is 781-652-4500. We maintain a website on the Internet at www.mustangbio.com and our e-mail address is info@mustangbio.com. Our Internet website, and the information contained on it, are not to be considered part of this prospectus supplement.

We are a majority-controlled subsidiary of Fortress Biotech, Inc. ("Fortress").

THE OFFERING

Securities Offered by Us:

920,000 shares of Common Stock

Pre-funded Warrants to purchase up to 1,668,236 shares of Common Stock at an exercise price of \$0.001 per share. Each Pre-funded Warrant will be exercisable immediately upon issuance and will not expire until exercised in full. This prospectus supplement also relates to the offering of the shares of Common Stock issuable upon exercise of such Pre-funded Warrants. There is no established public trading market for the Pre-funded Warrants, and we do not expect a market to develop. In addition, we do not intend to list the Pre-funded Warrants on the Nasdaq Capital Market or any other nationally recognized trading system. See "Description of the Securities We are Offering—Pre-funded Warrants Issued in This Offering" for a discussion of the terms of the Pre-funded Warrants.

Offering Price:

\$1.70 per share of Common Stock and \$1.699 per Pre-funded Warrant

Common Stock to be Outstanding After the Offering:

10,885,426 shares of Common Stock, assuming exercise of all Pre-funded Warrants being offered herein, and no exercise of the Warrants being issued in the concurrent private placement transaction.

Use of Proceeds:	<p>We estimate the net proceeds from this offering will be approximately \$3.9 million, after deducting placement agent fees and estimated offering expenses payable by us.</p> <p>The net proceeds from this offering will be used for general corporate purposes and working capital requirements, which may include, among other things, the advancement of our product candidates to obtain regulatory approval from the FDA. We will, however, have broad discretion to allocate the net proceeds of this offering.</p> <p>See “<i>Use of Proceeds</i>” on page S-16 of this prospectus supplement.</p>
Concurrent Private Placement:	<p>In a concurrent private placement, we are issuing to the same institutional investor purchasing shares of our Common Stock and Pre-funded Warrants in this offering, Warrants to purchase up to 2,588,236 shares of Common Stock at an exercise price of \$1.58 per share, exercisable for a period of five and one-half years from the date of issuance. We will receive gross proceeds from the concurrent private placement transaction solely to extent such Warrants are exercised for cash. The Warrants and the shares of Common Stock issuable upon the exercise of the Warrants are not being offered pursuant to this prospectus supplement and the accompanying prospectus and are being offered pursuant to the exemption provided in Section 4(a)(2) under the Securities Act. There is no established public trading market for the Warrants, and we do not expect a market to develop. In addition, we do not intend to list the Warrants on the Nasdaq Capital Market or any other nationally recognized trading system. See “<i>Private Placement Transaction</i>” on page S-20 of this prospectus supplement.</p>

S-8

Prohibitions on Subsequent Equity Sales:	<p>Pursuant to the securities purchase agreement with the investor, we are prohibited from entering into any agreement to issue or announcing the issuance or proposed issuance of any shares of Common Stock or securities convertible or exercisable into Common Stock, subject to certain exceptions, for a period commencing on the date of the securities purchase agreement and expiring 45 days from the closing date of the offering.</p> <p>Furthermore, we are prohibited from entering into any agreement to issue Common Stock or Common Stock equivalent involving a Variable Rate Transaction (as defined in the securities purchase agreement), subject to certain exceptions, for a period commencing on the date of the securities purchase agreement and expiring one year from the closing date of the offering.</p>
Risk Factors:	<p>See “<i>Risk Factors</i>” beginning on page S-10 of this prospectus supplement and in our Annual Report on Form 10-K for the year ended December 31, 2022, which is incorporated by reference herein, for a discussion of factors that you should consider before investing in our securities.</p>
Nasdaq Capital Market Symbol:	<p>MBIO</p>
<p>The number of shares of Common Stock to be outstanding after this offering is based on 8,297,190 shares of our Common Stock outstanding as of October 23, 2023, and excludes:</p> <ul style="list-style-type: none"> · 70,102 shares of Common Stock issuable upon exercise of outstanding warrants having a weighted-average exercise price of \$22.80 per share; · 160,100 shares of Common Stock issuable upon the vesting and settlement of outstanding restricted stock units; · 76,112 shares of Common Stock issuable upon the vesting and exercise of outstanding stock options; · 287,606 shares of Common Stock reserved for issuance and available for future grant under our 2016 Incentive Plan; · 2,588,236 shares of Common Stock issuable upon exercise of the Warrants being issued in the concurrent private placement, at an exercise price of \$1.58 per share, as described in “<i>Private Placement Transaction</i>”; and · 155,294 shares of Common Stock issuable upon exercise of warrants to be issued to the Placement Agent as compensation in connection with this offering, at an exercise price of \$2.125 per share, as described in “<i>Plan of Distribution</i>.” <p>Unless otherwise indicated, all information in this prospectus supplement assumes no exercise of the outstanding warrants or settlement of outstanding restricted stock awards/units, described above.</p>	

S-9

RISK FACTORS

Investing in our securities involves a high degree of risk. This prospectus supplement does not describe all of those risks. You should consider the risk factors described in this prospectus supplement below, as well as the those described under the caption “Risk Factors” in the accompanying prospectus, and in the documents incorporated by reference herein, including our Annual Report on Form 10-K for the fiscal year ended December 31, 2022, and in our most recent Quarterly Report on Form 10-Q, together with the other information contained or incorporated by reference in this prospectus supplement and the accompanying prospectus, and in any free writing prospectus that we have authorized for use in connection with this offering, before making an investment decision.

If any of these risks occur, our business, financial condition, results of operations and future prospects would likely be materially and adversely affected. In these circumstances, the market price of our Common Stock would likely decline and you may lose all or part of your investment. Share information set forth in these risk factors is as of the dates set forth herein or therein and unless otherwise indicated, does not give effect to the issuance of the securities in connection with this offering.

Risks Related to this Offering and our Securities

The trading price of the shares of our Common Stock has been and is likely to continue to be highly volatile, and purchasers of our Common Stock could incur substantial losses.

Our stock price has been and will likely continue to be volatile for the foreseeable future. The stock market in general and the market for biotechnology companies in particular have experienced extreme volatility that has often been unrelated to the operating performance of particular companies. As a result of this volatility, investors may not be able to sell their Common Stock at or above the price they paid.

In addition, in the past, stockholders have initiated class action lawsuits against biotechnology and pharmaceutical companies following periods of volatility in the market prices of these companies' securities. Such litigation and any litigation that may be instituted against us, our officers and/or our directors in the future, could cause us to incur substantial costs and divert management's attention and resources, which could have a material adverse effect on our business, financial condition and results of operations.

You will experience immediate and substantial dilution.

Because the price per share of Common Stock being offered is substantially higher than the net tangible book value per share of Common Stock, you will incur substantial dilution in the net tangible book value of the Common Stock you purchase in this offering. If you purchase shares of Common Stock in this offering, you will incur immediate and substantial dilution of \$0.07 per share in the net tangible book value of the Common Stock. In addition, we may issue additional securities in the future, including shares of Common Stock, securities that are convertible into or exchangeable for, or that represent the right to receive, Common Stock or substantially similar securities. The issuance of these securities may cause further dilution to our stockholders. The exercise of outstanding stock options and the vesting of outstanding restricted stock units may also result in further dilution of your investment, the Warrants sold in our concurrent private placement or other previously outstanding warrants. See the section titled "Dilution" below for a more detailed discussion of the dilution you would incur if you purchase securities in this offering.

The Pre-funded Warrants are not listed for trading on any exchange, and we do not expect a market to develop for the Pre-funded Warrants.

There is no established public trading market for the Pre-funded Warrants, and we do not expect a market to develop. In addition, we do not intend to apply for listing the Pre-funded Warrants on any national securities exchange or other trading market. Without an active market, the liquidity of the Pre-funded Warrants will be limited. Further, the existence of the Pre-funded Warrants and Warrants may act to reduce both the trading volume and the trading price of our Common Stock.

S-10

The Pre-funded Warrants are speculative in nature and do not entitle the holder to any rights as common stockholders until the holder exercises the warrant for shares of our Common Stock, except as set forth in the Pre-funded Warrants.

Except as otherwise provided in the Pre-funded Warrants, until holders of Pre-funded Warrants acquire shares of Common Stock upon exercise of the Pre-funded Warrants, holders of Pre-funded Warrants will have no rights with respect to our Common Stock underlying such Pre-funded Warrants. Upon exercise of the Pre-funded Warrants, the holders will be entitled to exercise the rights of a stockholder only as to matters for which the record date occurs after the exercise date. Moreover, following this offering, the market value of the Pre-funded Warrants is uncertain. There can be no assurance that the market price of our Common Stock will ever equal or exceed the price of the Pre-funded Warrants, and, consequently, whether it will ever be profitable for investors to exercise their Pre-funded Warrants.

