

USCDornsife

HBIO 320L – Muscle Physiology

4 Units

Spring 2020—Tu,Th—2:00 PM - 3:20 PM

Location: SGM 101

Instructor: Casey Donovan, Ph.D., Professor

Office: AHF B37

Office Hours: Tuesday 3:30 PM - 4:30 PM

Contact Info: donovan@usc.edu, (213) 740-3005

Learning Objectives

The primary objective of HBIO 320 is to develop a fundamental understanding of the structure and function of human skeletal muscle, its neural control and adaptation.

- To identify and explain the functional attributes of the contractile, cytoskeletal, and connective tissue elements that comprise skeletal muscle.
- To identify and explain the processes involved in motor nerve conduction, excitation-contraction coupling, muscle contraction, and motor unit recruitment.
- To model and explain the physiological/mechanical outcomes of skeletal muscle contraction, the impact of recruiting various muscle fiber types, and the energetic demands of muscle contraction.
- To explain skeletal muscle adaptation in response to changes in use, disuse, injury, aging, and pathological conditions.

Degree Learning Objectives (*relevant Human Biology BS & BA degree objectives addressed in part by this course*)

- *To develop a deeper understanding of the central and cross-disciplinary concepts of human biology*
- *To identify, locate, and describe the structure/function of cells, their subcellular components, tissues, organs, and organ systems of the human body.*
- *To apply cross-disciplinary scientific principles to explain how humans operate, adapt or evolve.*
- *To compile, analyze, synthesize and criticize primary articles. Use discipline-related criteria to identify which opinions can be accepted, rejected or need further study.*

Course Notes

General Course Outline:

1. Skeletal muscle and motor neuron anatomy/composition, excitation contraction coupling. Skeletal muscle mechanics
2. Muscle fiber type, motor unit recruitment, muscle energetics and blood flow.
3. Skeletal muscle fatigue, muscle adaptation under normal and pathological conditions and comparisons with cardiac and smooth muscle.

Required Readings and Supplementary Materials

Required: There are no required reading materials for this course beyond the powerpoints/notes provided by the instructor and your own notes from the course lectures. However, for those students who would like additional reading materials that support select aspects of the course lectures the following texts can be recommended (*this will be discussed further in the first lecture*) See the outline below for the which lectures are supported by these textbooks.

Recommended:

Advanced Neuromuscular Exercise Physiology, Phillip F. Gardiner, Human Kinetics,. ISBN-13: 978-0-7360-7467-4 (print; also available as an e-book)

Biochemistry Primer for Exercise Science. 4th ed. Tiidus, Peter M., A. Russell Tupling and Michael E. Huston. Human Kinetics, Champaign, IL, 2012. ISBN 9781492583431.

Grading Breakdown

| | |
|-------------------|-----------------------------------|
| Midterm Exam #1 | 30% |
| Midterm Exam #2 | 30% |
| Final Exam | 40% (<i>comprehensive exam</i>) |

Additional Policies

Make-up Exams: Make-up exams will not be given unless preapproved by the instructor or written/verifiable evidence of a medical emergency is provided. In general, make-up exams will not be preapproved unless University policy provides for such accommodations (e.g. religious holidays, athletic competition, etc.) or extenuating circumstances are involved. Where accommodations can be anticipated (e.g. religious holidays, athletic competition) requests must be made within the first 3 weeks of the semester. In most cases, verification of such requests will be required. **Note:** While covering the same material, make-up exams will be distinct from the main exam in content and format.

Course Schedule: A Weekly Breakdown

| Date | Lecture Topic | Recommended Readings/Chapters | |
|--------------------|---|-------------------------------|---------------|
| | | Gardiner | Tidus, etal. |
| Jan. 14 | Introduction/Overview: Muscle Architecture | | |
| Jan. 16 | Skeletal Muscle Proteins: Contractile | | |
| Jan. 21 | Skeletal Muscle Proteins: Cytoskeleton | | |
| Jan. 23 | Skeletal Muscle Proteins: Cytoskeleton | | |
| Jan. 28 | Motor Neuron: Structure & Proteins | | |
| Jan. 30 | Motor Neuron: Neural Transmission | | |
| Feb. 4 | Neuromuscular Junction & Transmission | | |
| Feb. 6 | Excitation-Contraction Coupling | | |
| Feb. 11 | Skeletal Muscle Mechanics | | |
| Feb. 13 | Skeletal Muscle Mechanics | | |
| Feb. 18 | MIDTERM 1 | | |
| Feb. 20 | Motor Unit & Fiber Types Motor Unit Recruitment | 1 | |
| Feb. 25 | Motor Unit & Fiber Types Motor Unit Recruitment | 2 | |
| Feb. 27 | Muscle Receptors | | |
| March 3 | Muscle Energetics: ATP, CP and Glycolysis | | 4 |
| March 5 | Muscle Energetics: TCA cycle | | 5 |
| March 10 | Muscle Energetics: ETC | | 6 (153-185) |
| March 12 | Muscle Energetics: Blood Borne Substrates | 3 (p.53-60) | 7 (205-31) |
| <i>March 17-19</i> | <i>Spring Break</i> | | |
| March 24 | Skeletal Muscle Blood Flow | 3 (p.45-52) | |
| March 26 | Skeletal Muscle Blood Flow | | |
| March 31 | MIDTERM 2 | | |
| April 2 | Skeletal Muscle Fatigue | 5 | |
| April 7 | Skeletal Muscle Fatigue | 4 | |
| April 9 | Adaptations to Decreased Use | | 1 & 3 (64-65) |
| April 14 | Adaptations to Increased Use | 10 & 8 | 3 (39-63) |
| April 16 | Adaptations to Increased Use | 6 | 3 (66-70) |
| April 21 | Muscle Injury, Degeneration & Regeneration | | |
| April 23 | Muscle Denervation & Re-Innervation | | |
| April 28 | Cardiac Muscle | | |
| April 30 | Smooth Muscle | | |
| | | | |
| May 7 | FINAL EXAM – 2:00 – 4:00 PM | | |

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

studenthealth.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call

suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298

equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298

usc-advocate.symplicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710

campussupport.usc.edu

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

ombuds.usc.edu

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.