UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

DIVISION OF
CORPORATION FINANCE

June 3, 2015

David G. Lowe, Ph.D.
Chief Executive Officer
Aeglea BioTherapeutics, Inc.
901 S. MoPac Expressway
Barton Oaks Plaza One
Suite 250
Austin, TX 78746

Re: Aeglea BioTherapeutics, Inc.
Draft Registration Statement on Form S-1
Submitted May 6, 2015
CIK No. 0001636282

Dear Dr. Lowe:

We have reviewed your draft registration statement and have the following comments. In some of our comments, we may ask you to provide us with information so we may better understand your disclosure.

Please respond to this letter by providing the requested information and either submitting an amended draft registration statement or publicly filing your registration statement on EDGAR. If you do not believe our comments apply to your facts and circumstances or do not believe an amendment is appropriate, please tell us why in your response.

After reviewing the information you provide in response to these comments and your amended draft registration statement or filed registration statement, we may have additional comments.

Prospectus Summary

1. Please clarify the meaning of any significant scientific or technical terms the first time they are used in your prospectus in order to ensure that lay readers will understand the disclosure. For example, please define each of the following at their first use:

   - arginine;
   - cysteine/cystine;
   - microbial;
   - methionine;
   - metabolite;

- immunogenicity;
- xenograft;
- immunogenic;
- moieties;
- pharmacodynamic marker;
- native manganese cofactor;
- pegylation;
- orphan drug designation; and
- urea cycle disorders

2. We refer to your product pipeline table on pages 2 and 77. Please revise your product candidate pipeline table to add "solid tumors" in the therapeutic category for AEB1102. In addition, please revise your table to identify the target amino acid for AEB4104. The product pipeline table is intended to provide information about actual products. Unless a therapeutic category and a compound have been identified, the product appears too preliminary for inclusion in the table. Accordingly, please identify the target amino acid for AEB4101 in the table or alternately, eliminate this product candidate from the table.

Risks Affecting Us, page 5

3. Please expand your list of bullet point risks to include:

   - risks related to the novelty associated with your engineered human enzyme product candidates for your potential cancer indications, which could result in heightened regulatory scrutiny, delays in clinical development, or delays in your ability to achieve regulatory approval or commercialization of your product candidates; and

   - the availability of patients to enroll in your planned Phase 1/2 proof-of-concept clinical trial of AEB1102 for the treatment of Arginase I deficiency.

Risk Factors, page 11

4. We note that certain of your risk factors are substantially repetitive including:

   - the last risk factors on page 13 and 15;
   - the last risk factors on page 20 and 21;
   - the first full risk factor on page 25 and the first risk factor on page 11 and the last risk factor on page 25; and
   - the first full risk factor on page 30 and the second risk factor on page 32.

   Please revise your disclosure in the above referenced examples to provide a single risk factor.

5. We refer to your disclosure on page 125, "Choice of Forum." Please add a risk factor describing the disadvantages to stockholders attendant to the exclusive forum provision contained in your proposed amended and restated certificate of incorporation.

If we fail to comply with environmental, health and safety laws…, page 36

6. Please state in this risk factor whether the company currently maintains insurance with sufficient coverage to protect against the liability risks discussed and whether, to your knowledge, this coverage is consistent with industry norms.

Valuation of Equity Instruments, page 69

7. We may have additional comments on your accounting for equity issuances including stock compensation and beneficial conversion features. Once you have an estimated offering price, please provide us an analysis explaining the reasons for the differences between recent valuations of your common stock leading up to the IPO and the estimated offering price.

Business, page 71

8. Please revise your Intellectual Property disclosure on page 85, to the extent not otherwise disclosed, to discuss any rights of your founding scientists in your intellectual property.

Background on inborn errors of metabolism, page 73

9. We note your illustration on the top on page 74. Please expand your disclosure to provide, through a legend or other explanatory narrative, a brief guide in layman's terms to the images as they relate to Arginase I and the reduction in arginine levels in the urea cycle.

AEB1102, page 77

10. We note that an integral part of your development programs involves the precise identification of patients who are best suited for amino acid depletion therapy. Please advise us what, if any, regulatory approvals of concomitant genetic and biomarker diagnostic tests will be necessary in order to advance your product to commercialization. We may have further comments based on your response.

11. We refer to your first bullet point on page 78. Please revise your disclosure to explain how the development of AEB1102 in two indications provides you with a capital efficient product development strategy. In that regard, we note the planned indications for AEB1102 require separate clinical trials for different indications with separate INDs developed under potentially different regulatory pathways. In the alternative, please

remove the statement.