A substantial number of shares of our Common Stock could be sold into the public market in the near future, which could depress our stock price.

Sales of substantial amounts of Common Stock in the public market could reduce the prevailing market prices for our Common Stock. Substantially all of our outstanding Common Stock is eligible for sale as are shares of Common Stock issuable under vested and exercisable stock options. If our existing stockholders sell a large number of shares of our Common Stock, or the public market perceives that existing stockholders might sell shares of Common Stock, the market price of our Common Stock could decline significantly. These sales might also make it more difficult for us to sell equity securities at a time and price that we deem appropriate.

We have broad discretion over the use of our cash and cash equivalents, including the net proceeds we receive in this offering, and may not use them effectively.

Our management has broad discretion to use our cash and cash equivalents, including the net proceeds we receive in this offering, to fund our operations and could spend these funds in ways that do not improve our results of operations or enhance the value of our Common Stock. The failure by our management to apply these funds effectively could result in financial losses that could have a material adverse effect on our business, cause the price of our Common Stock to decline or delay the development of our product candidates. Pending their use to fund operations, we may invest our cash, cash equivalents and marketable securities in a manner that does not produce income or that loses value.

Provisions of the Pre-funded Warrants offered by this prospectus could discourage an acquisition of us by a third party.

Certain provisions of the Pre-funded Warrants offered by this prospectus could make it more difficult or expensive for a third party to acquire us. The Pre-funded Warrants prohibit us from engaging in certain transactions constituting "fundamental transactions" unless, among other things, the surviving entity assumes our obligations under the Pre-funded Warrants. These and other provisions of the Pre-funded Warrants offered by this prospectus could prevent or deter a third party from acquiring us even where the acquisition could be beneficial to stockholders.

S-11

CAPITALIZATION

The following table sets forth our capitalization as of June 30, 2023:

- on an actual basis; and
- on an as adjusted basis to give further effect to the issuance and sale of (a) 920,000 shares of Common Stock at an offering price of \$1.70 per share and (b) Pre-funded Warrants to purchase up to 1,668,236 shares of Common Stock at an offering price of \$1.699 per Pre-funded Warrant, after deducting placement agent fees and estimated offering expenses payable by us.

You should read this table together with our financial statements and related notes and the "Management's Discussion and Analysis of Financial Condition and Results of Operations" in each of our Annual Report on Form 10-K for the year ended December 31, 2022 and our Quarterly Report on Form 10-Q for the quarter ended June 30, 2023.

(\$ in thousands, except share and per share amounts)	June 30, 2023 (unaudited)	
	Actual	As Adjusted
Cash and cash equivalents	\$ 15,385	\$ 19,401
Stockholders' Equity (Deficit)		

Preferred Stock (\$0.0001 par value), 2,000,000 shares authorized, 250,000 shares of Class A Preferred Stock issued and outstanding

Class A Preferred Stock	—	—
Common Stock (\$0.0001 par value), 200,000,000 shares authorized		
Class A Common shares	—	—
Common shares	1	1
Additional paid-in capital	376,009	380,025
Accumulated deficit	(362,297)	(362,297)
Total Stockholders' Equity (Deficit)	<u>13,713</u>	<u>17,729</u>
Total Capitalization	<u>\$ 13,713</u>	<u>\$ 17,729</u>

The number of shares of Common Stock to be outstanding after this offering is based on 8,165,829 shares of our Common Stock outstanding as of June 30, 2023, and excludes:

- 51,880 shares of Common Stock issued pursuant to sales under our at-the-market facility since June 30, 2023;
- 70,102 shares of Common Stock issuable upon exercise of outstanding warrants having a weighted-average exercise price of \$22.80 per share;
- 129,476 shares of Common Stock issuable upon the vesting and settlement of outstanding restricted stock units;
- 76,112 shares of Common Stock issuable upon the vesting and exercise of outstanding stock options;
- 302,535 shares of Common Stock reserved for issuance and available for future grant under our 2016 Incentive Plan;

S-12

- 2,588,236 shares of Common Stock issuable upon exercise of the Warrants being issued in the concurrent private placement, at an exercise price of \$1.58 per share, as described in "*Private Placement Transaction*"; and
- 155,294 shares of Common Stock issuable upon exercise of warrants to be issued to the Placement Agent as compensation in connection with this offering, at an exercise price of \$2.125 per share, as described in "*Plan of Distribution*."

Unless otherwise indicated, all information in this prospectus supplement assumes no exercise of the outstanding options or warrants or settlement of outstanding restricted stock units, described above.

S-13

DILUTION

Purchasers of the shares of Common Stock or Pre-funded Warrants offered by this prospectus supplement and the accompanying prospectus will suffer immediate and substantial dilution in the net tangible book value per share of Common Stock or Pre-funded Warrant they purchase. Net tangible book value per share represents the amount of total tangible assets less total liabilities, divided by the number of shares of Common Stock outstanding as of June 30, 2023. Our net tangible book value as of June 30, 2023 was approximately \$13.7 million, or \$1.68 per share of Common Stock.

Dilution in net tangible book value per share represents the difference between the amount per share paid by purchasers in this offering and the net tangible book value per share of our Common Stock immediately after this offering. After giving effect to (i) the sale of 920,000 shares of our Common Stock in this offering at an offering price of \$1.70 per share, (ii) the sale of Pre-funded Warrants to purchase 1,668,236 shares of Common Stock for \$1.699 per share and (iii) the issuance of the shares of Common Stock underlying the Pre-funded Warrants upon the exercise thereof, and after deducting the fees of the placement agent and the estimated expenses payable by us, our net tangible book value as of June 30, 2023 would have been approximately \$17.6 million, or \$1.63 per share of Common Stock. This represents an immediate decrease in net book value of \$0.05 per share to our existing stockholders and an immediate dilution in net tangible book value of \$0.07 per share to new investors participating in this offering.

The following table illustrates this calculation on a per share basis:

Offering price per share	\$	1.70
Net tangible book value per share as of June 30, 2023	\$	1.68
Increase (decrease) in net tangible book value per share attributable to the offering	\$	(0.05)
As-adjusted net tangible book value per share after giving effect to the offering	\$	1.63
Dilution in net tangible book value per share to new investors	\$	0.07

The foregoing discussion and table do not take into account further dilution to new investors that could occur upon the exercise of outstanding warrants having a per share exercise or conversion price less than the per share offering price in this offering.

The number of shares of Common Stock to be outstanding after this offering is based on 8,165,829 shares of our Common Stock outstanding as of June 30, 2023, and excludes:

- 51,880 shares of Common Stock issued pursuant to sales under our at-the-market facility since June 30, 2023;
- 70,102 shares of Common Stock issuable upon exercise of outstanding warrants having a weighted-average exercise price of \$22.80 per share;
- 129,476 shares of Common Stock issuable upon the vesting and settlement of outstanding restricted stock units;
- 76,112 shares of Common Stock issuable upon the vesting and exercise of outstanding stock options;
- 302,535 shares of Common Stock reserved for issuance and available for future grant under our 2016 Incentive Plan;
- 2,588,236 shares of Common Stock issuable upon exercise of the Warrants being issued in the concurrent private placement, at an exercise price of \$1.58 per share, as described in "*Private Placement Transaction*"; and

155,294 shares of Common Stock issuable upon exercise of warrants to be issued to the Placement Agent as compensation in connection with this offering at an exercise price of \$2.125 per share, as described in “*Plan of Distribution*.”

Unless otherwise indicated, all information in this prospectus supplement assumes no exercise of the outstanding options or warrants or settlement of outstanding restricted stock units, described above.

To the extent any of these outstanding options or warrants are exercised at a price less than the offering price, there may be further dilution to purchasers of our Common Stock in this offering.

USE OF PROCEEDS

We estimate that the proceeds from the sale of Common Stock and Pre-funded Warrants in this offering, after deducting placement agent fees and estimated offering expenses payable by us and underwriting fees, will be approximately \$3.9 million.

We will only receive additional proceeds from the exercise of the Warrants issuable in connection with the concurrent private placement if the Warrants are exercised and the holders of such Warrants pay the exercise price in cash upon such exercise and do not utilize the cashless exercise provision of the Warrants.

The net proceeds from this offering will be used for general corporate purposes and working capital requirements, which may include, among other things, the advancement of our product candidates to obtain regulatory approval from the FDA. We have not determined the amounts we plan to spend on the areas listed above or the timing of these expenditures, and we have no current plans with respect to acquisitions as of the date of this prospectus supplement. As a result, we will have broad discretion to allocate the net proceeds of this offering. The timing and amounts of our actual expenditures will depend on several factors. As of the date of this prospectus supplement, we cannot specify with certainty all of the particular uses for the net proceeds to us from an offering. Accordingly, our management will have broad discretion in the application of proceeds.

DIVIDEND POLICY

We have never declared or paid any cash dividends on our Common Stock and do not anticipate paying any cash dividends in the foreseeable future. Any future determination to pay dividends will be at the discretion of our board of directors and will depend on our financial condition, results of operations, capital requirements and other factors our board of directors deems relevant.

