

KINE 301: Motor Control and Learning

California State University San Marcos

Fall 2017

CRN: 40897

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Office Hours: Tuesdays 12:00–1:00
and by appointment

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4 Credit Hours

“Information is not knowledge” - Albert Einstein

COURSE DESCRIPTION

Learning principles of motor control and skill acquisition, with an emphasis on the relevance to rehabilitation, human factors, physical education and performance. Specific topics include: 1) The properties of moving (dynamical) segmented systems and some of the challenges of motor control; 2) Physiological properties of the musculoskeletal system that relate to movement control; 3) Basic control systems theory and vocabulary; 4) Organization of the nervous system from the motor unit to the brain; 5) Capabilities and limitations of neural compensations for controlling movement; 6) The interactions between neural and musculoskeletal systems that underlie movement; 7) The development of motor function in infancy and childhood; 8) Neurophysiological principles of learning; 9) Principles of effective learning at the behavioral level; 10) Principles for maximizing performance as applied to athletics and rehabilitation. **PREREQUISITES:** BIOL 177, 178, KINE 202

CONTENT LEARNING OUTCOMES

The overall objective of KINE 301 is to share an understanding of how humans make effective movements. Understanding involves thinking about what the *requirements* for making movements are – what makes movement inherently difficult. Even simple movements that we take for granted are complex at many levels! From the physics of segmented systems themselves, to the many muscles involved in most movements, to the physiological properties of muscle and the nervous system that both enable and constrain movement. KINE 301 is about understanding how the nervous system works with the musculoskeletal system to overcome complexity and achieve high performance. Understanding the dynamic neuro-musculo-skeletal interactions that result in effective movement involves learning a bit about how neurons work, how the spinal cord and brain function, and some ideas about how movements may be planned and executed. However, because we learn to do so many movements, we need also to think about the process of learning – where learning happens and how.

There are clearly many factors that affect motor control! An added challenge is to appreciate the interconnections among many factors that influence motor control (mechanical, musculoskeletal, neural, psychological, developmental, etc.). Completing KINE 301 involves being able to:

1. Apply basic principles of segmental mechanics to understanding movement
2. Explain how the brain, spinal cord, and musculoskeletal systems interact to plan and execute movement using concepts from control systems theory, dynamical systems theory, neuroanatomy, neurophysiology, and psychology
3. Evaluate factors that limit or constrain motor performance, including muscle- and neuro-physiological properties, and cognitive information processing
4. Use research findings about motor learning to generate strategies to improve motor performance, including structuring practice, providing feedback, and adapting training to skill level
5. Evaluate the effects of individual differences on motor control and performance, including differences due to age/development

SKILL LEARNING OUTCOMES

Another objective of KINE 301 is to become more skilled in scientific reasoning and quantitative measurement, analysis, and evaluation. Completing KINE 301 involves being able to:

1. Apply principles of effective learning to improving study strategies
2. Apply principles and knowledge of motor control to specific movement contexts
3. Effectively read, understand, analyze, and evaluate scientific literature
4. Generate motor control hypotheses that are novel, important, reasonable and testable
5. Use data acquisition tools to quantitatively measure human movement
6. Use data and basic statistics to evaluate motor control hypotheses
7. Identify sources of uncertainty and use them to weigh evidence
8. Construct arguments to defend hypotheses, experimental methods, and data-based conclusions
9. Report scientific findings using clear, well-organized written and oral presentation

KINESIOLOGY PROGRAM STUDENT LEARNING OUTCOMES

KINE 301 is designed to contribute to all of the Kinesiology Department student learning outcomes (KSLOs):

1. Describe fundamental principles of Kinesiology, including anatomy and physiology, teaching movement related skills, physiological response to exercise, and the mechanics and control of movement.
2. Apply Kinesiology related skills to real-world problems through empirical research, internships, field experience, and/or service learning.
3. Evaluate movement science questions through 1) the performance of health, fitness, and movement assessment, 2) the acquisition, analysis, and interpretation of original data, and 3) the appraisal and application of information from current research literature.
4. Utilize oral and written communication that meets appropriate professional and scientific standards in Kinesiology.
5. Model behavior consistent with that of a Kinesiology professional, including 1) advocacy for a healthy, active lifestyle, 2) adherence to professional ethics, 3) service to others, 4) shared responsibility and successful collaboration with peers, and 5) pursuit of learning beyond CSUSM.

