Faculty of Medicine

School of Medical Sciences

NEUR3101

Muscle and Motor Control

COURSE OUTLINE

TERM 2, 2019

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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

Convenor: **A/Prof Ingvars Birznieks**   i.birznieks@unsw.edu.au
Department of Physiology
Ph 9385 8311   Office: Wallace Wurth 314

Technical officer: **Mr Balu Daniel**   d.balu@unsw.edu.au
School of Medical Sciences

Course details

Credit points: 6 UoC (0.125 FTSL)

Course pre-requisites
PHSL2101- Physiology 1A or PHSL2121- 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. The course intertwines normal physiological mechanisms with analyses of motor system disorders to help understand both aspects. The lectures provide the core topics explored in the course. Practicals and tutorials focus on how fundamental knowledge can be applied to solving clinical, practical and sports performance problems. Advanced practical classes range from experiments with isolated mammalian muscle to human studies using electromyography (EMG) and electrical stimulation. One of the aims is to train students to obtain and process high quality EMG recordings, analyse, critically evaluate and interpret obtained data. In an interactive practical /tutorial the students watch professionally developed short educational and patient examination videos that aim to actively engage in the related learning tasks. A tutorial-supported creative group assessment strengthens deep learning and the connections between theoretical knowledge and real-life applications in day-to-day activities, sports performance, and/or pathology. Students create a brief video illustrating one theoretical aspect of motor control in the context of a real-life situation. This allows fostering student own vision of course relevance to real life situations from their own diverse perspectives. The assessment is peer marked on engagement/entertainment, educational value and scientific quality. The student-created materials are used for blended learning by other students of the same and following years.

Course aims

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.

The aims of this course are to encourage the development of an understanding of skeletal muscle function and adaptation and how the brain and spinal cord interact to produce different movements. The course furthermore aims to develop an understanding of the mechanisms of motor learning and factors that influence motor learning, and an appreciation of current techniques and future directions in movement neuroscience research. The course aims to apply the fundamental knowledge to allow an awareness of the underlying mechanisms and treatments of motor system disorders.

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 are expected to -
- Be able to effectively communicate how skeletal muscle and the nervous system work to generate controlled movements.
- Demonstrate an understanding of the key theoretical concepts in the field of movement neuroscience that allows an extension to specific areas relevant for future professional practice in this field.
- Demonstrate the knowledge of current and (likely) future directions in movement neuroscience research and have ability to independently research and interpret relevant literature in the field.
- Demonstrate an understanding of experimental study design in the area of motor and muscle control and present relevant scientific data.
- Demonstrate an understanding of the physiological principles and practicalities involved to perform EMG recordings and use of nerve stimulation techniques.

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

Muscle and Motor Control is delivered across 10 teaching weeks in Term 2, with teaching activities encompassing face-to-face lectures, tutorials and practical classes. Together these comprise 4 hours of classroom activities plus 3 hours of practicals in 5 weeks of the teaching period. Two weeks will be allocated for self-directed work on two assessments when no face-to-face classes are planned. Lectures will provide you with the concepts and theory essential for an understanding of the course content. The practical classes assist in the development of research and analytical skills, and further learning of the key objectives. The skills you will learn in practical classes are relevant to your development as researchers or professional career. These practical classes and tutorials allow students to engage in a more interactive form of learning than is possible in the lectures. Students are strongly recommended to allocate additional self-directed study for on-line quizzes (progress, pre-prac, and post-prac), revision for assessments, testing knowledge, self-study assessments tasks and working on the group project. Additionally, effective learning can also be enhanced through self-directed use of other resources such as textbooks, literature references, web-based sources and educational materials created by students themselves.

The teaching strategy is based on principles that concepts and understanding are more important than memorising details, that learning should be fun and thereby facilitate deeper learning, and that student engagement and creativity is the way for students to see connections between learned knowledge and real-life experiences. The teaching rationale fosters a deep sense of community and belonging through use of engaging and enjoyable group work and peer engagement that applies course content to real-life situations. The teaching rationale engages all forms of memory for multisensory reinforcement and to suit different learning styles and to enable greater understanding and memorizing of complex concepts. This covers all the different learning styles in the classical Neil Flemings V.A.R.K. model: visual, auditory, read/write and kinaesthetic (tactile)

learning. Hence the teaching rationale fuses classic principles of pedagogy with contemporary neuroscience learning models.

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. 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. There is no one textbook to follow; the content of each lecture is unique, delivered by discipline experts, drawn from different research areas.

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. 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

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, Mooney RD, Platt ML, White LE. (2017). *Neuroscience,* (6th Ed)*.* Oxford University Press. ISBN 978-1605353807 (hardcover); 978-1605358413 (paperback).
- 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.

