



HBIO 408L Biomechanics

Units: 4

Fall 2021

Instructor: Jill McNitt-Gray PhD FISB FASB

Office: PED B9

Office Hours: outside SLH 100, M&W 3-3:30, 4:50-5:30PM

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Teaching Assistant: Harper Stewart

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Office Hours: use online appointment tools

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Teaching Assistant: Shannon Cross

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Office Hours: use online appointment tools

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COVID-19 Resource Center: The COVID-19 pandemic is constantly evolving and USC community members need critical information to better protect themselves and others as well as their work and living areas.

<https://ehs.usc.edu/welcome/covid-19-resource-center/>

Course Description

Kinematic and kinetic analysis of human motion. Emphasis on performance enhancement and injury prevention. Geared for junior and senior undergraduate students. Concepts from high school algebra (word problems and solving for an unknown) and the use of sine, cosine, and tangent concepts from trigonometry. Calculus is not required.

Prerequisites: [MATH 108](#) and [PHYS 135A](#) or higher

Learning Objectives

1. Discuss the interplay and relative influence of biology and social context on dimensions of human diversity and health.
2. Apply cross-disciplinary scientific principles to explain how humans function, adapt and evolve.
3. Analyze and synthesize discipline-related content specific to real world problems and utilize the scientific method, basic scientific principles and methodologies concepts to clarify what is known, unknown or need further study.
4. Independently and collaboratively apply scientific knowledge as well as analytical and experimental skills to produce integrative original work.
5. Describe the structure/function of muscles, bones, joints and tissues of the human body.
6. Formulate testable hypotheses, design and conduct experiments, present interpretations of results and articulate reasoned conclusions to solve real-world and conceptual problems.
7. Safely and properly use scientific equipment, databases, Newton's Laws, and other mathematical and computational tools to advance working knowledge of cause-effect relationships governing human movement.
8. Use relevant sources of scientific evidence to construct a well-supported, logical argument, explain it to others using oral, written, and multimedia forms of communication in real world contexts.

University of Southern California – Department of Biological Sciences

HBIO-408L* –Biomechanics (4 Units) Fall 2021

<http://hbio408biomechanics.usc.edu/lab/lab.html>

Instructors: Jill McNitt-Gray, Ph.D. mcnitt@usc.edu

Lecture: MON, WED, 3:30-4:50 PM SLH 100

Office Hours: Outside SLH 100, M, W 3-3:30, 4:50-5:30 PM
(be prepared to share work done during office hours)

Laboratory: 3 hours/week

Content builds weekly, Comprehensive Final Exam

***Course includes project-based capstone experience**

Kinematic and kinetic analysis of human motion; emphasis on performance enhancement and injury prevention. Concepts from high school algebra (word problems and solving for an unknown) and the use of sine, cosine, and tangent concepts from trigonometry. Calculus is not required. **Prerequisite:** 1 from ([MATH 108](#) or [MATH 125](#)) and 1 from ([PHYS 135a](#) or [PHYS 151](#))

Required Texts and Supplies:

1. Web-Based Content (Blackboard and Google Drive)
2. Selected Literature Readings available through PubMed@usc through USC Library
3. Electronic Storage Device (back up and store homework, labs, and project content)

Learn-by-Doing Objectives

- Develop critical thinking and analytical skills to solve meaningful problems; use Newton's Laws to understand cause-effect relationships governing human movement.
- Improve oral, written, electronic information and communication skills.
- Gain hands-on experience analyzing motion and quantifying and interpreting biomechanical information in scientific, ethical, social, and environment related contexts.

II. Grading Procedures:

- Assessment 1 - 20%
- Assessment 2 - 20%
- Comprehensive Assessment - 25%
- Lab experiential Learning - 20%
- Project - 15%

Lab Experiential Learning Activities

- Pre/Post Lab: Reports, Demonstrations, Community of Practice Posts, Literature Review, Collection Protocols etc. 50%
- Lab Quizzes (prelab): 25%, Practicals: 25%
 - Check +: demonstrates full understanding and can apply to novel situations
 - Check: demonstrates solid understanding
 - Check -: demonstrates emerging understanding

Couse Grading Scale: >90%=A, > 80%=B, >70%=C, >65%=D, otherwise =F

III. Laboratory Component

Human Biology Instructional Laboratory Manager

Anh-Khoi Nguyen

agnguyen@usc.edu

Teaching Assistants

Harper Stewart

hestewar@usc.edu

Office hours: sign up on google doc

Shannon Cross

sjcross@usc.edu

Office hours: sign up on google doc

IV. Expectations

1. Come prepared for class and labs (lecture pop quizzes).
2. Sincere Personal Investment in independent discovery and lab activities.
3. USC conduct code (you must do your own work!) - Refer to **SCampus** Academic Integrity Section.
4. Excused absences require written notification *one week in advance*.
5. Honor due dates in lab and lecture (**anything turned in after due date = zero points**).
6. Email (HBIO 408 as subject line), class participation including participation on blackboard discussion board

VI. Project Overview and Grading

Project: Identify significant problem (compare/contrast), generate a meaningful hypothesis, design and conduct a biomechanical experiment to test hypothesis (limitation of analysis: compare and contrast 2D planar movements).