LECTURES AND QUIZZES

The primary content for this course will be available through reading (primary literature), and in-class discussions. Online lectures and textbooks will be used as resources to find information necessary for in-class activities and discussions, or provide opportunities for review. The texts (below) are listed for reference only (you will not be responsible for information in a textbook that is not covered elsewhere in class). Each section of the course will address one or more of the questions, as listed in the schedule below.

REFERENCE TEXTS (optional)

Schmidt, R. A. & Wrisberg (2008). *Motor Learning and Performance: A Situation-based Learning Approach* (4th Edition). Human Kinetics Publishers Ltd. (ISBN-13: 9780736069649)

Schmidt, R. A. & Lee, T.D. (2011). *Motor Control and Learning: A Behavioral Emphasis* (5th Edition). Human Kinetics Publishers Ltd., Champaign, IL. (ISBN: 0-7360-4258-1)

Supplementary Texts (optional):

Latash, M.L. (2008). *Neurophysiological Basis of Movement*, 2nd ed. Human Kinetics: Champaign, IL.

Kandel, E.R., Schwartz, J.H., Jessell, T.M. (2000). *Principles of Neural Science* 4th ed. McGraw-Hill Medical: New York, NY.

WEBSITE

Assignments, handouts, online lectures and notes, quizzes, instructor correspondence, grades, etc. will be available through the course website. If you need help with web access or computer use or have any unique needs, please contact the instructor.

EMAIL

I always make an effort to respond to emails as promptly and thoroughly as possible. To facilitate this it is important for me to be able to easily identify class emails. Consequently, I request that any emails that you send me about the course begin with "KINE301:" in the subject line. For example, a subject could read "KINE301: Appointment Request." I cannot guarantee responses to emails that do not have "KINE301:" in the subject. In the case that I am slow to respond to an email, please feel free to simply re-send the message. My inbox gets out of control sometimes, and emails can get lost or mis-filed, and I appreciate the reminder if I have somehow misplaced a message or failed to respond for any other reason.

SCHEDULES

The schedules and assignments contained in this syllabus may be subject to change. It is up to you to make sure that you are aware of all announcements concerning changes in the course outline, readings, assignments, exams, and other matters made during class periods whether or not you are in attendance when announcements are made. Some assignments for each class are listed below. Preparing before class is likely to lead to more interesting class time and also facilitate studying.

ATTENDANCE

Regular attendance is essential. Many missed assignments, including quizzes or lab activities, CANNOT be made up, except in the case of university business or religious holiday. Accepting late assignments is not fair to other students for several reasons. For example, late assignments interfere with our ability to discuss assignments during class periods.

CLASSROOM COURTESY

Please follow these guidelines for common courtesy:

- Respect individual diversity of each person in the class.
- Turn Cell Phones off before class, do not text message.
- Do not listen to a device during class time, including keeping the ear piece in your ear.
- Use computers in class only for class activity. Attempts to multitask (i.e. texting, etc.) will decrease performance

ACCOMODATIONS FOR DISABILITIES

We will make any reasonable accommodations for limitations due to any disability including learning disabilities. Please arrange an appointment to see me to discuss any needs you might have. All discussions are confidential. Students with disabilities who require academic accommodations must be approved for services by providing appropriate and recent documentation to the Office of Disabled Student Services (DSS). This office is located in Craven Hall 4300 and can be contacted by phone at (760) 750-4905, TDD (760) 750-4909 or by email at: dss@csusm.edu. Students authorized by DSS to receive accommodations should meet with me during my office hours, or in another private setting, in order to ensure your confidentiality. **Note:** Please inform me during the first week of classes about any disability or special needs that you have that may require specific arrangements related to attending the class sessions, carrying out class assignments, or writing papers or examinations.

COLLABORATIVE WORK

You will work in small groups to complete lab assignments, discuss assignments, and compile written and oral presentations (e.g. KSL0 5). However, some assignments will be submitted individually. Collaborative work is an opportunity to learn from each other, divide labor on

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assignments, learn through teaching, meet others in the class and major, become accustomed to team-based work, etc. Therefore, collaborative work is an important part of the class and your grade will reflect your contribution to the success of your groups. Evidence of leadership, effort, organization, congeniality and flexibility will favorably reflect on your performance in the class. However, collaborative work is not meant to include sending emails to the entire class with answers to quizzes or tests, which is considered a violation of the honesty and integrity policies.

