Faculty of Medicine

School of Medical Sciences

DEPARTMENT OF PHYSIOLOGY

NEUR3101

Muscle and Motor Control

Semester 1, 2018
Course Manual

CRICOS Provider Code 00098G

Please read this outline in conjunction with the following pages on the School of Medical Sciences website:

- Advice for Students
- Learning Resources

(or see "STUDENTS" tab at medicalsciences.med.unsw.edu.au)

Course staff

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Course details

Credit points: 6 UoC (0.125 FTSL)

Course pre-requisites

PHPH2101- Physiology 1A or PHPH2121- Principles of Physiology A or PHSL2501- Human Physiology A or NEUR2201- Neuroscience Fundamentals

Course description

This course examines how movement is controlled from brain to skeletal muscle. The major themes are the contribution of the brain and spinal cord to the control of movement, muscle function, motor learning, movement disorders, fatigue and ageing. The course will reinforce the relationship between integrative neuromotor function, movement physiology and cellular and molecular physiology. A series of advanced practical classes will range from experiments with isolated mammalian muscle to human studies using electromyography. The lectures, practicals and tutorials will be complemented by a series of seminars which will focus on how fundamental knowledge can be applied to solving clinical, practical and sports performance problems.

Course aims

To encourage the development of:

1. an understanding of skeletal muscle function and adaptation
2. an awareness of the mechanisms and current treatments of various neuromuscular disorders
3. an understanding of how the brain and spinal cord interact to produce different movements
4. an understanding of the mechanisms of motor learning and factors that influence motor learning
5. an appreciation of current techniques and future directions in movement neuroscience research.

The motor system is a vibrant research area in brain sciences, spanning, for example, the molecular genetics of muscle tissue, the cellular physiology of motoneurones, the plasticity of nerve cells in the brain, animal models of movement diseases, unravelling systems physiology in human subjects, and engineering control theories to identify the fundamental principles of motor control. In this course, you will be encouraged to learn and understand more about the physiology of the neuromuscular system. The emphasis is on how the motor control centres, sensory and muscular systems work together to produce movements and how this is disrupted by disease and normal ageing.

Student learning outcomes

Student learning outcomes describe what it is that you should be able to do, explain or understand if you have learned effectively in the course. For each lecture, tutorial, practical and assessment item, the expected learning outcomes will be explicitly stated. The assessment in the course will be designed to test how well you have achieved the learning outcomes of the course. The general learning outcomes for the course are as follows:

At the end of the course you should:

- Be able to communicate how skeletal muscle and the nervous system work to generate controlled movements at a level sufficient for effective communication with health care professionals.
- Have an understanding of the key theoretical concepts in the field of movement neuroscience in order to allow easy extension of your understanding beyond the material covered in this course to specific topics that may be important in future clinical, research or educational contexts.
- Have an awareness of current and (likely) future directions in movement neuroscience research and an ability to independently research the literature to address questions related to the field that may arise in your future professional activities.
- Be able critically evaluate peer-reviewed research publications and understand the logical structure of research study.
- Be able to design an experimental study and present scientific data.
- Be competent in the use of basic EMG and nerve stimulation techniques for research and clinical procedures.

Graduate Attributes developed in this course – *for Medical Science and Science students*

- the skills involved in scholarly enquiry
- an in-depth engagement with disciplinary knowledge in its interdisciplinary context
- the capacity for analytical and critical thinking
- the ability to engage in independent learning
- Information Literacy – the skills to locate, evaluate and use relevant information

- the skills of effective communication.

Graduate Attributes developed in this course – *for Exercise Physiology students*

- understand the relationship between physical activity and health
- apply clinical skills and knowledge relevant to cardiovascular, metabolic, musculoskeletal and neuromuscular rehabilitation
- engage in independent and reflective learning for the betterment of professional clinical practice, following an evidence-based approach
- communicate effectively with patients, colleagues and other health professionals.

Rationale for the inclusion of content and teaching approach

***How the course relates to the exercise physiology profession* (for students in program 3871-Exercise Physiology) –** A solid understanding of mechanisms by which humans plan and execute movement is central to a comprehensive training program in exercise science, and critical for effective professional practice in exercise rehabilitation.