DESCRIPTION OF THE SECURITIES WE ARE OFFERING

We are offering through this prospectus supplement and the accompanying prospectus (i) 920,000 shares of our Common Stock, and (ii) Pre-funded Warrants to purchase up to 1,668,236 shares of our Common Stock. We are also registering the offer and sale of shares of our Common Stock issuable from time to time upon exercise of the Pre-funded Warrants offered hereby.

Common Stock

The material terms and provisions of our Common Stock and each other class of our securities which qualifies or limits our Common Stock are described in the section entitled “*Description of Capital Stock*” of the accompanying prospectus and the Description of Registered Securities included as Exhibit 4.3 to our Annual Report on Form 10-K for the year ended December 31, 2022, filed with the SEC on March 30, 2023, which descriptions are supplemented as set forth below.

On March 3, 2023, the Board of Directors of the Company unanimously adopted resolutions to approve and recommend stockholder approval of a form amendment to the Company’s Amended and Restated Certificate of Incorporation, as amended, to effect a reverse stock split of our issued and outstanding Common Stock within a range of between 5-for-1 and 20-for-1 (with our Board being authorized to determine the exact ratio), with such reverse stock split to be effected at such time and date before January 31, 2024, if at all, as determined by the Board in its sole discretion (such reverse stock split, the “Reverse Stock Split” and such amendment, the “Amendment”). On March 3, 2023, the holders of a majority in voting power of issued and outstanding shares of our Common Stock and issued and outstanding shares of our Class A Preferred Stock, par value \$0.0001 (together, the “Majority Holders”) approved the Amendment by written consent in lieu of a meeting (the “Written Consent”). On March 15, 2023, the Board selected the 15-for-1 reverse stock split ratio.

Proportionate adjustments were made to the per share exercise price and/or the number of shares issuable upon the exercise or vesting of all stock options, restricted stock and warrants outstanding at April 3, 2023, which resulted in a proportional decrease in the number of shares of the Company’s Common Stock reserved for issuance upon exercise or vesting of such stock options, restricted stock and warrants, and, in the case of stock options and warrants, a proportional increase in the exercise price of all such stock options and warrants.

No fractional shares were issued in connection with the Reverse Stock Split and stockholders who would otherwise be entitled to a fraction of one share received a proportional cash payment.

Pre-funded Warrants Issued in This Offering

The following summary of certain terms and provisions of the Pre-funded Warrants that are being offered hereby is not complete and is subject to, and qualified in its entirety by the provisions of, the Pre-funded Warrants. You should carefully review the terms and provisions of the form of the Pre-funded Warrant for a complete description of the terms and conditions of the Pre-funded Warrants.

The term “pre-funded” refers to the fact that the purchase price of our Common Stock in this offering includes almost the entire exercise price that will be paid under the Pre-funded Warrants, except for a nominal remaining exercise price of \$0.001. The purpose of the Pre-funded Warrants is to enable investors that may have restrictions on their ability to beneficially own more than 4.99% (or, upon election of the holder, 9.99%) of our outstanding Common Stock following the consummation of this offering the opportunity to make an investment in the Company without triggering their ownership restrictions, by receiving Pre-funded Warrants in lieu of our Common Stock which would result in such ownership of more than 4.99% (or 9.99%), and receive the ability to exercise their option to purchase the shares underlying the Pre-funded Warrants at such nominal price at a later date.

Duration and Exercise Price. The Pre-funded Warrants offered hereby will entitle the holder thereof to purchase up to an aggregate of 1,668,236 shares of our Common Stock at an exercise price of \$0.001 per share, commencing immediately on the date of issuance until exercised in full. The Pre-funded Warrants will be issued separately from the Common Stock and may be transferred separately immediately thereafter.

S-18

Exercisability. The Pre-funded Warrants will be exercisable, at the option of each holder, in whole or in part, by delivering to us a duly executed exercise notice accompanied by payment in full for the number of shares of Common Stock purchased upon such exercise (except in the case of a cashless exercise as discussed below). A holder (together with its affiliates) may not exercise any portion of such holder’s warrants to the extent that the holder would own more than 4.99% (or, at the election of the holder, 9.99%) of our outstanding shares of Common Stock immediately after exercise, except that upon notice from the holder to us, the holder may increase or decrease the amount of ownership of outstanding shares of Common Stock after exercising the holder’s Pre-funded Warrants up to 9.99% of the number of shares of Common Stock outstanding immediately after giving effect to the exercise, as such percentage ownership is determined in accordance with the terms of the Pre-funded Warrants, provided that any increase in this limitation shall not be effective until 61 days after notice to us.

Cashless Exercise. In lieu of making the cash payment otherwise contemplated to be made to us upon the exercise of a Pre-funded Warrant in payment of the aggregate exercise price, the holder may elect instead to receive upon such exercise (either in whole or in part) the net number of shares of Common Stock determined according to a formula set forth in the Pre-funded Warrant.

Exercise Price Adjustment. The exercise price of the Pre-funded Warrants is subject to appropriate adjustment in the event of certain stock dividends and distributions, stock splits, stock combinations, reclassifications or similar events affecting our Common Stock.

Fundamental Transaction. In the event of any fundamental transaction, as described in the Pre-funded Warrants and generally including any merger with or into another entity, sale of all or substantially all of our assets, tender offer or exchange offer, reclassification of our shares of Common Stock or acquisition of more than 50% of the voting power represented by our Common Stock, then upon any subsequent exercise of a Pre-funded Warrant, the holder will have the right to receive as alternative consideration, for each share of Common Stock that would have been issuable upon such exercise immediately prior to the occurrence of such fundamental transaction, the number of shares of Common Stock of the successor or acquiring corporation or of our Company, if it is the surviving corporation, and any additional consideration receivable upon or as a result of such transaction by a holder of the number of shares of Common Stock for which the Pre-funded Warrant is exercisable immediately prior to such event.

Transferability. In accordance with its terms and subject to applicable laws, a Pre-funded Warrant may be transferred at the option of the holder upon surrender of the Pre-funded Warrant to us together with the appropriate instruments of transfer and payment of funds sufficient to pay any transfer taxes (if applicable).

Fractional Shares. No fractional shares of Common Stock will be issued upon the exercise of the Pre-funded Warrants. Rather, the number of shares of Common Stock to be issued will, at our election, either be rounded up to the nearest whole number or we will pay a cash adjustment in respect of such final fraction in an amount equal to such fraction multiplied by the exercise price.

Exchange Listing. There is no established trading market for the Pre-funded Warrants, and we do not expect a market to develop. In addition, we do not intend to apply for the listing of the Pre-funded Warrants on any national securities exchange or other trading market. Without an active trading market, the liquidity of the Pre-funded Warrants will be limited.

Rights as a Stockholder. Except as otherwise provided in the Pre-funded Warrants or by virtue of such holder’s ownership of shares of our Common Stock, the holder of a Pre-funded Warrant does not have the rights or privileges of a holder of our Common Stock, including any voting rights, until the holder exercises the Pre-funded Warrant.

S-19

PRIVATE PLACEMENT TRANSACTION

In a concurrent private placement, we plan to issue and sell to the single institutional investor the Warrants to purchase up to an aggregate of up to 2,588,236 shares of Common Stock. The Warrants have an exercise price equal to \$1.58 per share, subject to adjustment.

The Warrants and the shares of Common Stock issuable upon the exercise of such Warrants are not being registered under the Securities Act, are not being offered pursuant to this prospectus supplement and the accompanying prospectus and are being offered pursuant to the exemption provided in Section 4(a)(2) under the Securities Act. Accordingly, investors may only sell shares of Common Stock issued upon exercise of the Warrants pursuant to an effective registration statement under the Securities Act covering the resale of those shares, an exemption under Rule 144 under the Securities Act or another applicable exemption under the Securities Act.

Exercisability. The Warrants are exercisable immediately following issuance and will have a term of five and one-half (5.5) years from the initial exercise date. The Warrants will be exercisable, at the option of the holder, in whole or in part by delivering to us a duly executed exercise notice and, at any time a registration statement registering the issuance of shares of Common Stock underlying the Warrants under the Securities Act is effective and available for the issuance of such shares, or an exemption from registration under the Securities Act is available for the issuance of such shares, by payment in full in immediately available funds for the number of shares of Common Stock purchased upon such exercise.

Cashless Exercise. If at the time of exercise there is no effective registration statement registering, or the prospectus contained therein is not available for the issuance of the shares of Common Stock underlying the Warrants, then the Warrants may also be exercised, in whole or in part, at such time by means of a cashless exercise, in which case the holder would receive upon such exercise the net number of shares of Common Stock determined according to the formula set forth in the warrant.

