USC Department of Biological Sciences

HBIO 439L: Human Performance and Bioenergetics

This project-based course can be taken for 2 units or 4 units

Units:
4 units (quantitative approaches)
2 units (qualitative approaches)

Spring 2020— First meeting is on Wed at 2PM during the first week at school

Subsequent meeting times for class and lab component are specific to the student's project

Students are encouraged to contact the Dr. McNitt-Gray (mcnitt@usc.edu) to sort out any potential time conflicts and course preparation including prerequisites.

Location: PED B9-10 Meeting Location

Instructor: Jill L McNitt-Gray
Office: PED B9
Office Hours: Wed 2-5PM
Contact Info: mcnitt@usc.edu

Course Description (4 units)

This course is for students interested in the interface of human and technology to advance human health in wellness. Students will learn about the cause-effect relationships governing human performance by gaining hands-on experience analyzing the physiological and biomechanical aspects contributing to human performance through the use of emerging technology.

Exemplar topics specific to preserving mobility include integration of concepts from human performance, motor control, mechanical & physiological energy cost in normal, elite, and clinical populations, including

a) *Positive learning transfer* during skill acquisition (e.g. task intention / movement integrity / coordination strategies / metabolic cost / role of feedback in improving performance)

b) *Mobility in individuals with and without disability* (e.g. Compare and contrast wheelchair propulsion mechanics of paralympians with clinical populations using wheelchairs)

c) *Mobility of individuals with and without assistive devices*: Compare and contrast locomotion in different contexts (e.g. start-stop mechanics of paralympians with those of clinical populations using assistive devices including prostheses)

d) *Movement mechanics of individuals under physically challenging conditions*: (e.g. Human performance changes with the onset of physiological fatigue; motor complexity, coordination strategies, altered mechanical loading strategies)

Data Collection Sites:
USC Laboratories; US Olympic Training Center, Chula Vista, California; Rancho Los Amigos National Rehabilitation Center, Downey, California

Goals

To develop a deeper understanding of the central and cross-disciplinary concepts of human biology

To foster students' independent and collaborative work, which entails identifying, exploring, assessing and solving both conceptual and real-world problems through engineering design and the application of the scientific method, basic scientific principles and methodologies

To place biological knowledge into an ethical context and apply biological principles to the resolution of ethical, sociocultural, and environmental issues

Learning Objectives

Apply cross-disciplinary principles to explain structure-function relationships

Independently and collaboratively apply scientifici knowledge, experimental, and analytical skills to produce integrative original work

Formulate working hypotheses from peer-reviewed literature and test using scientific methodology

Present scientific evidence in an ecological context using well-supported rational

Course Notes: 4 units quantitative approach

Meeting Times: To be determined together by student and professor (4-units: 200 minutes; 2-units: 100 minutes) While class time is formally scheduled for Wed afternoon, the project based nature of this course requires that the meeting times will be specific to the project.
Students are encouraged to contact the Dr. McNitt-Gray (mcnitt@usc.edu) to sort out any potential time conflicts and course preparation including prerequisites.

Required Readings and Supplementary Materials

Web-Based Lecture Notes, Selected Literature Readings, Electronic Storage Device
Lab Notebook required at all times

Grading Breakdown

Effective application of principles in projects during class (weekly attendance required)
(10%) **weekly communication on progress/challenges using oral, written, and electronic means**
(10%) **Human Subjects Data management, data integrity, security, and privacy**
(10%) **Litererature Review of effective and ineffective approaches to date**
(15%) **integration of multiple sources of information**
(15%) **data visualization of cause effect relationships**
(40%) **project demonstration & technical note**

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

Course and Lab Schedule: A Weekly Breakdown

Weekly Topics: Class and Lab activities are integrated each week and will emphasize the following aspects from both a human biology and computer science point of view. Teams will be formed based on mutual interest and complementary skill sets.

1. **Introduction: Research involving Human Subjects and Data management, security, and privacy**
   Lab: On-line certification process (CITI certification)
2. **Experimental Design and Literature Review, effective and ineffective approaches to date**
   Lab: Electronic library search and bibiliography references (Mendeley)
3. **Physiology & Nutrition of Human Performance, integrating behavior data over time**
   Lab: Quantify metabolic aspects of complex motor skill, evaluate performance variables
4. **Kinematic Data - principles & analysis, value what is measured**
   Lab: Define mechanical objectives in each phase of task, digitally capture human motion / determine critical performance variables
5. **Motor Learning - Complex Motor Skills, integration of multiple sources of information**
   Lab: Analyze kinematic data in terms of perception-action, determine multi-joint coordination patterns
6. **Kinetic Data - principles & analysis, data visualization of cause effect relationships**
   Lab: Collect reaction force data, analyze critical performance variables
7. **Propose Pilot Project (Draft of design, implementation, testing, evaluation)**
   Lab: Develop plan for quantitatively evaluating performance between two conditions
8. **Assimilate results from data collection (apply data management skills and dealing with messy data)**
   Lab: Develop plan for communicating results of performance evaluation
9. **Physiology/ Motor Control Analysis (time synchronization of multimodal data collection approaches)**
   Lab: Analyze bioenergetics and motor performance using observed motion
10. **Kinematic data analysis & Interpretation (establishing functionally relevant differences)**
    Lab: Characterize an individual's observed motion (total body / joint / segment levels)
11. **Kinetic data analysis & Interpretation (data visualization of cause-effect relationships)**

