

Tissue Engineering and Regenerative Medicine PhD Qualifying Exam

Given by Dr. Matthew Fisher

Instructions and Study Guide

Exam Details

- Date and Time: Date 5/25/23, 9:00am
- Location: 3 hour in person exam (due in writing or email to mbfisher@ncsu.edu by 12pm on 5/25/23)
- Format: This exam focuses on the application of a basic understanding of tissue engineering and regenerative medicine, and the science and engineering principles, which underpin these topic areas. You will be expected to answer qualitative (essay) questions that require critical thinking on the topics listed below.
- The references and resources provided contain all topics that will be tested.

Materials

- You have access to all electronic versions of all documents listed via the NC State library and Pubmed. If you are unable to access the documents, please email the instructor.
- A book is listed as a resource. Specific chapters of interest relevant to the exam are called out, but information in other chapters may be useful depending on the particulars of your answers to the questions.
- No other materials are required; other resources (non-AI) can be used. Cite your sources.
- You may either submit the assignment via pen and paper or electronically.

Potential Topics

General topics and concepts may include:

- Basic principles of tissue engineering, regenerative medicine, and functional tissue engineering, in particular:
 - Cell types, scaffold types, biofactors, and bioreactors
- Design criteria for tissue engineering and regenerative medicine
- Specifics of study design related to tissue engineering and regenerative medicine
- How concepts in tissue engineering can be applied to meet functional demands of normal tissues and design new replacement tissues.

References/Resources

Book

- Atala, Lanza, Mikos, and Nerem, *Principles of Regenerative Medicine, Third Edition*, Elsevier, 2019. (Available electronically via NCSU Libraries: <https://www.sciencedirect.com/book/9780128098806/principles-of-regenerative-medicine>). Covers basic principles in tissue engineering and regenerative medicine.
- Specific chapters of interest: **Ch. 15, 59, 61**
- Chapters for additional background: 17, 26, 33, 35

Journal Articles

1. Guilak F, Butler DL, Goldstein SA, Baaijens FP. Biomechanics and mechanobiology in functional tissue engineering. *J Biomech.* 2014;47(9):1933-40. doi: 10.1016/j.jbiomech.2014.04.019. PubMed PMID: 24818797; PubMed Central PMCID: PMC4051419.
2. Duan Y, Liu Z, O'Neill JO, Wan LQ, Freytes DO, Vunjak-Novakovic G. Hybrid Gel Composed of Native Heart Matrix and Collagen Induces Cardiac Differentiation of Human Embryonic Stem Cells without Supplemental Growth Factors. *J Cardiovasc Trans Res.* 2011; 4: 605-15. doi: 10.1007/s12265-011-9304-0. PubMed PMID: 21744185
3. Wong E, Nejad SP, D'Costa KA, Siqueira NM, Lecce M, Santerre JP, Simmons CA. Design of a Mechanobioreactor to Apply Anisotropic, Biaxial Strain to Large Thin Biomaterials for Tissue Engineered Heart Valve Applications. *Annals of Biomedical Engineering.* 2022;50(9):1073-89. doi: 10.1007/s10439-022-02984-3. PubMed PMID: 35622208