Exercise Limitation. A holder will not have the right to exercise any portion of the Warrants if the holder (together with its affiliates) would beneficially own in excess of 4.99% (or, upon election of the holder, 9.99%) of the number of our shares of Common Stock outstanding immediately after giving effect to the exercise, as such percentage ownership is determined in accordance with the terms of the Warrants. However, any holder may increase or decrease such percentage, but in no event may such percentage be increased to more than 9.99%, provided that any increase will not be effective until the 61st day after such election.

Exercise Price Adjustment. The exercise price of the Warrants is subject to appropriate adjustment in the event of certain stock dividends and distributions, stock splits, stock combinations, reclassifications or similar events affecting our shares of Common Stock.

Transferability. Subject to applicable laws, the Warrants may be offered for sale, sold, transferred or assigned without our consent.

Exchange Listing. There is no established trading market for the Warrants, and we do not expect a market to develop. In addition, we do not intend to apply for the listing of the Warrants on any national securities exchange or other trading market.

Fundamental Transactions. In the event of any fundamental transaction, as described in the Warrants and generally including any merger with or into another entity, sale of all or substantially all of our assets, tender offer or exchange offer, reclassification of our shares of Common Stock or acquisition of more than 50% of the voting power represented by our outstanding Common Stock, then upon any subsequent exercise of a Warrant, the holder will have the right to receive as alternative consideration, for each share of Common Stock that would have been issuable upon such exercise immediately prior to the occurrence of such fundamental transaction, the number of shares of Common Stock of the successor or acquiring corporation of our company, if it is the surviving corporation, and any additional consideration receivable upon or as a result of such transaction by a holder of the number of shares of Common Stock for which the Warrant is exercisable immediately prior to such event.

S-20

Notwithstanding the foregoing, in the event of a fundamental transaction, we or a successor entity shall, at the holder's option, exercisable at any time concurrently or within thirty (30) days following the consummation of a fundamental transaction, purchase the Warrant by paying to the holder an amount equal to the Black Scholes Value (as defined in each Warrant) of the remaining unexercised portion of the Warrant on the date of the fundamental transaction. If the fundamental transaction is not within our control, the holders of the Warrants will only be entitled to receive from us or a successor entity the same type or form of consideration (and in the same proportion), at the Black Scholes Value of the unexercised portion of the Warrant, that is being offered and paid to the holders of our Common Stock in connection with the fundamental transaction, whether that consideration is in the form of cash, stock or any combination thereof, or whether the holders of our Common Stock are given the choice to receive alternative forms of consideration in connection with the fundamental transaction.

Rights as a Stockholder. Except as otherwise provided in the Warrants or by virtue of such holder's ownership of our Common Stock, the holder of a Warrant will not have the rights or privileges of a holder of our Common Stock, including any voting rights, until the holder exercises the warrant.

You should review a copy of the securities purchase agreement and a copy of the form of the Warrant to be issued to the investors under the securities purchase agreement, which are executed or issued in connection with this offering and will be filed as exhibits to a Current Report on Form 8-K that we file with the SEC, for a complete description of the terms and conditions of the Warrants and the related transaction agreements.

S-21

PLAN OF DISTRIBUTION

We engaged H.C. Wainwright & Co., LLC ("Wainwright" or the "Placement Agent") to act as our exclusive placement agent in connection with this offering. The Placement Agent is not purchasing or selling any securities offered by us in this offering, nor is it required to arrange for the purchase and sale of any specific number or dollar amount of such securities, other than to use its "reasonable best efforts" to arrange for the sale of such securities by us. Therefore, we may not sell all of securities being offered. The terms of this offering were subject to market conditions and negotiations between us, the Placement Agent and prospective investors. The Placement Agent will have no authority to bind us by virtue of the engagement letter. We have entered into a securities purchase agreement directly with the institutional investor who has agreed to purchase securities in this offering. We will only sell securities in this offering to investors who have entered into securities purchase agreements.

Delivery of the securities offered hereby is expected to take place on or about October 30, 2023, subject to satisfaction of certain closing conditions.

We have agreed to pay the Placement Agent (i) a cash fee equal to 7.0% of the aggregate gross proceeds of this offering, (ii) a management fee equal to 1.0% of the gross proceeds raised in this offering, (iii) a non-accountable expense allowance of \$75,000, and (iv) \$15,950 for the clearing expenses of the Placement Agent in connection with this offering.

We have also agreed to pay Wainwright a tail fee equal to the cash and warrant compensation in this offering if any investor who had been contacted by Wainwright in connection with this offering during the term of our engagement of Wainwright, provides us with capital in any offering during the 12-month period following expiration or termination of our engagement of Wainwright, subject to certain exceptions.

The following table shows the per share and total placement agent fees we will pay to the Placement Agent in connection with the sale of Common Stock and Pre-funded Warrants pursuant to this prospectus supplement and the accompanying prospectus, assuming the purchase of all shares of Common Stock and Pre-funded Warrants offered hereby. Wainwright is also acting as the placement agent for the private placement transaction.

	Per Share	Per Pre-funded Warrant	Total
Offering price	\$ 1.70	\$ 1.699	\$ 4,398,332.96
Placement agent fees	\$ 0.119	\$ 0.119	\$ 308,000.08
Proceeds to us, before expenses	\$ 1,454,520.00	\$ 2,635,812.88	\$ 4,090,332.88

We estimate the total expenses of this offering paid or payable by us will be approximately \$0.5. After deducting the fees due to the placement agent and our estimated expenses in connection with this offering, we expect the net proceeds from this offering will be approximately \$3.9 million.

Subsequent Equity Sales

Under the terms of the securities purchase agreement, from the date of such agreement until 45 days after the closing of this offering, neither we nor any subsidiary shall (i) issue, enter into any agreement to issue or announce the issuance or proposed issuance of any shares of Common Stock or Common Stock equivalents, or (ii) file any registration statement or prospectus, or any amendment or supplement thereto, subject to certain exceptions.

We have also agreed under the terms of the securities purchase agreement, until one year after the closing of this offering, not to (i) issue or sell 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 our business or the market for our Common Stock or (ii) enter into, or effect a transaction under, any agreement, including, but not limited to, an equity line of credit or an "at-the-market offering", subject to certain exceptions (including our ability to use our existing "at-the-market" facility with B. Riley Securities, Inc. (formerly B. Riley, Inc.), Cantor Fitzgerald & Co. and Wainwright).

Placement Agent Warrants

In addition, we have agreed to issue to the Placement Agent, or its designees, at the closing of this offering, warrants to purchase 6.0% of the number of shares of our Common Stock (and shares of Common Stock underlying the Pre-funded Warrants) sold in this offering (or warrants to purchase up to 155,294 shares of our Common Stock). Such warrants will have substantially the same terms as the Warrants being sold and issued in the private placement, except that the Placement Agent's warrants will have a term of exercise equal to five (5) years from the commencement of the sales in this offering and will have an exercise price equal to 125% of the offering price per share (or \$2.125 per share). Neither the Placement Agent's warrants nor the shares of our Common Stock issuable upon exercise thereof are being registered hereby.

Indemnification

We have agreed to indemnify the Placement Agent against certain liabilities, including liabilities under the Securities Act and liabilities arising from breaches of representations and warranties contained in our engagement letter with the Placement Agent. We have also agreed to contribute to payments the Placement Agent may be required to make in respect of such liabilities.

Right of First Refusal

We have also granted Wainwright, subject to certain exceptions, a right of first refusal for a period of ten (10) months following the closing of this offering to act as sole book-running manager, sole underwriter or sole placement agent for each and every future debt financing or refinancing and public or private equity offering by us.

Other Relationships

From time to time, Wainwright may provide in the future various advisory, investment and commercial banking and other services to us in the ordinary course of business, for which they have received and may continue to receive customary fees and commissions. However, except as disclosed in this prospectus supplement, we have no present arrangements with Wainwright for any further services.

Regulation M Compliance

The Placement Agent may be deemed to be an underwriter within the meaning of Section 2(a)(11) of the Securities Act, and any commissions received by it and any profit realized on the sale of our shares of Common Stock offered hereby by it while acting as principal might be deemed to be underwriting discounts or commissions under the Securities Act. The Placement Agent will be required to comply with the requirements of the Securities Act and the Exchange Act, including, without limitation, Rule 10b-5 and Regulation M under the Exchange Act. These rules and regulations may limit the timing of purchases and sales of our securities by the Placement Agent. Under these rules and regulations, the Placement Agent may not (i) engage in any stabilization activity in connection with our securities; and (ii) bid for or purchase any of our securities or attempt to induce any person to purchase any of our securities, other than as permitted under the Exchange Act, until they have completed their participation in the distribution.

Transfer Agent and Registrar

The transfer agent and registrar for our Common Stock is VStock Transfer, LLC.

S-23

Trading Market

Our Common Stock is listed on the Nasdaq Capital Market under the symbol "MBIO." We do not intend to apply for listing of the Pre-funded Warrants or the Warrants on any securities exchange or other nationally recognized trading system.

S-24

LEGAL MATTERS

McGuireWoods LLP, Charlotte, North Carolina, will pass upon the validity of the securities we are offering by this prospectus supplement and the accompanying prospectus.