Lab: Analyze causes of observed motion (total body level analysis)

12. Propose final project based on lessons learned in pilot project

Lab: Refine and iterate analysis and communication

13. Integrate bioenergetics and human performance components of project

Lab: Explain cause-effect relationships using data visualization or demonstration

14. Final Project Demonstrations with peer review

Lab: Prepare experimental results and discussion (Presentation)

15. Final Project Demonstrations with peer review

Final Exam Component: Write 3000 word technical note (J of Biomechanics format)

****course plan may be modified as needed throughout the semester

In addition to in-class contact hours, all courses must also meet a minimum standard for out-of-class time, which accounts for time students spend on homework, readings, writing, and other academic activities. **For each unit of in-class contact time, the university expects two hours of out of class student work per week over a semester.**

Course Description (2 units)

This course is for students interested in the interface of human and technology to advance human health in wellness. Students will learn about the cause-effect relationships governing human performance by gaining hands-on experience analyzing the physiological and biomechanical aspects contributing to human performance through the use of emerging technology.

Exemplar topics specific to preserving mobility include integration of concepts from human performance, motor control, mechanical & physiological energy cost in normal, elite, and clinical populations, including

a) *Positive learning transfer* during skill acquisition (e.g. task intention / movement integrity / coordination strategies / metabolic cost / role of feedback in improving performance)

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Data Collection Sites:
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Learning Objectives

Apply cross-disciplinary principles to explain structure-function relationships

Independently and collaboratively apply scientifici knowledge, experimental, and analytical skills to produce integrative original work

Formulate working hypotheses from peer-reviewed literature and test using scientific methodology

Present scientific evidence in an ecological context using well-supported rational

Course Notes: 2 units (qualitative approach)

Meeting Times: To be determined together by student and professor (4-units: 200 minutes; 2-units: 100 minutes) While class time is formally scheduled for Wed afternoon, the project based nature of this course requires that the meeting times will be specific to the project.
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3. Physiology & Nutrition of Human Performance, integrating behavior data over time
Lab: Quantify metabolic aspects of complex motor skill, evaluate performance variables
4. Qualitative anlaysis of motion - principles & analysis, value what is analyzed
Lab: Define mechanical objectives in each phase of task, compare using qualitative techniques
5. Motor Learning - Complex Motor Skills, integration of multiple sources of information

Lab: Analyze motion using qualitative approaches for understanding of perception-action

6. **Visualization of cause effect relationships using qualitative approaches**
   Lab: analyze critical aspects of performance
7. **Propose Pilot Project (Draft of design, implementation, testing, evaluation)**
   Lab: Develop plan for qualitatively evaluating performance between two conditions
8. **Compare and contrast performance using qualitative approaches**
   Lab: Develop plan for communicating results of performance evaluation
9. **Physiology/ Motor Control Analysis using qualitative approaches**
   Lab: Analyze bioenergetics and motor performance using observed motion
10. **Analysis and Interpretation (establishing functionally relevant differences)**
    Lab: Characterize an individual's observed motion (total body / joint / segment levels)
11. **Analysis and Interpretation (data visualization of cause-effect relationships)**
    Lab: Analyze causes of observed motion (total body level analysis)
12. **Propose final project based on lessons learned in pilot project**
    Lab: Refine and iterate
13. **Integrate bioenergetics and human performance components of project**
    Lab: Explain cause-effect relationships using data visualization or demonstration
14. **Final Project Demonstrations with peer review**
    Lab: Prepare experimental results and discussion (Presentation)
15. **Final Project Demonstrations with peer review**

Final Exam Component: Oral presentation of project (10 minutes with 5 minutes of questions)

**course plan may be modified as needed throughout the semester

In addition to in-class contact hours, all courses must also meet a minimum standard for out-of-class time, which accounts for time students spend on homework, readings, writing, and other academic activities. **For each unit of in-class contact time, the university expects two hours of out of class student work per week over a semester.**

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.