WRITING

The University has an "All-University Writing Requirement" that students write at least 2,500 words for a 3 or more unit course. The University requirement reflects the importance of writing for virtually every field of study. Therefore, we will emphasize writing (specifically scientific/technical writing), and assessments for most work will be written papers. Writing is an expression of the critical/analytical/hierarchical thinking that is a major objective of KINE 301.

FORMATTING IS NOT WRITING. You may have been told (repeatedly) that effective writing involves use APA or MLA style to format your references. In my opinion, the emphasis on APA reference formatting comes at great cost to actually learning how to write. I don't care in the slightest how your references are formatted, so long as the formatting is clear and complete (including complete references that I can cross-check). Margins, spacing, reference styles, etc. are matters of appearance and are NOT important.

What IS important is that you write using specific, concise, and clearly-written sentences. MOST important is that you structure your paragraphs and papers using REASONING (deductive and/or inductive): that you lead the reader to specific, clear conclusions using specific, clear evidence. Use APA reference formatting if you want – I don't care. So long as your papers are well-reasoned, I'm good.

ASSIGNMENTS

Assignments will assess comprehension of the important concepts presented in the course, and the ability to apply concepts to novel problems. The assignments dates are scheduled ahead of time for your convenience, therefore plan accordingly. A missed assignment can potentially be excused with a VALID AND WRITTEN EXCUSE FROM A REPUTABLE SOURCE. Otherwise, no points can be given for the assignment. Cheating will result in a failing grade for the course and possible referral to the university for disciplinary action.

TIME EXPECTATIONS

Completing a college courses is traditionally expected to involve 2-3 hours per week per credit hour of effort outside the course. Therefore, a reasonable expectation of this course would be that it will entail about 8-12 hours of effort outside of class time during the normal semester (multiply all these values by 2-3 times in summer, where time is compressed but content is unchanged). The effort required each week may vary, but on average the time might be expected to break down as shown in the table to the right.

ACTIVITY	TIME INVESTED
Reviewing lectures/reading	3-4 hours
Completing short assignments/quizzes	1 hour
Case Studies	3-4 hours
Lab Reports	3-4 hours

Organization is half the battle. In my experience, there is a high correlation between organization and success. Be sure not to fall behind on assignments. Having a weekly schedule, and adding class time into your schedule for each course (as you might for your work and other activities) can greatly improve performance and reduce stress. Completing an assignment early takes as much time as completing it at the last minute, but usually results in higher grades (particularly if you get feedback). I encourage you to work with friends and groups to discuss course material and complete assignments.

CLASS PERIODS

Most class periods will consist of class discussions, group work, and class presentations. If there are other things that you read about, hear about, know about, etc. that are relevant to the course, please do bring these up and discuss them! Class discussions are always welcome so long as they are focused and include everyone.

OFFICE HOURS

I encourage you to make use of office hours, or make appointments to come talk to me if you have questions or concerns. I have observed dramatic improvements in grades through one-on-one interaction. I also appreciate any and all feedback about the structure of the course, the material, ideas for making things better or clearer, etc. Feedback provided will not factor into grading decisions.

My office is in UH 310. If you arrive for an appointment and my door is closed, please knock. I keep the door open for all meetings with students, without exception.

EXPECTATIONS OF THE INSTRUCTOR

What is the instructor's job? To transfer information from their brain to the students'? To sort and rank students through grades? I would argue that these are not possible or desirable, respectively. Ideally, instructors have several responsibilities:

- 1) Instructors identify information and concepts about their course topics that are most important for understanding. Based on their knowledge and experience, instructors select from the vast amounts of information available the most relevant topics for study and reflection.
- 2) Instructors design activities that guide students through the process of discovery and learning, providing encouragement and constructive criticism, identifying important questions and encouraging students to become actively engaged in their own inquiry.