EXPERTS

The financial statements of Mustang Bio, Inc. as of December 31, 2022 and 2021, and for each of the years in the two-year period ended December 31, 2022, have been incorporated by reference in this prospectus supplement, in reliance on the report of KPMG LLP, independent registered public accounting firm, incorporated by reference herein, and upon the authority of said firm as expert in accounting and auditing. The report on the financial statements contains an explanatory paragraph regarding the Company's ability to continue as a going concern.

WHERE YOU CAN FIND MORE INFORMATION

We are a public company and file reports with the SEC on an annual basis using Form 10-K, quarterly reports on Form 10-Q and current reports on Form 8-K. Additionally, the SEC maintains a website that contains annual, quarterly, and current reports, proxy statements, and other information that issuers (including us) file electronically with the SEC. The SEC's website address is <http://www.sec.gov>. You can also obtain copies of materials we file with the SEC from our Internet website found at www.mustangbio.com. Our stock is quoted on the Nasdaq Capital Market under the symbol "MBIO". We have not incorporated by reference into this prospectus supplement the information on our website, and you should not consider it to be a part of this prospectus supplement.

S-25

The SEC allows us to “incorporate by reference” the information we file with them which means that we can disclose important information to you by referring you to those documents instead of having to repeat the information in this prospectus supplement and accompanying prospectus. The information incorporated by reference is considered to be part of this prospectus supplement and accompanying prospectus, and later information that we file with the SEC will automatically update and supersede this information. This prospectus supplement incorporates by reference the documents listed below and any future filings made with the SEC under Sections 13(a), 13(c), 14 or 15(d) of the Exchange Act (1) after the date of the initial registration statement, as amended, and prior to effectiveness of the registration statement, and (2) after the date of this prospectus supplement and prior to the termination of this offering. Such information will automatically update and supersede the information contained in this prospectus supplement and the documents listed below; provided, however, that we are not, unless specifically indicated, incorporating any information furnished under Item 2.02 or Item 7.01 of any current report on Form 8-K, whether listed below or filed in the future, or related exhibits furnished pursuant to Item 9.01 of Form 8-K:

- our Annual Report on Form 10-K for the fiscal year ended [December 31, 2022](#) (the “2022 Form 10-K”);
- our Quarterly Reports on Form 10-Q for the three months ended [March 31, 2023](#) and [June 30, 2023](#);
- the information specifically incorporated by reference into the 2022 Form 10-K from our Definitive Proxy Statement on Schedule 14A, filed with the SEC on [April 28, 2023](#);
- our Current Reports on Form 8-K filed with the SEC on [March 3, 2023](#); [April 3, 2023](#); [April 13, 2023](#); [April 20, 2023](#); [May 22, 2023](#); [June 23, 2023](#); [June 30, 2023](#); [July 11, 2023](#); [July 20, 2023](#); [July 31, 2023](#); [August 14, 2023](#); [August 16, 2023](#); [October 4, 2023](#) and [October 26, 2023](#); and
- the description of the Company’s capital stock included in [Exhibit 4.3](#) to the 2022 Form 10-K.

All reports and other documents we subsequently file pursuant to Section 13(a), 13(c), 14 or 15(d) of the Exchange Act prior to the termination of this offering, including all such documents we may file with the SEC after the date of the initial registration statement and prior to the effectiveness of the registration statement, but excluding any information furnished to, rather than filed with, the SEC, will also be incorporated by reference into this prospectus supplement and deemed to be part of this prospectus supplement from the date of the filing of such reports and documents.

We will provide to each person, including any beneficial owner, to whom a copy of this prospectus supplement and the related prospectus is delivered, a copy of any or all of the information that we have incorporated by reference into this prospectus supplement and the related prospectus, but not delivered with this prospectus supplement and the related prospectus. We will provide this information upon written or oral request at no cost to the requester. You may request this information by contacting our corporate headquarters at the following address: 377 Plantation Street, Worcester, Massachusetts 01605, Attn: General Counsel, or by calling (781) 652-4500.

S-26

PROSPECTUS

\$200,000,000



**MUSTANG BIO, INC.
Common Stock
Preferred Stock
Warrants
Debt Securities
Units**

We may offer, from time to time, up to \$200,000,000 of our common stock, preferred stock, warrants to purchase our common stock, preferred stock, debt securities, or units comprised of two or more such securities (the “Securities”) from time to time under this prospectus. You should read this prospectus and any prospectus supplement carefully before you invest.

We may offer the Securities in one or more offerings in amounts, at prices, and on terms determined at the time of the offering. We may sell the Securities through agents we select or through underwriters and dealers we select. If we use agents, underwriters or dealers, we will name them and describe their compensation in a prospectus supplement.

This prospectus provides a general description of the Securities we may offer. Each time we sell Securities, we will provide specific terms of the Securities offered in a supplement to this prospectus. The prospectus supplement may also add, update or change information contained in this prospectus. You should read this prospectus and the applicable prospectus supplement carefully, together with additional information described under the heading “Where You Can Find More Information,” before you invest in any Securities. This prospectus may not be used to consummate a sale of Securities unless accompanied by the applicable prospectus supplement.

Our common stock is listed for trading on the Nasdaq Global Market under the symbol “MBIO.” On May 17, 2021, the per share closing price of our Common Stock as reported on the Nasdaq Capital Market was \$2.86 per share.

We are an “emerging growth company” as defined in the Jumpstart Our Business Startups Act and a “smaller reporting company” as defined in the Securities and Exchange Act of 1934 (the “Exchange Act”) and will therefore be subject to reduced reporting requirements.

Investing in our Securities involves risks. See “Risk Factors” in our Annual Report on Form 10-K for the year ended December 31, 2020, which has been filed with the U.S. Securities and Exchange Commission and are incorporated by reference into this prospectus. You should read this entire prospectus carefully before you make your investment decision.

Neither the U.S. Securities and Exchange Commission nor any state securities commission has approved or disapproved of these Securities or passed upon the accuracy or adequacy of this prospectus. Any representation to the contrary is a criminal offense.

TABLE OF CONTENTS

SUMMARY	1
IMPORTANT INFORMATION ABOUT THIS PROSPECTUS	3
DESCRIPTION OF CAPITAL STOCK	4
DESCRIPTION OF WARRANTS	6
DESCRIPTION OF DEBT SECURITIES	7
DESCRIPTION OF UNITS	10
PLAN OF DISTRIBUTION	11
LEGAL MATTERS	12
EXPERTS	12
WHERE YOU CAN FIND MORE INFORMATION	12
INCORPORATION OF CERTAIN DOCUMENTS BY REFERENCE	12

SUMMARY

Overview

We are a clinical-stage biopharmaceutical company focused on translating today's medical breakthroughs in cell and gene therapies into potential cures for hematologic cancers, solid tumors and rare genetic diseases. We aim to acquire rights to these technologies by licensing the rights or otherwise acquiring an ownership interest in the technologies, funding their research and development and eventually either out-licensing or bringing the technologies to market.

Our pipeline is currently focused in three core areas: gene therapy programs for rare genetic disorders, chimeric antigen receptor ("CAR") engineered T cell ("CAR T") therapies for hematologic malignancies and CAR T therapies for solid tumors. For each therapy we have partnered with world class research institutions. For our gene therapy program, we have partnered with St. Jude Children's Research Hospital ("St. Jude") in the development of a first-in-class *ex vivo* lentiviral treatment of X-linked severe combined immunodeficiency ("XSCID") and for our CAR T therapies we have partnered with the City of Hope National Medical Center ("COH"), Fred Hutchinson Cancer Research Center ("Fred Hutch") and Nationwide Children's Hospital ("Nationwide").

Gene Therapy

In partnership with St. Jude and the National Institutes of Health ("NIH"), our gene therapy program is being conducted under an exclusive license to develop a potentially curative treatment for XSCID, a rare genetic immune system condition also known as bubble boy disease in which affected patients do not live beyond infancy without treatment. This first-in-class *ex vivo* lentiviral gene therapy is currently in two Phase 1/2 clinical trials involving two different autologous cell products: a multicenter trial of the MB-107 product in newly diagnosed infants sponsored by St. Jude and a single-center trial of the MB-207 product in previously transplanted patients sponsored by the NIH.

In May 2020, we submitted an Investigational New Drug ("IND") application with the U.S. Food and Drug Administration ("FDA") to initiate a registrational multicenter Phase 2 clinical trial of MB-107 in newly diagnosed infants with XSCID who are under the age of two. In response, the FDA identified Chemistry, Manufacturing, and Control ("CMC") hold issues that the Company satisfactorily addressed in a December 2020 submission to the FDA, and the CMC hold was removed in January 2021. The trial is expected to enroll 10 patients who, together with 15 patients enrolled in the current multicenter trial led by St. Jude, will be compared with 25 matched historical control patients who have undergone hematopoietic stem cell transplant ("HSCT"). The primary efficacy endpoint will be event-free survival, and we are targeting topline data from the trial in the second half of 2022.