How the course relates to other courses in the Exercise Physiology program – The information and ideas presented in this course will build upon material on muscle and nervous system and function from the second level Anatomy and Physiology courses you have taken. This course also provides a conceptual base that is essential for the neuromuscular and musculoskeletal rehabilitation courses later in the program.

Teaching strategies

Lectures – This approach is used to present relatively large amounts of information at a time on specific topics throughout the course. PDF copies of the lecture notes will be available on Moodle prior to each lecture, so you should be able to think about and develop an understanding of the lecture concepts as they are presented, rather than writing voluminous notes. However, there will be information and explanations presented in lectures in addition to those covered in the notes that you should take down if they help you to understand the material. The lecturer will also try to allow some time for interaction and activities in each lecture to provide you with an opportunity to clarify or reinforce the ideas that have been presented. You should take these opportunities to think about the information that has been presented and ask questions to enhance your understanding.

Practicals – The purpose of the practical components of the course are twofold. The first purpose is to help you to develop technical and practical skills that will be relevant in your professional career. It is essential that you obtain some hands-on experience with the major research and/or clinical techniques in human motor control, before you begin your practicum or the clinical rehabilitation courses. The second purpose is to use experiments to demonstrate and reinforce key theoretical concepts that have been covered in lectures. The questions contained in the practical outlines will guide your learning in this respect. **Attendance of practicals is compulsory** and an attendance role will be taken.

Tutorials – This format provides a more informal learning environment than a lecture. Some tutorial sessions (see timetable) will be structured around a “classic” research paper chosen from a field relevant to the course content. You will be required to read the paper (which will be available on Moodle) before the tutorial. You will then be encouraged to participate either by speaking or active listening in the structured discussion based around the classic paper. The purpose of these

sessions is to enable you to gain a core understanding of the scientific basis of the discipline and strict research logic. **Attendance at Tutorials is compulsory** and an attendance role will be taken.

Flipped classroom approach - You will be given access to lecture and video material explaining modern approaches to research and therapy. This component will be assessed. You are required to carry out this component as a self-directed learning task. A dedicated time slot will be allocated in the formal teaching timetable.

Blended learning – The blended learning is designed to leverage the perspectives from the motor control lectures working on the content to produce a consolidated set of explanatory statements and provide answers to theoretical and everyday life problems thus encouraging broad communication across the motor control discipline. The blended tutorial sessions will review existing motor control lectures and make a set of summaries and ideas that will reflect the understanding from student's perspective. By working in creative teams you will produce your own audio visual products to be used as blended learning aids. Created media products will be peer marked and ranked. The best products will be demonstrated to the whole cohort. Creativity and engagement is a key component of the blended learning experience.

Independent study – The face-to-face time in the lectures, tutorials and practicals is too limited for you to develop a deep understanding of the concepts covered in this course. In order for you to achieve the learning outcomes that will be assessed, you will need to revise the material presented in the course regularly. You will probably also need to do additional reading beyond the lecture materials in order to learn effectively. Relevant additional resources will be cited in each lecture.

Assessments – These tasks have been chosen as tools to enhance and guide your learning as well as a way of measuring performance.

Course evaluation and development

myExperience is your opportunity to reflect on the quality of learning and teaching you receive at UNSW. The only way we can improve what we do – or keep doing the good things – is by hearing about what you liked and didn't like about your learning and teaching experience.
See instructions at https://youtu.be/9_L0WxCBKBU

In response to feedback from previous students we have:
1) Increased the duration of the practical sessions and expanded on the details provided in the instructions for practical classes and halved the class sizes to allow more student-instructor interaction.
2) Removed one EMG practical which was thought to be repetitive and replaced it with a new interactive session on the causes and treatment of conditions which affect motor control.
3) Reduced the didactic lecture content by 30%.
4) Changed the format of the short answer questions in the exams so that the students have a choice of questions to answer, whereas previously all short answer questions were compulsory.
5) Decreased weighting of the final exam, increased marks available for blended learning project and peer marking.
6) Now you can freely choose the topic and research question you are interested in and see merit investigating in your thought experiment (essay on research logic; part 2). Previously it had to stem out of the classic paper analysed in the part 1.

