



HBIO 408L Biomechanics

Units: 4

Fall 2022

Instructor: Jill McNitt-Gray PhD

Office: PED B9

Office Hours: courtyard SOS B46, M&W 2:30-3:30PM

Contact Info: mcnitt@usc.edu *408 in subject line*

Teaching Assistants:

Harper Stewart hestewar@usc.edu

Helaine Lopes lopes@usc.edu

Alexis Camancho ascamach@usc.edu

Office: PED B9

Office Hours: use online appointment tool in Blackboard

IT Help: Dornsife Technology Services

University of Southern California

835 Bloom Walk, SHS 260

Los Angeles, CA 90089

E: ts@dornsife.usc.edu

P: 213-740-2775

F: 213-740-5534

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 2022

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

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

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

Office Hours: Outside classroom M, W 2:30-3:30 PM (be prepared to share work done during office hours)

Laboratory: 3 hours/week **Content builds weekly through integrated lecture & lab experiences, Comprehensive Final Exam**

***Course includes project-based capstone experience that progressively builds each week**

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.
- Regularly check the accuracy and quality of your own work

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%, Practical: 25%
 - Check +: demonstrates full understanding and can apply to novel situations
 - Check: demonstrates solid understanding
 - Check -: demonstrates emerging understanding requiring further review and iteration by the student

Course Grading Scale >90% A range, > 80% B range, >70% C range, >65% D range, otherwise F, +/- given

III. Laboratory Component (PED B15a)

Human Biology Instructional Laboratory Manager

Anh-Khoi Nguyen

agnguyen@usc.edu

Contact the Teaching Assistant for your lab section

Harper Stewart hestewar@usc.edu

Helaine Lopes lopes@usc.edu

Alexis Camancho ascamach@usc.edu

Office Hours: use online appointment tool in Blackboard

IV. Expectations

1. Come prepared for class and labs (lecture pop quizzes).
2. Sincere Personal Investment in independent discovery, lab activities, and **checking your own work**.
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 to investigate (compare/contrast goal-directed well-practiced tasks (e.g., sport, ergonomics))
- Generate a meaningful hypothesis (e.g., a logical guess based on principles, peer review literature etc.)
- Design and conduct a biomechanical experiment to test hypothesis
 - (Focus of analysis: compare and contrast 2D planar movements).
- Compare synthesized results with peer reviewed literature

Slides for oral presentation of capstone learning experience are generated and shared as project progresses.

Slides include:

- 1. Project Title** (Who: task & team),
- 2. Research questions of interest** (What & Why: literature),
- 3. Movement Analysis** (Whole-part-Whole approach using Filmstrip, events and phases),
- 4. Cause-Effect** during interval of interest (imp/mom),
- 5. Mechanical Demand** at an instant (joint kinetics),
- 6. Interpretation and implications of results** (*preparation for improved performance* (link biomechanics to muscle-mechanics- F-v-I relationships), *skill acquisition* (mechanical objectives of each phase)).

Prior to submitting and sharing work, all students are expected to

- check the quality of their own work as well as explain the work done by all members of their working group and
- as a group, provide near-peer mentoring/constructive feedback to others throughout the process

Project Grade will include the following components:

1. Background/Significance/Research Questions (10%) *What is known/unknown in peer reviewed literature? Expert clinicians?*
2. Kinetics at whole body level: net imp- Δ mom (25%) *mechanical objectives and cause-effect during movement phases?*
3. Kinematics (angle-angle) (25%) *multijoint coordination, kinematic context for muscle force generation?*
4. Joint kinetics (25%) *mechanical demand imposed on muscles groups controlling extremity of interest (leg, arm)?*
5. Presentation (4 min) and hand-in materials (15%) submitted as .pdf and .ppt files uploaded into individual's google folder
 - a) Scientific peer-reviewed journal articles related to research (.pdf uploaded and referenced in slides)
 - b) Hand written joint kinetics, FBD, data used, and associated calculations (show all work, single .pdf uploaded, emailed to TA)
 - c) Presentation (.ppt file and .pdf versions uploaded, .pdf emailed to TA prior to presentation, Font size at least 18 point)
 - d) Self-reflection and peer evaluation of team members (complete confidential survey) and "I like, I wish, I learned" anonymous evaluation of oral presentations in lab section.

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.

Week by week plan: Lecture and Lab*

HBIO 408	Location	Monday	Wed	Labs	Tool building/Habits of Mind
1	SOS B46	Motion analysis	Events, Phases	Independent set up	Habits, Data analysis
22-Aug		Whole Body (CM)	Mechanical Objectives	Own Tools	Community of Practice
2	SOS B46	Cause-Effect, FBD, MAD, CM	Equations of Motion	Body segment Parameters	Evidence (video, filmstrip)
29-Aug		Force vector, time	squat-stand, stand-squat	CM	Data Visualization
3	SOS B46	Labor Day Week (no labs)	net impulse= Δ momentum	Field Work	Literature Library (References)
5-Sep		no lecture on Monday	running	Video/Vayu	
4	SOS B46	net impulse= Δ momentum	Projectile Motion	Linear impulse	Ask an expert (network)
12-Sep		Jump Shot: multiple phases	ball/body	Running	Interview based on lit
5	SOS B46	net ang impulse= Δ momentum	Context at Initiation	Angular Impulse	Clarity of Mechanical Objectives
19-Sep		back, reverse dives	stand vs running front	Diving	how context influences mechanisms
6	SOS B46	Performance Improvement	Reduce Risk	Practical	Demonstrate Proficiencies in Lab
26-Sep		(Land and Go)	(Land and Stop)	Exam	
7	SOS B46	Midterm Exam	Motion Analysis: Segment/Joint Level (STS)	Multijoint Control	Pilot sensor data collection
3-Oct			Data Collection	Data Collection	phase plane, Muscle Length, Vel
8	PED B10	Project Data Collection	Data Collection	Data Collection	sign up for data collection days and
10-Oct		Sign up for times: PED B10		Midsemester break	
9	SOS B46	Lower Extremity Joint Kinetics	Lower Extremity Joint Kinetics	Project	Evidence (video, filmstrip)
17-Oct		STS horizontal thigh	STS ergonomics	Filmstrip, FBDs	Data Visualization
10	SOS B46	Lower Extremity Joint Kinetics	Upper Extremity Joint Kinetics	Project	Regulation of Momentum
24-Oct		STS seat raised	WC propulsion	Force-time plot	Implications on flight phases?
11	SOS B46	Preparation for Mech Demand	Preparation for Mech Demand	Project	Context for Muscle Force
31-Oct		Resistance training	Resistance training	angle-angle dot plots	Length, change in length/time
12	SOS B46	Preparation for Mech Demand	Review	Project	In Context at whole body level?
7-Nov		Resistance training		NJF, NJMs	Initial conditions? Real world?
13	SOS B46	Midterm Exam	Project Abstracts Shared	Project	Interpretation: Skill Acquisition?
14-Nov			in class (3 minute 1 slide)	Interpretation	Gaps in Literature?
14	Natural	Field Trip on Monday	no class Thanksgiving	Project	Implications:
21-Nov	History	Comparative Biomechanics		Presentation	Preparation/return to play
15	SOS B46	Review: Whole Body	Review: Joint/Segment level	Project Presentations	Communication
28-Nov					
Final 12/12	SOS B46	Comprehensive			
2-4 PM		Lab Rubrics: - (needs work), solid understanding, + (full understanding & can apply to novel situations)			

self-check your work each week using self-evaluation rubrics and provide near-peer mentoring and feedback to others in the community of practice

*** lecture and lab schedule will be modified as needed**

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