- 3) Instructors provide examples of the thinking process of their disciplines. Instructors demonstrate the creative process that leads to new ideas (e.g. testable models), and show examples of the evaluation and judgment that are used to come to conclusions.
- 4) Instructors assess the students in the course (i.e. grading). Instructors must determine the level of understanding required, design assessments for students to demonstrate understanding, and clearly communicate the instructor's expectations to students.
- 5) Instructors are responsible for maintaining academic standards and integrity. Instructors are responsible for ensuring that college-level coursework in each class is appropriate for the field, the class level, contributes to Department and University learning objectives, and is capable of having a long-term impact on students. Personally, I consider it an ethical imperative not to sell students short based on assumptions or potential misperceptions. I assume that ALL students are capable of HIGH QUALITY work on par with students anywhere. It is the instructor's job to try to find ways to achieve high performance for each individual, and help to motivate the students to put in the time and effort necessary for excellence.

Finally, instructors have an added responsibility. Instructors have a responsibility not to spell everything out for the students. Although guidance, clarity, and communication may seem conducive to **knowledge** learning, excessive guidance can actually be detrimental for **skill** learning and higher-order understanding. Improving writing, or analysis, or evaluation skills requires attempting to perform assignments without complete guidance – in the presence of perceived uncertainty both in the desired outcome and the best path to reach the outcome. Skill learning depends on making mistakes: having expectations that are not completely structured and allow for errors, trial and correction, and, yes, even the potential for frustration sometimes.

SOME SUGGESTIONS FOR SUCCESS

There is a lot that can be gained from KINE 301 (in my own humble opinion ;-). Getting the most out of the course is easiest if you are organized, not overly stressed out, and have enough time to reflect on some of the topics that we cover. Some suggestions:

- 1) Keep up-to-date on assignments and even get ahead a little. Just like setting your clocks faster by a few minutes can sometimes help getting places on time... if you set personal deadlines ahead of class deadlines, things will seem much easier.
- 2) Keep a record of areas that are confusing and ask questions. Come to office hours.
- 3) Try to understand, not simply memorize, course material. Understanding means putting information in frameworks of other things that are already known, and thinking about connections among different course topics. Compare and contrast different topics from the course, etc.
- 4) Please Please Please don't be satisfied with poor performance! If a score does not reflect the effort made to learn the material, then come to office hours, consult peers, take action to improve! I am confident that everyone is capable of getting a top grade. Don't sell yourself short and settle for less!
- 5) Please give me feedback about aspects of the course that you are not satisfied with. I can't change everything this semester, but some things I can!

CLASSROOM HONESTY AND INTEGRITY

Honesty and integrity are a reflection of your character. Therefore, cheating is considered a serious offense. Students will be expected to adhere to standards of academic honesty and integrity, as outlined in the Student Academic Honesty Policy. All written work and oral presentation assignments must be original work. All ideas/material that are derived from other sources must have appropriate references to the original sources. Any quoted material should give credit to the source and be punctuated with quotation marks.

Students are responsible for honest completion of their work including examinations. There will be no tolerance for infractions. If you believe there has been an infraction by someone in the class, please bring it to the instructor's attention. The instructor reserves the right to discipline any student for academic dishonesty, in accordance with the general rules and regulations of the university.

Disciplinary action may include the lowering of grades and/or the assignment of a failing grade for an exam, assignment, or the class as a whole. Incidents of Academic Dishonesty will be reported to the Dean of Students. Sanctions at the University level may include suspension or expulsion from the University.

Students are expected to conduct themselves in a manner appropriate for class and comply with the rules of student conduct. The rules of student conduct are included in the California Code of Regulations, Title 5, and beginning at Section 41301. A student who violates university policies or regulations is subject to disciplinary action, which can result in a warning, reprimand, probation, suspension, or expulsion. The Chancellor of the California State University specifies procedures under which the university may take disciplinary action against a student. These procedures are on file in the Office of the Dean of Students, Craven Hall, Room 5306.

GRADING.

I don't particularly like grading – but it has to be done. Ideally, grades are valid assessments of learning. Unfortunately, grades often assess only some aspects of learning and can be influenced by lots of other confounding factors ☹. My honest suggestion is to focus on really understanding the material well and don't worry about the grade – it will take care of itself (for the best). Also, it is usually best to keep focused on what YOU have control over. You have control over how you organize your time and how much time you allow for this course, how focused and dedicated you are when studying, how effectively you use your group time, the effort you put into connecting new information to things you already know, etc. You have control over your strategy for getting correct answers on each individual assignment. However, you DO NOT have control over your final grade. Final grades are the worry of one person – the instructor (and believe me I worry about grades and try to make sure that they are fair and reflect learning).