7) As ExPhysSoc presidents have suggested based on student feedback we have introduced pre-prac and post-prac quizzes to test understanding of the laboratory practicals. We have also introduced a new tutorial in which results obtained during practicals are discussed and evaluated.

RESOURCES

See also: Learning Resources

There isn't one prescribed textbook for this course as the lecture content will not follow or match any particular textbook. Recommended sources of literature will be given for each lecture individually selected preferentially from the listed below.

Textbooks

- Kenney WL, Wilmore JH, Costill DL. (2015). *Physiology of sport and exercise,* (6th Ed). Human Kinetics Publishers, Champaigne IL, USA. ISBN-13: 978-1450477673.
- Purves D, Augustine GJ, Fitzpatrick D, Hall WC, LaMantia A, McNamara JO, White LE. (2012). *Neuroscience,* (5th Ed). Sinauer Associates, Inc. Sunderland, Massachusetts. ISBN 978-0-87893-695-3.
- Kandel ER, Schwartz JH, Jessell TM, Siegelbaum SA, Hudspeth AJ. (2012). *Principles of Neural Science,* (5th Ed). McGraw Hill Education. ISBN-13: 978-0071390118.

Suggested reference books

- Bear MF, Connors BW, Paradiso MA. (2015). *Neuroscience: Exploring the Brain,* (4th Ed). Lippincott Williams & Wilkins, USA. ISBN-13: 978-0781778176.
- Shumway-Cook A, Woollacott MH. (2011). *Motor Control: Translating research into clinical practice,* (4th Ed). Lippincott Williams & Wilkins, USA. ISBN-13: 978-1608310180.
- Lieber RL. (2009). *Skeletal Muscle Structure, Function, and Plasticity*, (3rd Ed). Lippincott Williams & Wilkins, USA. ISBN-13: 978-0781775939.
- Enoka, RM. (2008). *Neuromechanics of Human Movement,* (4th Ed). Human Kinetics Publishers, Champaigne IL, USA. ISBN: 0736066799.
- Zigmond MJ, Rowland LP, Coyle JT. (2014). *Neurobiology of Brain Disorders.* Academic Press. ISBN: 9780123982704.

Suggested reference journals

Nature Neuroscience, Nature Reviews Neuroscience, The Journal of Neuroscience, The Journal of Physiology, The Journal of Applied Physiology, Experimental Brain Research Clinical Neurophysiology The Journal of Motor Behaviour Progress in Neurobiology, Muscle and Nerve.

ASSESSMENT

Assessment of your learning in the course will be achieved through examinations. The examination format tests your ability to recall and communicate knowledge of the subject matter without outside resources and in a time-constrained context.
These requirements are similar to those encountered when dealing with a client or patient in a face-to-face setting, or when communicating with other health professionals or researchers. The examinations will be designed to determine how well you have achieved the general learning outcomes outlined above, and the specific learning outcomes outlined in each lecture/practical/tutorial.
The essay on research logic and impact will assess your ability to critically evaluate scientific rigour and interpret the scientific literature in the field of muscle and motor control. You may be required to perform similar tasks in many professional settings within exercise physiology practice or medical research. For example, you will evaluate evidence and refer to the scientific literature to inform clinical exercise prescription. In the second part of the essay you will have opportunity to demonstrate your creativity through attempting to solve one of outstanding scientific challenges through your own designed experiment. In the process of defining aims, hypothesis and methods you are expected to demonstrate your ability to apply critical thinking learned from the classic paper analyses. You will also learn skills of research data presentation.