We further expect to file an IND in the second quarter of 2021 for a registrational multicenter Phase 2 clinical trial of lentiviral gene therapy in previously transplanted XSCID patients (MB-207). We anticipate enrolling 20 patients, and we are targeting topline data for this trial in the first half of 2023.

CAR T Therapies

Our pipeline of CAR T therapies is being developed under exclusive licenses from several world class research institutions. Our strategy is to license these therapies, support preclinical and clinical research activities by our partners and transfer the underlying manufacturing technology to our cell processing facility located in Worcester, Massachusetts, to conduct our own clinical trials.

We are developing CAR T therapies for hematologic malignancies in partnership with COH targeting CD123 (MB-102) and CS1 (MB-104) and with Fred Hutch targeting CD20 (MB-106). Phase 1 clinical trials sponsored by COH for MB-102 and MB-104 and by Fred Hutch for MB-106 are underway. In the third quarter of 2019 the FDA approved our IND application to initiate a multicenter Phase 1/2 clinical trial of MB-102, and our clinical trial has begun enrollment for the treatment of patients with blastic plasmacytoid dendritic cell neoplasm ("BPDCN"). On May 10, 2021, the FDA approved our IND application to initiate a multicenter Phase 1/2 clinical trial of MB-106 for the treatment of patients with non-Hodgkin lymphoma and chronic lymphocytic leukemia, and in the third quarter of 2021 we expect to enroll the first patient in this trial. We plan to file an IND application for a multicenter Phase 1/2 trial for MB-104 for the treatment of patients with multiple myeloma once COH has established a safe and effective dose.

We are also developing CAR T therapies for solid tumors in partnership with COH targeting IL13R α 2 (MB-101), HER2 (MB-103) and prostate stem cell antigen (“PSCA”) (MB-105). In addition, we have partnered with Nationwide for the C134 oncolytic virus (MB-108) in order to enhance the activity of MB-101 for the treatment of patients with glioblastoma multiforme (GBM). Phase 1 clinical trials sponsored by COH for MB-101, MB-103 and MB-105 are underway. A Phase 1 clinical trial sponsored by the University of Alabama at Birmingham (“UAB”) for MB-108 began during the third quarter of 2019 and, in the fourth quarter of 2021, we plan to file an IND application for the combination of MB-101 and MB-108 for the treatment of patients with GBM. In the third quarter of 2019, we announced that COH had started enrolling patients on a Phase 1 clinical trial of MB-101 in combination with nivolumab (commercial name: Opdivo[®]) and ipilimumab (commercial name: Yervoy[®]) in patients with recurrent malignant glioma. In the fourth quarter of 2020 we announced that COH had initiated a Phase 1, two-arm clinical trial of MB-101 in patients with leptomeningeal brain tumors (e.g., glioblastoma, ependymoma or medulloblastoma). We also plan to file IND applications and initiate our own clinical trials for MB-103 for the treatment of patients with metastatic breast cancer to brain and for MB-105 for the treatment of patients with prostate and pancreatic cancer.

To date, we have not received approval for the sale of our product candidates in any market and, therefore, have not generated any product sales from our product candidates. In addition, we have incurred substantial operating losses since our inception, and expect to continue to incur significant operating losses for the foreseeable future and may never become profitable. As of March 31, 2021, we have an accumulated deficit of \$200.4 million.

Company Information

We are a majority-controlled subsidiary of Fortress Biotech, Inc. (“Fortress”).

Our principal executive office is located at 377 Plantation Street, Worcester, Massachusetts 02605, and our telephone number is 781-652-4500. We maintain a website on the Internet at www.mustangbio.com and our e-mail address is info@mustangbio.com. Our Internet website, and the information contained on it, are not to be considered part of this prospectus.

ABOUT THIS PROSPECTUS

In this prospectus, unless the context suggests otherwise, references to “Mustang Bio,” “Mustang,” the “Company,” “we,” “us,” and “our” refer to Mustang Bio, Inc.

This prospectus is part of a “shelf” registration statement that we filed with the U.S. Securities and Exchange Commission (“SEC”). By using a shelf registration statement, we may sell our Securities, as described in this prospectus, from time to time in one or more offerings. Each time we sell Securities, we will provide a prospectus supplement to this prospectus that contains specific information about the terms of such offering. The prospectus supplement may also add, update or change information contained in this prospectus. Before purchasing any Securities, you should carefully read both this prospectus and any prospectus supplement, together with the additional information incorporated into this prospectus or described under the heading “Where You Can Find More Information.”

You should rely only on the information contained or incorporated by reference in this prospectus and any prospectus supplement. We have not authorized any other person to provide you with different information. If anyone provides you with different or inconsistent information, you should not rely on it. We will not make an offer to sell Securities in any jurisdiction where the offer or sale is not permitted. You should assume that the information appearing in this prospectus, as well as information we previously filed with the SEC and have incorporated by reference, is accurate as of the date on the front cover of this prospectus only, or when such document was filed with the SEC. Our business, financial condition, results of operations and prospects may have changed since the relevant date.

Neither we, nor any of our officers, directors, agents or representatives or underwriters, make any representation to you about the legality of an investment. You should not interpret the contents of this prospectus, any prospectus supplement, or any free writing prospectus to be legal, business, investment or tax advice. You should consult with your own advisors for that type of advice and consult with them about the legal, tax, business, financial and other issues that you should consider before investing in our common stock.

We will not use this prospectus to offer and sell Securities unless it is accompanied by a prospectus supplement that more fully describes the terms of the offering.

Solely for convenience, tradenames referred to in this prospectus, the accompanying prospectus and the documents incorporated by reference may appear without the ® or TM symbol, but those references are not intended to indicate, in any way, that we will not assert, to the fullest extent under applicable law, our rights or that the applicable owner will not assert its rights, to these tradenames.

THIS PROSPECTUS MAY NOT BE USED TO CONSUMMATE A SALE OF SECURITIES UNLESS IT IS ACCOMPANIED BY A PROSPECTUS SUPPLEMENT.

DESCRIPTION OF CAPITAL STOCK

The following description summarizes the material terms of Mustang capital stock as of the date of this registration statement. Because it is only a summary, it does not contain all the information that may be important to you. For a complete description of our capital stock, you should refer to our certificate of incorporation, our bylaws and to the provisions of applicable Delaware law.

Our common stock is traded on The Nasdaq Capital Market under the symbol “MBIO.” The closing sale price of our common stock on May 17, 2021 was \$2.86 per share.

Capital Stock

The Company is authorized to issue 125,000,000 shares of common stock with a par value of \$0.0001 per share, of which 1,000,000 shares are designated as Class A common stock and 2,000,000 of preferred stock at \$0.0001 par value of which 250,000 are designated as Class A preferred stock.

The holders of common stock are entitled to one vote per share of common stock held.

The undesignated preferred stock may be issued from time to time in one or more series. The Board of Directors is authorized to determine or alter the dividend rights, dividend rate, conversion rights, voting rights, rights and terms of redemption (including sinking fund provisions, if any), the redemption price or prices, the liquidation

preferences and other designations, powers, preferences and relative, participating, optional or other special rights, if any, and the qualifications, limitations and restrictions granted to or imposed upon any wholly unissued series of preferred stock, and to fix the number of shares of any series of preferred stock (but not below the number of shares of any such series then outstanding).

Class A Common Stock

The holders of Class A common stock are entitled to the number of votes equal to the number of whole shares of common stock into which the shares of Class A common shares held by such holder are convertible. For a period of ten years from issuance, the holders of the Class A common stock have the right to appoint one member of the board of directors of Mustang. To date, the holders of Class A common stock have not yet appointed such director.

Class A Preferred Stock

The Class A Preferred Stock is identical to undesignated common stock other than as to voting rights, conversion rights, and the PIK dividend right.

The holders of the outstanding shares of Class A Preferred Stock receive on each January 1 (each a "PIK Dividend Payment Date") after the original issuance date of the Class A Preferred Stock until the date all outstanding Class A Preferred Stock is converted into common stock or redeemed (and the purchase price is paid in full), pro rata per share dividends paid in additional fully paid and non-assessable shares of common stock such that the aggregate number of shares of common stock issued pursuant to such PIK dividend is equal to 2.5% of the Corporation's fully-diluted outstanding capitalization on the date that is one business day prior to any PIK Dividend Payment Date ("PIK Record Date"). In the event the Class A Preferred Stock converts into common stock, the holders shall receive all PIK dividends accrued through the date of such conversion. No dividend or other distribution shall be paid, or declared and set apart for payment (other than dividends payable solely in capital stock on the capital stock) on the shares of common stock until all PIK dividends on the Class A Preferred Stock shall have been paid or declared and set apart for payment. All dividends are non-cumulative.