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In general, thinking about your grade is not really a good use of time apart from using your current score to change the way you approach the class. Whether half way through the term you have the grade you want or not, I would argue that in either case, what you DO should be the same: try to learn the material the most effectively you can using the time that you have. Therefore, I would advise against spending time thinking about the grade (which you do NOT have control over) and focusing on learning (which you DO have control over).

Grades will be assigned according to points earned during the course. The course is NOT curved (it is criterion-referenced, not norm-referenced). If everyone gets an "A," then I'll be ecstatic.

GRADING	Points	Percent of final grade
Class Attendance	55	11%
Class Participation/Leadership	20	4%
Quizzes	70	14%
Exam	30	6%
Personal Statement	10	2%
Literature Grids (3)	30	6%
Lab Outlines (3)	30	6%
Lab Write-Ups (3)	105	21%
Case Study Write-Ups (3)	105	21%
Class Presentations (3)	45	9%
Total	500	100%

POINTS	PERCENTAGE	LETTER GRADE
500-465	100%-93.0%	A
464-450	92.9%-90.0%	A-
449-440	89.9%-88.0%	B+
439-415	87.9%-83.0%	B
414-400	82.9%-80.0%	B-
399-390	79.9%-78.0%	C+
389-365	77.9%-73.0%	C
364-350	72.9%-70.0%	C-
349-340	69.9%-68.0%	D+
339-300	67.9%-60.0%	D
299-000	59.9%-0.00%	E

CLASS SCHEDULE

Subject to change at any time

Classes are TR 4:00-5:15 PM, Academic Hall 304

DATE/SECTION	TOPICS	POTENTIAL QUESTIONS	REFERENCE READING / ASSIGNMENTS
LECTURE MONTH: INTRODUCTION AND SCIENCE SKILLS TUTORIAL			
29 AUGUST <i>Course Introduction</i>	-Logistics -Expectations and Potential	Who is this person? What is this class all about?	- Read this syllabus carefully
31 AUGUST SECTION 1 <i>Pedagogy/Andragogy</i>	-Learning objectives of college classes	1. What is Bloom's Taxonomy, and how can it help our thinking about learning? 2. What three principles have been shown to contribute to effective learning?	- Required reading: Mayer (2002), NRC Report
05 SEPTEMBER SCIENCE SECTION 2 Scientific Method	-Scientific Method	3. What is science? What isn't science? 4. What is the difference between using induction and deduction for science? 5. What is "strong inference" in a historical context?	- Required reading: Goodstein: "How Science Works"
07 SEPTEMBER SCIENCE SECTION 2 Scientific Method, cont.	-Hypotheses	6. What are hypotheses? Alternative hypotheses? 7. Why is it useful to distinguish between general and measurable hypotheses? 8. How do we reasonably reject measurable hypotheses?	- Required reading: Platt (1964)
12 SEPTEMBER SCIENCE SECTION 2 Scientific Method, cont.	-Hill's Criteria	9. How can we support general hypotheses?	- Required reading: Fedak et al. (2015)
14 SEPTEMBER SCIENCE SECTION 3 Statistics Review	-Descriptive statistics -Parametric statistics -Types of Controls	10. Can we intuitively understand the calculations for measures such as variance and coefficient of determination? 11. What are the assumptions of common statistical tests? 12. What are common types of controls, and why are they important?	- Required reading: Shintani (2014A)
19 SEPTEMBER SCIENCE SECTION 3 Statistics Review	-Correlation -Limitations of statistics	13. What can statistical tests tell us, and what don't they tell us? 14. How do we use statistics to test hypotheses?	- Required reading: Shintani (2014B)
21 SEPTEMBER SCIENCE SECTION 4 Effective writing	-Writing the Introduction and Discussion -Narrative Writing	15. How can we use reasoning frameworks to help structure Introduction and Discussion sections? 16. How can we use narrative writing/storytelling to improve scientific writing?	- Required Reading: Brand, 2001, 2008, Introduction and Discussion sections
CASE STUDY 1: STRUCTURING PRACTICE			
26 SEPTEMBER INTRODUCTION TO CASE STUDY 1	-Introduction to Practice and Feedback (lecture)	17. What is "performance" and how can we measure it? 18. Do changes in performance mean that learning has occurred? 19. How do we assess performance and learning?	- Required reading: Steele and Aronson (1995) Shea and Morgan (1979) Winstein and Schmidt (1990)
28 SEPTEMBER		EXAM: SCIENCE AND SCIENTIFIC WRITING	
28 SEPTEMBER – 17 OCTOBER	-Possibilities and Limitations -Different types of error	20. Does increased performance during practice directly correspond to increased learning?	- Reference online lectures: Assessment, Practice, Feedback,