Project Grade will include the following components:

1. Background/Significance (10%) *Problem? known/unknown in peer reviewed literature?*
2. Kinematics (angle-angle) (25%) *kinematic context for muscle force generation*
3. Kinetics (whole body: imp/mom (25%); joint kinetics (25%) *cause/effect at joint &CM levels*
4. Presentation and hand-in materials (15%); *all comparisons specific to research question*
 - a) 3 related scientific journal articles (.pdf emailed to TA prior to presentation)
 - b) hand written Free Body Diagrams and associated calculations (show all work)
 - c) Paper copy of presentation (must be able to read all text on all figures)
 - d) Peer evaluation (emailed to TA prior to presentation)

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.

HBIO 408	Location	Monday	Wed	Labs (weekly quiz)
Week 1	SLH 100	Motion analysis	Events, Phases	Intro/
23-Aug		Whole Body (CM)	Mechanical Objectives	Tools
Week 2	SLH 100	Cause-Effect, FBD, MAD, CM	Equations of Motion	2D Model of Body (CM)
30-Aug		Force vector, time	squat-stand, stand-squat	Body Segment Parameters
Week 3	SLH 100	Labor Day Week (no labs)	net impulse= Δ momentum	Field Work
6-Sep		no lecture on Monday, no labs	running	Video
Week 4	SLH 100	net impulse= Δ momentum	Projectile Motion	Linear Impulse
13-Sep		Jump Shot: multiple phases	ball/body	Running/ Lab RF & Vayu Demo
Week 5	SLH 100	net ang impulse= Δ momentum	Context at Initiation	Angular Impulse
20-Sep		back, reverse dives	stand vs running front	Diving
Week 6	SLH 100	Performance Improvement	Reduce Risk	Practical Exam
27-Sep		(Land and Go)	(Land and Stop)	
Week 7	SLH 100	Motion Analysis:	Midterm Exam	Multijoint Control (Vayu)
4-Oct		Segment/Joint Level (STS)		
Week 8	PED B10	Field Project Data Collection	Recorded Lecture - Field work	Data Collection
11-Oct	DATA	Sign up for data collection in the field (Vayu)	no labs this week	Midsemester break
Week 9	PED B10	Lab Force Data Collection	Recorded Lecture- Lab work	Project
18-Oct	DATA	Sign up for B10 Data Collection	Labs will meet this week	
Week 10	SLH 100	Lower Extremity Joint Kinetics	Upper Extremity Joint Kinetics	Project
25-Oct		STS Ergonomics	STS Ergonomics	
Week 11	SLH 100	Preparation for Mech Demand	Preparation for Mech Demand	Project
1-Nov		WC propulsion	resistance/assistance training	
Week 12	SLH 100	Preparation for Mech Demand	Project Abstracts Shared	Project
8-Nov		Modifications over time	in class (3 minute 1 slide)	
Week 13	SLH 100	Review: Joint Kinetics	Midterm Exam	Project
15-Nov				
Week 14	Natural	Field Trip on Monday (USC ID)	no class Thanksgiving	Project
22-Nov	History M	Comparative Biomechanics		
Week 15	SLH 100	Review: Whole Body	Review: Joint/Segment level	Present final Project in lab
29-Nov				
Final 12/13	SLH 100	Comprehensive Exam		
	Grade	Rubric		
	Check -	needs work		
	Check	solid understanding		
	Check +	full understanding + apply to novel situations		0

Develop Your Habits of Mind as Part of the Learning Process

1. **THINK** critically and creatively to solve problems

What, How, Why, Modify, Reflect and Repeat

2. **COMMUNICATE** effectively in multiple mediums, languages, and settings

Purpose (clarity, Why this? Why now?)

Rationale for approach (structure)

Evidence (accuracy, reliability)

Assimilation with existing knowledge: How experience advanced understanding?

3. **COLLABORATE** with others to achieve more together

Show respect

Leverage strengths

Build consensus

4. **PRODUCE** quality work, through initiative, self-direction, and perseverance

Goals: whole-part-whole

Accountability: relevant, understandable, timely

Perseverance: learn, embrace errors as part of growth

5. **ADAPT** to new challenges by reflecting and growing

Learn

Adjust

Play on, play well together

6. **CONTRIBUTE** to the success of the community and world

With respect and social awareness

Active participation and listening