On any matter presented to the stockholders for their action or consideration at any meeting of stockholders (or by written consent of stockholders in lieu of meeting), each holder of outstanding shares of Class A Preferred Stock shall be entitled to cast for each share of Class A Preferred Stock held by such holder as of the record date for determining stockholders entitled to vote on such matter, the number of votes that is equal to one and one-tenth (1.1) times a fraction, the numerator of which is the sum of (A) the number of shares of outstanding common stock and (B) the whole shares of outstanding Class A Common Stock and the Class A Preferred Stock are convertible, and the denominator of which is number of shares of outstanding Class A Preferred Stock. Thus, the Class A Preferred Stock will at all times constitute a voting majority.

4

Each share of Class A Preferred Stock is convertible, at the option of the holder, into one fully paid and nonassessable share of common stock, subject to certain adjustments. If the Company, at any time effects a subdivision or combination of the outstanding common stock (by any stock split, stock dividend, recapitalization, reverse stock split or otherwise), the applicable conversion ratio in effect immediately before that subdivision is proportionately decreased or increased, as applicable, so that the number of shares of common stock issuable on conversion of each share of Class A Preferred Stock shall be increased or decreased, as applicable, in proportion to such increase or decrease in the aggregate number of shares of common stock outstanding. Additionally, if any reorganization, recapitalization, reclassification, consolidation or merger involving the Company occurs in which the common stock (but not the Class A Preferred Stock) is converted into or exchanged for securities, cash or other property, then each share of Class A Preferred Stock becomes convertible into the kind and amount of securities, cash or other property which a holder of the number of shares of common stock of the Company issuable upon conversion of one share of the Class A Preferred Stock immediately prior to such reorganization, recapitalization, reclassification, consolidation or merger would have been entitled to receive pursuant to such transaction.

Additional Features

Other features of our capital stock include:

- *Dividend Rights.* The holders of outstanding shares of our common stock, including Class A common stock, are entitled to receive dividends out of funds legally available at the times and in the amounts that our board of directors may determine. All dividends are non-cumulative.
- *Voting Rights.* The holders of our common stock are entitled to one vote for each share of common stock held on all matters submitted to a vote of the stockholders, including the election of directors. Our certificate of incorporation and bylaws do not provide for cumulative voting rights.
- *No Preemptive or Similar Rights.* The holders of our common stock have no preemptive, conversion, or subscription rights, and there are no redemption or sinking fund provisions applicable to our common stock.
- *Right to Receive Liquidation Distributions.* Upon our liquidation, dissolution, or winding-up, the assets legally available for distribution to our stockholders would be distributable ratably among the holders of our common stock, including Class A common stock, outstanding at that time after payment of other claims of creditors, if any.
- *Fully Paid and Non-Assessable.* All of the outstanding shares of our common stock, including Class A common stock, and the Class A Preferred Stock are duly issued, fully paid and non-assessable.

5

DESCRIPTION OF WARRANTS

We may issue warrants to purchase shares of our common stock or preferred stock in one or more series together with other Securities or separately, as described in each applicable prospectus supplement.

The prospectus supplement relating to any warrants we offer will include specific terms relating to the offering. These terms will include some or all of the following:

- the title of the warrants;
- the aggregate number of warrants offered;
- the designation, number and terms of the shares of common stock purchasable upon exercise of the warrants and procedures by which those numbers may be adjusted;
- the exercise price of the warrants;

- the dates or periods during which the warrants are exercisable;
- the designation and terms of any Securities with which the warrants are issued;
- if the warrants are issued as a unit with another security, the date on and after which the warrants and the other security will be separately transferable;
- if the exercise price is not payable in U.S. dollars, the foreign currency, currency unit or composite currency in which the exercise price is denominated;
- any minimum or maximum amount of warrants that may be exercised at any one time;
- any terms relating to the modification of the warrants;
- any terms, procedures and limitations relating to the transferability, exchange or exercise of the warrants; and
- any other specific terms of the warrants.

DESCRIPTION OF DEBT SECURITIES

We may offer debt securities which may be senior, subordinated or junior subordinated and may be convertible. Unless otherwise specified in the applicable prospectus supplement, our debt securities will be issued in one or more series under an indenture to be entered into between us and a trustee. We will issue the debt securities offered by this prospectus and any accompanying prospectus supplement under an indenture to be entered into between us and the trustee identified in the applicable prospectus supplement. The terms of the debt securities will include those stated in the indenture and those made part of the indenture by reference to the Trust Indenture Act of 1939, as in effect on the date of the indenture. We have filed a copy of the form of indenture as an exhibit to the registration statement in which this prospectus is included. The indenture will be subject to and governed by the terms of the Trust Indenture Act of 1939.

The following description briefly sets forth certain general terms and provisions of the debt securities that we may offer. The particular terms of the debt securities offered by any prospectus supplement and the extent, if any, to which these general provisions may apply to the debt securities, will be described in the related prospectus supplement. Accordingly, for a description of the terms of a particular issue of debt securities, reference must be made to both the related prospectus supplement and to the following description.

Debt Securities

The aggregate principal amount of debt securities that may be issued under the indenture is unlimited. The debt securities may be issued in one or more series as may be authorized from time to time pursuant to a supplemental indenture entered into between us and the trustee or an order delivered by us to the trustee. For each series of debt securities we offer, a prospectus supplement accompanying this prospectus will describe the following terms and conditions of the series of debt securities that we are offering, to the extent applicable:

- title and aggregate principal amount;
- whether the debt securities will be senior, subordinated or junior subordinated;
- applicable subordination provisions, if any;
- provisions regarding whether the debt securities will be convertible or exchangeable into other Securities or property of the Company or any other person;
- percentage or percentages of principal amount at which the debt securities will be issued;
- maturity date(s);
- interest rate(s) or the method for determining the interest rate(s);
- whether interest on the debt securities will be payable in cash or additional debt securities of the same series;
- dates on which interest will accrue or the method for determining dates on which interest will accrue and dates on which interest will be payable;
- whether the amount of payment of principal of, premium, if any, or interest on the debt securities may be determined with reference to an index, formula or other method;
- redemption, repurchase or early repayment provisions, including our obligation or right to redeem, purchase or repay debt securities under a sinking fund, amortization or analogous provision;
- if other than the debt securities' principal amount, the portion of the principal amount of the debt securities that will be payable upon declaration of acceleration of the maturity;
- authorized denominations;
- form;
- amount of discount or premium, if any, with which the debt securities will be issued, including whether the debt securities will be issued as "original issue discount" securities;
- the place or places where the principal of, premium, if any, and interest on the debt securities will be payable;
- where the debt securities may be presented for registration of transfer, exchange or conversion;

- the place or places where notices and demands to or upon the Company in respect of the debt securities may be made;
- whether the debt securities will be issued in whole or in part in the form of one or more global securities;
- if the debt securities will be issued in whole or in part in the form of a book-entry security, the depository or its nominee with respect to the debt securities and the circumstances under which the book-entry security may be registered for transfer or exchange or authenticated and delivered in the name of a person other than the depository or its nominee;
- whether a temporary security is to be issued with respect to such series and whether any interest payable prior to the issuance of definitive securities of the series will be credited to the account of the persons entitled thereto;
- the terms upon which beneficial interests in a temporary global security may be exchanged in whole or in part for beneficial interests in a definitive global security or for individual definitive securities;
- the guarantors, if any, of the debt securities, and the extent of the guarantees and any additions or changes to permit or facilitate guarantees of such debt securities;
- any covenants applicable to the particular debt securities being issued;
- any defaults and events of default applicable to the debt securities, including the remedies available in connection therewith;
- currency, currencies or currency units in which the purchase price for, the principal of and any premium and any interest on, such debt securities will be payable;
- time period within which, the manner in which and the terms and conditions upon which the Company or the purchaser of the debt securities can select the payment currency;
- securities exchange(s) on which the debt securities will be listed, if any;
- whether any underwriter(s) will act as market maker(s) for the debt securities;
- extent to which a secondary market for the debt securities is expected to develop;
- provisions relating to defeasance;
- provisions relating to satisfaction and discharge of the indenture;
- any restrictions or conditions on the transferability of the debt securities;
- provisions relating to the modification of the indenture both with and without the consent of holders of debt securities issued under the indenture;
- any addition or change in the provisions related to compensation and reimbursement of the trustee;
- provisions, if any, granting special rights to holders upon the occurrence of specified events;
- whether the debt securities will be secured or unsecured, and, if secured, the terms upon which the debt securities will be secured and any other additions or changes relating to such security; and
- any other terms of the debt securities that are not inconsistent with the provisions of the Trust Indenture Act (but may modify, amend, supplement or delete any of the terms of the indenture with respect to such series of debt securities).

General

One or more series of debt securities may be sold as “original issue discount” securities. These debt securities would be sold at a substantial discount below their stated principal amount, bearing no interest or interest at a rate which at the time of issuance is below market rates. One or more series of debt securities may be variable rate debt securities that may be exchanged for fixed rate debt securities.

United States federal income tax consequences and special considerations, if any, applicable to any such series will be described in the applicable prospectus supplement.