CASE STUDY 1: ASSESSING AND STRUCTURING PRACTICE	<ul style="list-style-type: none"> -Performance curves -Stereotype threat -Structuring the learning experience -Practice Schedules -Desirable Difficulties -Contextual interference -Intrinsic and Extrinsic -Augmented Feedback -Feedback schedules -Long-term memory 	<ul style="list-style-type: none"> 21. How can practice be structured to maximize learning for different people? 22. What types of feedback are available to learners, and how can feedback be augmented? 23. Does providing more feedback during practice increase performance and learning? 24. Does the type and amount of feedback provided during practice affect performance and learning? 25. Can learning occur in muscles or in the spinal cord? 26. Does learning different types of information involve different brain areas? 27. When we are learning a motor task, what are we learning to control? Kinematics? Forces? 28. Does making mistakes help or hinder learning? 	Learning
05 OCTOBER CASE STUDY 1	- Case Study 1 Background Research: Literature Grids Due	29. What are some ways that we can structure library research?	- Work on Case Study 1 Outline
12 OCTOBER CASE STUDY 1	- Case Study 1 Logical Outlines Due	<ul style="list-style-type: none"> 30. How can we use a logical outline to structure problem solving and written presentation? 31. How can we write to defend reasoned conclusions in science? 	- Work on Case Study 1 written presentations
CASE STUDY 2: SEGMENTED SYSTEMS			
19 OCTOBER INTRODUCTION TO CASE STUDY 2	<ul style="list-style-type: none"> - Case Study 1 Written Presentation Due - Segmented Systems: Introduction (lecture) 	<ul style="list-style-type: none"> 32. Are segmented systems like arms, legs, and bodies relatively easy to control, or are they complex? 33. Is neural feedback necessary for controlling complex aspects of movement such as stability? 34. How do the intrinsic dynamics of musculoskeletal systems influence motor performance? 	
19 OCTOBER – 09 NOVEMBER CASE STUDY 2: SEGMENTED SYSTEMS	<ul style="list-style-type: none"> -Segmented Systems -Chaos -Arm Movements -Interaction torques 	<ul style="list-style-type: none"> 35. If we know the forces in all the muscles crossing a joint, do we know how a joint will move? 36. Can muscle properties contribute to controlling complex aspects of movement such as stability? 37. What aspects of movement affect muscle force generation? 	<ul style="list-style-type: none"> - Required reading: Turvey (1990) Hirashima et al. (2003) Marconi et al. (2008) - Reference online lectures: Segmented Systems, Intrinsic Dynamics, Muscles
26 OCTOBER CASE STUDY 2	- Case Study 2 Background Research: Literature Grids Due	38. What are some ways that we can structure library research?	- Work on Case Study 2 Outline
02 NOVEMBER CASE STUDY 2	- Case Study 2 Logical Outlines Due	<ul style="list-style-type: none"> 39. How can we use a logical outline to structure problem solving and written presentation? 40. How can we write to defend reasoned conclusions in science? 	- Work on Case Study 2 written presentations
CASE STUDY 3: BRAIN-CONTROLLED NEUROPROSTHESES			
09 NOVEMBER INTRODUCTION TO CASE STUDY 3	- Case Study 2 Written Presentation Due	41. What is “open-loop” and “closed-loop” control and why do time delays matter?	<ul style="list-style-type: none"> - Required reading: Anderson (2004) Lebedev and Nicolelis (2017)
09 NOVEMBER – 07 DECEMBER	<ul style="list-style-type: none"> -Open Loop control -Neuroanatomy 	<ul style="list-style-type: none"> 42. How are neurons organized in the spinal cord? 43. Is the spinal cord mostly a conduit of information from the brain to the 	- Reference online lectures: Nervous System, Spinal Cord, Brain, Learning