AEB1102 clinical development in Arginase I deficiency, page 81

12. Please explain the FDA's preference for alternative endpoints in connection with your intended Phase 1/2 proof-of-concept trial and any concerns the FDA expressed about the appropriateness of your proposed endpoint(s).

13. We refer to your disclosure on the top of page 82. Please briefly explain the meaning and significance of the terms "clinically meaningful benefit" and "statistically significant" as they relate to your planned clinical trials.

Clinical development plan for AEB1102 in oncology, page 83

14. Please revise your disclosure to include the anticipated number of patients in your planned Phase 1 clinical trial.

Intellectual Property, page 85

15. We note your disclosure in this section regarding your patent portfolio. Please revise your disclosure on page 86 for your material patents and patent applications to include whether each of the patents or patent applications are owned or licensed (if licensed, please identify the licensor and the term of the license). Please also state whether you believe your owned or licensed patents will provide sufficient protection for your lead product candidates.

Licensing, page 86

16. Please revise your disclosure for each agreement to include the duration and the aggregate amounts paid or received to date under each agreement which may include up-front, execution payments or license fees received or paid. In addition, please file each agreement as exhibits to your Form S-1 pursuant to Item 601 of Regulation S-K.

Sponsored Research Agreement, page 87

17. Please revise your disclosure to discuss the material terms of the agreement including:

    - nature and scope of each party's intellectual property rights in the sponsored research;
    - each parties' rights and obligations;
    - duration and termination provisions;
    - material payment provisions, which may include up-front or execution payments;
    - milestones, royalty rates or revenue sharing; and
    - aggregate amounts paid or received to date.

Manufacturing, page 88

18. We refer to your disclosure regarding your third-party suppliers and manufacturers. We also note your last risk factor on page 26, citing your dependence on these third parties to manufacture your product candidates for nonclinical and for your future planned clinical testing. In that regard, please expand your disclosure to provide the material terms of each of your agreements with KBI Biopharma, Inc. and Lyophilization Services of New England Inc., including each party's material rights and obligations, duration, minimum purchase obligations, termination provisions and any material payment provisions. In addition, please disclose whether you believe you have sufficient supplies of AEB1102 for your planned Phase 1 and Phase 1/2 studies. In accordance with Item 601 of Regulation S-K, please file each of the agreements as exhibits to your Form S-1. Alternatively, please provide an analysis as to why the company is not substantially dependent upon these agreements.

19. We refer to your disclosure in note 11 on page F-22. Please revise your prospectus to provide the material terms of your agreement with your contract research organization, including the identity of the contracting party, each party's material rights and obligations, duration, termination provisions and any material payment provisions and/or stock issuances. In addition, please file the agreement as an exhibit in accordance with Item 601 of Regulation S-K.

Consulting Agreement with Ann M. Lowe, M.D.., page 116
Consulting Agreement with George Georgiou, Ph.D.., page 116

20. Please revise your prospectus to disclose whether Dr. Lowe or Dr. Georgiou entered into a nondisclosure and assignment of invention agreement.

Assignment of Intellectual Property from George Georgiou, Ph.D.., page 117

21. Please revise your prospectus to disclose the nature and scope of the material assets purchased from GMA. In addition, please disclose the nature, rights and scope of the intellectual property acquired from GMA including a description of the material patents or patent applications. In addition, please file a copy of the Assignment of Intellectual Property as an exhibit in accordance with Item 601 of Regulation S-K.

Description of Capital Stock, page 121

22. We note that all of the outstanding convertible preferred stock will automatically convert into common shares in the event that you receive gross proceeds in this offering of at least $70,000,000 with a per share price of at least $2.55. Please advise us of the material risks to investors, if any, should the preferred stock not automatically convert.

Other Comments

23. Please submit all exhibits as soon as practicable. We may have further comments upon examination of these exhibits.

24. Please confirm that the graphics included in your registration statement are the only graphics you will use in your prospectus. If those are not the only graphics, please provide any additional graphics prior to their use for our review.

25. Please supplementally provide us with copies of all written communications, as defined in Rule 405 under the Securities Act, that you, or anyone authorized to do so on your behalf, present to potential investors in reliance on Section 5(d) of the Securities Act, whether or not they retain copies of the communications.

You may contact Keira Nakada at (202) 551-3659 or Joel Parker at 202-551-3651 if you have questions regarding comments on the financial statements and related matters. Please contact Tara Keating Brooks at (202) 551-8336, Daniel Greenspan at 202-551-3623 or me at (202) 551-3715 with any other questions.

Sincerely,

/s/ Daniel Greenspan for

Jeffrey P. Riedler
Assistant Director

cc: Via E-mail
Robert Freedman
Fenwick & West LLP