Debt securities may be issued where the amount of principal and/or interest payable is determined by reference to one or more currency exchange rates, commodity prices, equity indices or other factors. Holders of such debt securities may receive a principal amount or a payment of interest that is greater than or less than the amount of principal or interest otherwise payable on such dates, depending upon the value of the applicable currencies, commodities, equity indices or other factors. Information as to the methods for determining the amount of principal or interest, if any, payable on any date, the currencies, commodities, equity indices or other factors to which the amount payable on such date is linked and certain additional United States federal income tax considerations will be set forth in the applicable prospectus supplement.

The term “debt securities” includes debt securities denominated in U.S. dollars or, if specified in the applicable prospectus supplement, in any other freely transferable currency or units based on or relating to foreign currencies.

We expect most debt securities to be issued in fully registered form without coupons and in denominations of \$1,000 and any integral multiples thereof. Subject to the limitations provided in the indenture and in the prospectus supplement, debt securities that are issued in registered form may be transferred or exchanged at the principal corporate trust office of the trustee, without the payment of any service charge, other than any tax or other governmental charge payable in connection therewith.

Global Securities

The debt securities of a series may be issued in whole or in part in the form of one or more global securities that will be deposited with, or on behalf of, a depository identified in the prospectus supplement. Global securities will be issued in registered form and in either temporary or definitive form. Unless and until it is exchanged in whole or in part for the individual debt securities, a global security may not be transferred except as a whole by the depository for such global security to a nominee of such depository or by a nominee of such depository to such depository or another nominee of such depository or by such depository or any such nominee to a successor of such depository or a nominee of such successor. The specific terms of the depository arrangement with respect to any debt securities of a series and the rights of and limitations upon owners of

beneficial interests in a global security will be described in the applicable prospectus supplement.

Governing Law

The indenture and the debt securities shall be construed in accordance with and governed by the laws of the State of New York.

9

DESCRIPTION OF UNITS

We may issue, in one more series, units comprised of shares of our common stock, preferred stock, warrants to purchase common stock or preferred stock, debt securities or any combination of those securities. Each unit will be issued so that the holder of the unit is also the holder of each security included in the unit. Thus, the holder of a unit will have the rights and obligations of a holder of each included security. The unit agreement under which a unit is issued may provide that the securities included in the unit may not be held or transferred separately, at any time or at any time before a specified date.

We may evidence units by unit certificates that we issue under a separate agreement. We may issue the units under a unit agreement between us and one or more unit agents. If we elect to enter into a unit agreement with a unit agent, the unit agent will act solely as our agent in connection with the units and will not assume any obligation or relationship of agency or trust for or with any registered holders of units or beneficial owners of units. We will indicate the name and address and other information regarding the unit agent in the applicable prospectus supplement relating to a particular series of units if we elect to use a unit agent.

We will describe in the applicable prospectus supplement the terms of the series of units being offered, including:

- the designation and terms of the units and of the securities comprising the units, including whether and under what circumstances those securities may be held or transferred separately;
- any provisions of the governing unit agreement that differ from those described herein; and
- any provisions for the issuance, payment, settlement, transfer or exchange of the units or of the securities comprising the units.

The other provisions regarding our common stock, preferred stock, warrants and debt securities as described in this section will apply to each unit to the extent such unit consists of shares of our common stock, warrants and/or debt securities.

10

PLAN OF DISTRIBUTION

We may sell the Securities covered in this prospectus in any of three ways (or in any combination):

- through underwriters or dealers;
- directly to a limited number of purchasers or to a single purchaser; or
- through agents.

Each time that we use this prospectus to sell Securities, we will also provide a prospectus supplement that contains the specific terms of the offering. The prospectus supplement will set forth the terms of the offering of the Securities, including:

- the name or names of any underwriters, dealers or agents and the amounts of any Securities underwritten or purchased by each of them; and
- the public offering price of the common stock and the proceeds to us and any discounts, commissions or concessions allowed or reallocated or paid to dealers.

Any public offering price and any discounts or concessions allowed or reallocated or paid to dealers may be changed from time to time.

If underwriters are used in the sale of any Securities, the Securities will be acquired by the underwriters for their own account and may be resold from time to time in one or more transactions, including negotiated transactions, at a fixed public offering price or at varying prices determined at the time of sale. The Securities may be either offered to the public through underwriting syndicates represented by managing underwriters, or directly by underwriters. Generally, the underwriters' obligations to purchase the Securities will be subject to certain conditions precedent. The underwriters will be obligated to purchase all of the Securities if they purchase any of Securities.

We may sell the Securities through agents from time to time. The prospectus supplement will name any agent involved in the offer or sale of the Securities and any commissions we pay to them. Generally, any agent will be acting on a best efforts basis for the period of its appointment.

We may authorize underwriters, dealers or agents to solicit offers by certain purchasers to purchase the Securities from us at the public offering price set forth in the prospectus supplement pursuant to delayed delivery contracts providing for payment and delivery on a specified date in the future. The contracts will be subject only to those conditions set forth in the prospectus supplement, and the prospectus supplement will set forth any commissions we pay for solicitation of these contracts.

Agents and underwriters may be entitled to indemnification by us against certain civil liabilities, including liabilities under the Securities Act of 1933, as amended, or to contribution with respect to payments which the agents or underwriters may be required to make in respect thereof. Agents and underwriters may be customers of, engage in transactions with, or perform services for us in the ordinary course of business.

We may enter into derivative transactions with third parties, or sell Securities not covered by this prospectus to third parties in privately negotiated transactions. If the applicable prospectus supplement indicates, in connection with those derivatives, the third parties may sell Securities covered by this prospectus and the applicable prospectus supplement, including in short sale transactions. If so, the third party may use Securities pledged by us or borrowed from us or others to settle those sales or to close out any related open borrowings of Securities, and may use Securities received from us in settlement of those derivatives to close out any related open borrowings of Securities. The third party in such sale transactions will be an underwriter and will be identified in the applicable prospectus supplement (or a post-effective amendment).

11

LEGAL MATTERS

Certain legal matters will be passed upon for us by Alston & Bird LLP, New York, New York. Additional legal matters may be passed upon for us or any underwriters, dealers or agents, by counsel that we will name in the applicable prospectus supplement.

EXPERTS

The financial statements as of December 31, 2020 and 2019 and for each of the two years in the period ended December 31, 2020 incorporated by reference in this Prospectus and in the Registration Statement have been so incorporated in reliance on the report of BDO USA, LLP, an independent registered public accounting firm, incorporated herein by reference, given on the authority of said firm as experts in auditing and accounting.

WHERE YOU CAN FIND MORE INFORMATION

We are a public company and file reports with the SEC on an annual basis using Form 10-K, quarterly reports on Form 10-Q and current reports on Form 8-K. Additionally, the SEC maintains a website that contains annual, quarterly and current reports, proxy statements, and other information that issuers (including us) file electronically with the SEC. The SEC's website address is <http://www.sec.gov>. You can also obtain copies of materials we file with the SEC from our Internet website found at www.mustangbio.com.

INCORPORATION OF CERTAIN DOCUMENTS BY REFERENCE

The SEC allows us to "incorporate by reference" the information we file with them which means that we can disclose important information to you by referring you to those documents instead of having to repeat the information in this prospectus and accompanying prospectus. The information incorporated by reference is considered to be part of this prospectus and accompanying prospectus, and later information that we file with the SEC will automatically update and supersede this information. This prospectus incorporates by reference the documents listed below (other than, unless otherwise specifically indicated, current reports furnished under Item 2.02 or Item 7.01 of Form 8-K and exhibits filed on such form that are related to such items):

- a) [Our Annual Report on Form 10-K for the fiscal year ended December 31, 2020](#);
- b) The information specifically incorporated by reference into our Annual Report on Form 10-K for the year ended December 31, 2020 from our definitive proxy statement on Schedule 14A (other than information furnished rather than filed), filed with the SEC on [April 30, 2021](#);
- c) [Our Quarterly Report on Form 10-Q for the quarter ended March 31, 2021](#) and
- d) [The description of our Common Stock contained in Exhibit 4.3 of our Annual Report on Form 10-K for the year ended December 31, 2020, filed with the SEC on March 24, 2021](#), including any other amendment or report filed for the purpose of updating such descriptions.

All reports and other documents we subsequently file pursuant to Section 13(a), 13(c), 14 or 15(d) of the Exchange Act prior to the termination of this offering, including all such documents we may file with the SEC after the date of the initial registration statement and prior to the effectiveness of the registration statement, but excluding any information furnished to, rather than filed with, the SEC, will also be incorporated by reference.



**920,000 Shares of Common Stock
Pre-funded Warrants to Purchase up to 1,668,236 Shares of Common Stock
Up to 1,668,236 Shares of Common Stock Underlying the Pre-Funded Warrants**

MUSTANG BIO, INC.

PROSPECTUS SUPPLEMENT

H.C. WAINWRIGHT & CO.

October 26, 2023