CASE STUDY 3: BRAIN-CONTROLLED NEUROPROSTHESES	<ul style="list-style-type: none"> -Pathways, Relays -Functional principles -Serial and Parallel processing -Motor programs -Learning vs. Plasticity -Spinal learning -Muscle memory -Learning in the context of biomechanics and neurophysiology 	<p>muscles, or is it capable of computations on its own?</p> <p>44. What brain regions are associated with motor control and what are their functions?</p> <p>45. Are there some common principles that can describe how brain regions communicate with each other, the spinal cord, and periphery?</p> <p>46. How does information flow in the brain to make movements?</p>	
16 NOVEMBER CASE STUDY 3	- Case Study 3 Background Research: Literature Grids Due	<p>47. What are some ways that we can structure library research?</p>	<p>- Work on Case Study 3 Outline</p>
30 NOVEMBER CASE STUDY 3	- Case Study 3 Logical Outlines Due	<p>48. How can we use a logical outline to structure problem solving and written presentation?</p> <p>49. How can we write to defend reasoned conclusions in science?</p>	<p>- Work on Case Study 3 written presentations</p>
14 DECEMBER 4:00-6:00 PM	CASE STUDY 3 WRITTEN PRESENTATIONS DUE		

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LABORATORY GUIDELINES

“Education is the path from cocky ignorance to miserable uncertainty.” -- Mark Twain

Laboratories will consist of designing hypothesis-based studies to test questions in motor control. The objective of the laboratory is to gain reasoning skills and learn about how to design and conduct experiments in motor control (not to learn how to use fancy equipment). Lab activities will typically involve (1) a short review of the problems and relevant literature highlighting a gap in our knowledge of a particular problem; (2) generating both GENERAL and MEASURABLE hypotheses (3) designing an experiment that will allow for controlled, quantitative measurements; (4) collecting data using laboratory equipment and techniques; (5) analyzing the collected data to test the measurable hypothesis; and (6) discussion of the implications of the outcomes of the experiment on the general hypothesis, potential limitations that could have affected the results, and potential alternative interpretations. Specific guidelines for effective scientific writing and presentation will be an important component of the laboratory.

Requirements for Lab

- Attendance and participation are mandatory, except for health reasons at the discretion of the instructor. Laboratory activities may be moved to the lecture time of the course. The instructor will take Roll at the beginning of lab. Missing a lab will result in losing at least 4 points. Being late for lab will also result in forfeiture of participation points.
- No food allowed in the laboratory.
- Proper attire, including closed-toed shoes is required.
- Laboratory write-ups are due on the dates specified below.
- You must bring a thumb drive or equivalent to store your personal data for analysis.
- Leaving without completion of the in-class portion of your lab will be considered an absence.

Recommendations for Lab

- Computers will be available for data analysis in the Motor Control Lab. There will be up to 20 students in each lab section. You may choose to bring your own laptop computer for data analysis.
- On some lab days, we will only have one data collection system and 20 students. You will have down time. A productive student might choose to use this down time to work on their homework assignments and/or discuss them with other students.

Safety

- Your safety is the highest priority. If for any reason you don't feel comfortable participating in any laboratory activity, please speak with your instructor.

Lab Assignments

Laboratory assignments will be made available for download from Cougar Courses. Assignments will contain three parts: **preparation, lab activities, and assignments**. You will be expected to arrive prepared by having completed pre-laboratory assignments (online lectures, readings, etc.). During the lab activity section, you must complete the lab activity before you leave for the day. You may choose to work on the analysis section of your laboratory assignment at home or in the computer lab if you prefer. However, it is recommended that you make use of your instructor's assistance in completing the lab requirements. Your lab assignment will be due as indicated (typically the next time that your lab section meets). *Laboratory papers that are not typed will not be accepted*. Many lab sections involve acquiring or reinforcing specific **skills**. Although you will work in groups, it is important to make sure that you are competent with each required skill, because each skill will be required for future labs.

PAPER SUBMISSION

Laboratory handouts will be collected at the end of each laboratory period. Written papers will be submitted through **Turnitin**. Please include your name within any document that you submit.

PLAGIARISM

“Plagiarism” can be defined as using another's words, ideas, materials or work without properly acknowledging and documenting the source. Students are responsible for knowing the rules governing the use of another's work or materials and for acknowledging and documenting the source appropriately.