	Assessments (chronologically)	**Value, final marks**	**Due Date**
I.	*QUIZZES RELATED TO PRACTICALS*	**Pre-prac quizzes: (pracs 1-4) 2%** **Post-prac quizzes: (pracs 1-5) 3%**	Wednesday on the week of prac you are enrolled in **27th May** Sunday Week 12
IV- part I.	*PROGRESS EXAMINATION (1 HOUR)*	**MCQ : 10%** **Short answer : 10%**	**11th April** Wednesday Week 6
II.	*ESSAY ON RESEARCH LOGIC AND IMPACT BASED ON CLASSIC PAPER AND THOUGHT EXPERIMENT*	**Classic paper : 10%** **Thought experiment : 10%**	**6th May** Sunday Week 9
III.	*BLENDED LEARNING ASSIGNMENT – MOTOR CONTROL EXPLAINED*	**Project : 10%** **Completion of peer marking : 5%**	**19th May** Saturday Week 11 **26th May** Saturday Week 12
IV- part II.	*FINAL EXAMINATION (2 HOURS)*	**MCQ : 20%** **Short answer : 20%**	Examination period

ASSESSMENT TASK 1 – Pre-prac and post-prac quizzes

The purpose of pre-prac quizzes is to ensure you come to the laboratory prepared, don't waste laboratory resources, and finish work on (or before) time. Pre-prac quizzes are available for practicals 1-4 only, note that practical 5 does not have pre-prac quiz.

The pre-prac quiz is available until midnight on the day before the prac (Wednesday) in the week scheduled for the group you are enrolled in. If for some reason you attend practical on a different week from that when you are enrolled in, the pre-prac deadline for you will not change.

Post-prac quizzes are testing your understanding of the results you obtained and your ability to put that in context of theoretical framework. Some questions in the quiz might be ungraded where you only have to report the outcomes of your performed experiments. All post-prac quizzes remain open until 27th of May. You can complete them straight after each practical or leave to the end of semester. In fact it is recommended that you use your first attempt straight after the practical and leave the last (third) attempt for week 12 when it is due and we have a tutorial to discuss practicals.

Thus there are 4 pre-prac and 5 post-prac quizzes all together worth 5% of your final mark. Each pre-prac and post-prac quiz may have a different number of questions and different weighting, which isn't determined by the number of questions.

ASSESSMENT TASK 2 – Essay on research logic and impact

Detailed instructions will be provided during tutorial on week 7. To complete this assessment successfully, you have to carefully study the instruction slides. Marks will be given for quality of the content, but will be subtracted if the prescribed formatting rules typically used in research reports are not adhered to.
Each section has word limit – 1000 words maximum (word count for subsections is given as recommendation and will not be checked). There is no lower boundary – it is only the content that matters – you might be able to demonstrate understanding by explaining the main concepts concisely and still get maximum marks. This assessment is worth 20% of your final mark. The essay will consist of two parts.

<u>Part 1</u> – Classic paper analyses (worth 50% of this assessment)
After week five, you will be randomly assigned to one of the four classic papers presented in the tutorials on weeks 2 to 5. Tutorials attendance is compulsory. A role will be taken.

In the first section of this essay you will provide a synopsis of the assigned classic paper both from your reading of the paper and the notes you took on the discussion which took place during the tutorial. It is in your best interests to be prepared for classic paper tutorial, and participate by being part of the classroom discussion or by active listening. Most elements required for this part of the essay will be analysed during tutorials dedicated to each classic paper.
Part 1 should include sections and headings:

1. **Background of physiological context (10%; 200 words)**
   In this section you should explain why the question addressed in the paper is important to study, what prior knowledge has led to this question, what is the context in which this question is studied, what prior knowledge is required to justify the experimental approach.

2. **Experimental approach, techniques used and data analysis (10%; 200 words)**
   Summarise how experiments were done so that a person who hasn't read the paper would understand the procedure. Pay special attention to unique experimental approaches and clever solutions pioneered in the paper.

3. **Principal findings (10%; 200 words)**
   Summarise and explain what the main findings are and what does it mean in a wider context.

4. **Statement of why this is a "classic" paper i.e. what impact on development of the field it had (20%; 400 words).**
   This section requires you to look beyond the text of the paper as you have to discuss the impact the classical paper had over time on further development of the research field. You can discuss fundamental, practical or clinical benefit.