Peer-reviewed journals

Search PubMed for peer-reviewed articles https://www.ncbi.nlm.nih.gov/pubmed

Some journals of interest: Nature Neuroscience, Nature Reviews Neuroscience, Current Biology, 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 quizzes and final exam. This 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 solving a research challenge 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 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	Value, final marks	Due Date
I.	*QUIZZES*	**Pre-prac quizzes :** **4%** *(pracs 1-3,5)* **Post-prac quizzes :** **6%** *(pracs 1-5)* **Progress quizzes :** **10%** *(weeks 1, 3-5,7-8,10)*	**Monday** on the week of prac you are enrolled in **18ᵗʰ Aug** Sunday Week 11 **Sunday** of each lecture week
II.	*ESSAY ON RESEARCH LOGIC: SOLVING A RESEARCH CHALLENGE*	**Essay :** **20%**	**14ᵗʰ Jul** Sunday Week 6
III.	*BLENDED LEARNING ASSIGNMENT – MOTOR CONTROL EXPLAINED*	**Project :** **15%** **Peer marking :** **5%**	**3ʳᵈ Aug** Saturday Week 9 **6ᵗʰ Aug** Tuesday Week 10
IV.	*FINAL EXAMINATION (2 HOURS)*	**MCQ :** **20%** **Short answer :** **20%**	Examination period

Note: unless stated otherwise submissions close at 11:59 pm

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

There are 4 pre-prac, 5 post-prac and 7 progress quizzes all together worth 20% of your final mark. Each quiz may have a different number of questions and different weighting, which isn't determined by the number of questions.

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 1-3,5 only, note that practical 4 does not have pre-prac quiz.

The pre-prac quiz is available until midnight on the day before the prac on 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. You can complete them straight after each practical or leave to the end of semester. It is recommended that you use your first attempt straight after the practical and leave the last (third) attempt for week 10 when it is due and we have a tutorial to discuss practicals.

Progress quizzes test your knowledge you gained during the lecture week. Quizzes test your knowledge on lecture content given on the same week and close on Sunday.

ASSESSMENT TASK 2 – Essay on research logic: Solving a research challenge

Detailed instructions will be provided during tutorial on week 5. To complete this assessment successfully, you have to carefully study the instruction slides. Marks will be given for quality of the content, and ability to follow the prescribed formatting rules typically used in research reports.
The word limit is – 1500 words maximum in total (word count for each section 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.

In this assignment you will attempt solving any muscle or motor control related problem or controversy in a thought experiment and present mock results.

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

It should include following sections and headings:

1. **Background and physiological context of the problem (25%; 400 words)**
   In this section you should demonstrate your knowledge of the topic and ability to search scientific literature. Introduce context and research problem. Minimum 6 references to original peer-reviewed journal papers needed in this section. Other types of references (books, journal review papers, internet pages, documentaries, movies) are all equally important, but do not contribute to minimum reference count. 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.

In this section you should explain
- why the question you would like to address is important to you and in wider context (describe either practical or theoretical importance, or both),
- what prior knowledge is available in the literature,
- why existing evidence is inconclusive or what hasn't been investigated yet.

2. **The experimental aim and hypothesis (10%; 200 words)**
   In this section describe what exactly you want to investigate in your thought experiments, define aim and explain expected outcome. Use subheadings Aim, Hypothesis and Rationale. 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 expected outcomes of the experiment). In the Rationale section you have to explain rationale behind your hypothesis and if hypothesis is confirmed, what does it mean?

3. **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.

4. **Results (20%; 300 words)**
   In this section you are expected demonstrate your knowledge how research data are analysed, presented and formatted. The mock 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. This section should only report the results, but should not discuss them.

5. **Discussion (explanation of mock results and discussion in the wider context) (20%; 300 words)**
   You should demonstrate understanding of the topic by being able to interpret mock results and explain what results mean.

6. **References list (10%)**
   Has to be consistently formatted using standards for research reports.

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. 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.

By completing this assessment you will

- develop and refine the skills needed to obtain information on a topic in muscle and motor control from scientific journals,
- improve your ability to interpret and assess scientific articles,
- 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 muscle physiology or 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. This assessment is worth 15% of your final mark.

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 (names only without 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 the course convenors based on the average peer marks. Your contribution to the peer-marking is worth 5% of your final mark.

Peer marking criteria
- **Scientific quality of the narrative (8 marks):** scientific depth (4 marks), scientific correctness (4 marks).
- **Adequate multiple choice question and answer choices provided for the project (2 marks)**
- **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.

By completing this assessment you will

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

ASSESSMENT TASK IV – End of session examination

The purpose of this exam is to test your understanding of concepts you have gained during this course. You will be tested on lecture content (including flipped classroom topics), five laboratory practicals and tutorials. 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. Please review Study guides for lectures when available and Q&As submitted together with Blended learning video projects.

Deferred exams

Supplementary exam period is 9-13 September 2019. The exact time for supplementary exams for the course will be announced in due time.

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 25% of the maximum marks available for that assignment will be incurred for each day assignment is late. Assignments received more than four (4) days after the due date **will not be allocated a mark**.