LABORATORY SCHEDULE
 Subject to change at any time
 Classes are T or R 1:00-3:50 PM, University Hall 240

WEEK	DATES	TOPIC/PREPARATION	LAB ACTIVITY	SKILL EXPECTATIONS	ASSIGNMENT
LAB 1 INTRODUCTION AND SKILLS TUTORIAL: Reasoning and Science, Applied to Scientific Writing					
1	29/31 AUGUST	- Introduction to the Lab - Reasoning	- Lecture: Reasoning - Critical evaluation of arguments - Reasoning group activity	- Basics of Logic - Premises and Conclusions - Logical Fallacies	Read this syllabus and ask any questions you may have
2	05/07 SEPTEMBER	- Fundaments of scientific writing	- Structuring sentences and paragraphs - Hierarchy and Trees - Writing sentences and paragraphs group activity	- Ability to write clear, specific sentences - Ability to write well-structured, logical paragraphs - Critical thinking through writing	
3	12/14 SEPTEMBER	- Fundaments of scientific writing, cont. - Writing Style and Pointers	- Writing style and pointers group activity	- Ability to identify and correct common stylistic problems that interfere with clear writing	- Career Preparation (online lecture) - Assignment: Personal Statement outline and paragraph written using reasoning and logical transitions
4	19/21 SEPTEMBER	- Papers as Rhetoric - Writing the Methods and Results	- Writing critique of Bock et al. (2005)	- Critical analysis of scientific writing	- Reading: Brand, 2001, 2008, Methods and Results sections Bock et al. (2005)
LAB 2 – Perceptual Adaptation					
5	26/28 SEPTEMBER	- Experiment design	- Mini-Lecture: Perceptions - Prism Goggles Experiment design	- Application of the scientific method to designing a controlled experiment	
6	03/05 OCTOBER	- Data collection	- Perceptions Experiment design	- Careful and thorough data collection - Ability to use conclusions to support general hypotheses and/or propose new hypotheses	- Compile data into spreadsheet
7	10/12 OCTOBER	- Data analysis	- Lecture: Giving Effective Presentations - Perceptions data collection	- Ability to perform statistics (t-tests) using spreadsheet - Ability to make graphs in spreadsheet - Normalization as a control - t-tests to test hypotheses	- Prepare graphs - Perceptions: OUTLINE of REASONING of Methods
8	17/19 OCTOBER	- Perceptions outline due - Data analysis and writing	- Group data analysis - Group lab writing	- Ability to write scientific papers using reasoning	Reading for compensations Lab: Holmes and Keir (2012), Burke et al., (1996)
LAB 3 – Compensations					
9	24/26 OCTOBER	- Perceptions write-up due - Experiment design	- Perceptions Presentations (during lecture)	- Ability to structure effective presentations	

			- Introduction: Compensations (lecture) - Experimental Preparation: Compensations		
10	31 OCTOBER / 02 NOVEMBER	- Data collection	- Data collection: Compensations	- Basic computer Data Acquisition - Upper-extremity EMG measurements	- Reduce EMG data for analysis
11	07/09 NOVEMBER	- Data collection and analysis	- Data analysis: Compensations	- Normalization to compare different types of measurements	- Compensations: OUTLINE of REASONING of Methods and Results
12	14/16 NOVEMBER	- Compensations outline due - Data analysis and writing		- Using reasoning to test hypotheses	Reading for next lab: Trudeau et al. (2012), Van den Tillar and Ulvik (2014)
13	21/23 NOVEMBER	THANKSGIVING BREAK (NO LAB)			
LAB 4 – Information Processing in the Brain					
14	28/30 NOVEMBER	- Compensations Lab Due	- Compensations Lab Presentations (during lecture) - Information, Hick's and Fitts' Laws (mini lecture and activity)	- Ability to use information theory to explain motor performance	
15	05/07 DECEMBER	- Data collection	Fitts' Law Data Collection	- Ability to individually use effective structured, reasoned analysis and writing	
FINAL ORAL PRESENTATIONS					
	14 DECEMBER 4:00-6:00 PM	-Finished Lab reports for Fitts' Law (individual submission) due			

"Stay Hungry. Stay Foolish" – Stewart Brand