<u>Part 2</u> – Logic of experimental design - thought experiment (worth 50% of this assessment)

In the second section of the assignment you will use the learned foundations of experimental research logic to either

- design an experiment and present mock results of your thought experiment to develop the hypothesis and findings laid out in the classic paper

or alternatively you can chose to

- attempt solving any muscle or motor control related problem or controversy in a thought experiment and present mock results.

For this part of the essay, all students will be encouraged to post on the dedicated Moodle forum research problems, practical questions you want to know answers to, or research controversies.

Part 2 should include following sections and headings:

1. **The problem to investigate, experimental aim and hypothesis (15%; 300 words).**
   In this section describe research problem or describe known controversy, define aim and explain expected outcome (or alternative outcomes). Use subheadings Problem, Aim and Hypothesis. Aim is usually defined in one or two sentences. Hypothesis should be described in one to three sentences and add another one to three sentences if you have an alternative hypothesis (two alternative outcomes of the experiment). If you are addressing research controversy you should refer to or cite literature expressing two opposing views and evidence used to support each of them. You may even form pairs or groups where each of you will advocate for a different view.

2. **Experimental design and methods to test the aim (15%; 300 words).**
   This is a thought experiment – show your creativity and technical knowledge, let your imagination fly: money is no object. What matters is the logic of your thinking and meaningful experimental design appropriate for solving the research problem.

3. **Presentation, justification and explanation of mock results (20%; 400 words).**
   In this section you are expected demonstrate your knowledge how research data are analysed, presented and formatted. The data in this section should be in the form of tables,

diagrams or graphs. You can use either one or a combination of these elements. Pay particular care to the formatting of figure labels, figure/table captions and legends. You should demonstrate understanding of the topic by being able to interpret mock results and explain what results mean.

Referencing and References list

The scientific literature should be cited in both parts using in-text citation style https://student.unsw.edu.au/harvard-referencing. A full Reference list should be inserted at the end of the essay. There is only one joint reference list for both parts together (part 1 and part 2). The number of required references may differ depending on your chosen question, some topics may require more than others. The general rule is if you give a specific statement about something which is not a general knowledge, you may need to refer to the source of this statement or where more information could be found.
It is suggested that you use one of available reference management software packages like EndNote which is available to UNSW students for free (https://www.it.unsw.edu.au/students/software/endnote.html). You can also choose to use freeware like Mendeley (https://www.mendeley.com/). Search for introductory and how-to demos on YouTube.
It is suggested that you use Harvard referencing style, which has detailed instructions on UNSW website: https://student.unsw.edu.au/citing-different-sources
Most research papers will have DOI (Digital Object Identifier), please include those in the list when available.

Marks will be subtracted for formatting and referencing style inconsistencies and errors.

Learning outcomes for Assignment 2

- To develop and refine the skills needed to obtain information on a topic in muscle and motor control from scientific journals
- To improve your ability to interpret and assess scientific articles
- To develop your ability to comprehend and extend a field of scientific research.

Submission through Turnitin

ASSESSMENT TASK 3 – Motor control explained (blended learning assignment)

The educational video project

For the educational video project students will choose one of the motor control topics discussed during lectures or tutorials. Project may be also based on relevant literature research. It is expected that you will produce a short educational video or use any widely accessible audio-visual means and animations to explain the underlying principles and demonstrate motor control in action. This is group assignment performed by 3-4 students. While it is teamwork and everyone is expected to take part in every step of the production, in some situations, when communication between team members is less efficient, it is suggested that the group assigns task-coordinating responsibilities to individuals. For example, the group may designate one student to coordinate narrative, one student to coordinate screenplay and one or two students to coordinate video editing.

The videos should be no longer than 3 minutes. It is the idea that counts, video quality should not matter provided that it is sufficient to convey the message. You can use your smartphone, i-device, webcam or digital camera. You can digitally edit and combine separately shot videos or shoot as one continuous take requiring no editing. The videos can also be made entirely from animated slide presentations created by software like PowerPoint, Keynote or similar, that has the ability to save presentations as animated video files.

It is suggested that the videos are uploaded to YouTube. You should carefully consider privacy settings and respect copyright. Depending on content usually the most appropriate YouTube setting is that videos remain unlisted (could not be found by search engine) and are shared by a private link. The videos should be made freely accessible for peer marking and public demonstration in the classroom. If there are concerns, instead of uploading videos on-line, you can submit video files via MOODLE and grant permissions to demonstrate submitted file in the classroom.

The videos require some embedded text recapping the main concepts. The videos should start with a title page and finish with end credits stating individual contributions (no personal information like student IDs, z numbers), software used to create it and links to audio-visual materials taken from elsewhere (you should indicate duration and time of insertion point).

Each video submission should be accompanied with one multiple choice question related to the content of your video. It has to include at least 4 answer choices indicating a correct answer.

The process of video creation will be demonstrated during one of the tutorials. Updated technical instructions will be given during the course.

Peer marking

Created blended learning products will be peer marked by other students enrolled in this course. You will receive marks for contribution to the peer assessment process. The final mark will be decided by course convenors based on the average peer marks.

Peer marking criteria

- **Scientific quality of the narrative (4 marks):** scientific depth (2 marks), scientific correctness (2 marks).
- **Adequate multiple choice question and answer choices provided for the project (1 mark)**
- **Media learning value (5 marks) as detailed in the table below:**

	5 marks	3-4 marks	2 marks	1 mark	0 marks
Media learning value: clever, engaging, entertaining, demonstrations helping to explain difficult concepts and promoting interest in the topic.	Product has high learning and entertaining value. Explanation of scientific concept is significantly aided by screenplay and audio visual means. Visually appealing or humorous presentation.	Product has good learning value. The investigated concept is explained well, but presentation is not sufficiently engaging.	Product has little learning value. Project has shortcomings explaining the scientific concept. Presentation is not engaging.	Product requires amendments to be considered for learning. Project identifies the question, but fails to explain it properly.	Product not suitable for learning. Project has no substance.

Learning outcomes for Assessment Task 3

- To learn skills of creating educational, research or professional presentation materials using various widely assessable tools and media
- To improve your ability to present complex scientific ideas in a straightforward manner using a video style format
- To work as an effective member of a creative educational team
- To understand and engage in the Peer assessment process.

ASSESSMENT TASK 4

PART I – Progress examination

The purpose of this exam is to test your understanding of the concepts covered in the first part of the course during weeks 1-6 (lectures 1 – 10). The content of laboratory practicals and tutorials will be tested only in the final exam. The format will be a mixture of multiple choice and short answer questions. The progress exam will be held during the tutorial timeslots on Wednesday,

11th of April 1:00-2:30pm (see the Course Schedule table). The exam will have 20 MCQ and you will have to choose 2 out of 4 short answer questions to answer. This assessment is worth 20% of your final mark.

A practice exam will be available on Moodle a week prior to the progress exam.

PART II – End of session examination

The purpose of this exam is to test your understanding of concepts not tested in the progress exam: lectures 11-24 (including flipped classroom topics), all five laboratory practicals and all four classic papers. The format will be 40 multiple choice questions and 4 sections of 2 short answer questions. You will have to answer one question from each section (4 short answer questions in total). The exam will be held during the end of session exam period. As format is similar to the Progress exam, no practice exam will be made available. Please use Study guides available for each lecture and Q&As submitted together with Blended learning video projects.

Deferred exams

It is intended that supplementary exams for the School of Medical Sciences in Semester 1, 2018 will be held Saturday 14 July - Saturday 21 July 2018.

Penalties for late submission of assignments

In cases where an extension has NOT been granted, the following penalties will apply: For assignments submitted after due date, a penalty of 50% of the maximum marks available for that assignment will be incurred. A further 25% of the maximum possible allocated marks (i.e., a total of 75%) will be deducted from assignments which are two (2) days late. Assignments received more than two (2) days after the due date **will not be allocated a mark,** however, these assignments **must** still be submitted to pass the unit.