UNSW AUSTRALIA | Medical Sciences Medicine

DEPARTMENT OF PHYSIOLOGY

NEUR3101

Muscle and Motor Control

Semester 1, 2017
Course Manual

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. A series of advanced practical classes will range from experiments with isolated mammalian muscle to human studies with electromyography. The lectures, practicals and tutorials will be complemented by a series of expert seminars which provide insight into current research in the field and reinforce the relationship between integrative neuromotor function, movement physiology and the cellular and molecular physiology underlying muscle and motor control.

Course Aims

To encourage the development of:

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

Understanding 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 diseases of movement, 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 central nervous, sensory and muscular systems work together to produce movements and how this is disrupted by disease and normal ageing.

Student Learning Outcomes

This term is used to 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 matched as closely as possible to the stated learning outcomes. That is, the assessment will 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 a mature understanding of 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 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 cardiopulmonary, 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 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.

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 from the preceding week. Students will be requires to read the paper (which will be available on Moodle) before the tutorial. Students 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 the students to gain a core

understanding of the scientific basis of the discipline. Attendance at Tutorials is compulsory and an attendance role will be taken.

Flipped classroom approach - Students will be given access to lecture and video material describing sarcopenia and explaining the modern approached to research and therapy. Available via Moodle (see timetable). This component will be assessed in the final exam with one SAQ devoted to the content accessed in the blended learning module. Students are required to carry out this component as a self-directed learning task. One hour has been 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 answers to the questions set (based on the content covered provided by Dr Ingvars Birznieks) in order to encourage broad communication for students 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 of the students. Students will produce their own audio visual products to be used as blended learning aids. Created media products will be peer marked and ranked. Best products will be demonstrated in the lecture theatre. Creativity and engagement is a key component of the blended learning experience.

Independent study – There is insufficient time in the lectures, tutorials and practicals 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, and are therefore central teaching strategy in this course.

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 effect motor control.
3) Reduced the didactic lecture contend 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.

Deferred exams

It is intended that supplementary exams for the School of Medical Sciences in Semester 1, 2017 will be held MID-END July 2017.

RESOURCES

See also: Learning Resources

Textbooks

- Physiology of sport and exercise (6th Ed), by Kenney WL, Wilmore JH, Costill DL. Human Kinetics Publishers, Champaigne IL, USA. ISBN-13: 9780736094092. (Strongly recommended for the skeletal muscle components of the course, especially those in Exercise Science)
- Skeletal Muscle Structure, Function, and Plasticity by Richard L. Lieber PhD Hardcover Third edition ISBN-13: 978-0781775939 Pubs Lippincott Williams Wilkins (Strongly recommended for the skeletal muscle components of the course, especially those in Science and Medical Sciences)
- 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.
- Enoka, RM. (2008). Neuromechanics of Human Movement, (4th Ed). Human Kinetics Publishers, Champaigne IL, USA. ISBN: 0736066799. Library call no. MBQ 612.76/160

Suggested reference books

Students in Advanced Science (Neuroscience) or Medical Sciences may prefer to use the textbook:

- Bear MF, Connors BW, Paradiso MA. (2015). *Neuroscience: Exploring the Brain,* (4th Ed). Lippincott Williams & Wilkins, USA. ISBN-13: 978-0781778176. Library call no for 3rd edition: MBQ 612.8/187 F
- Zigmond MJ, Rowland LP, Coyle JT. (2014). *Neurobiology of Brain Disorders.* Academic Press. ISBN: 9780123982704.
- Shumway-Cook A, Woollacott MH. (2011). Motor Control: Translating research into clinical practice (4th Ed). Lippincott Williams and Wilkins. ISBN-13: 978-1608310180. Library call no. 612.7/24 A
- Latash ML. (2008). *Neurophysiological Basis of Movement, (*2nd Ed). Human Kinetics Publishers, Champaigne IL, USA. ISBN-13: 9780736063678. Library call no. (1st Ed). MBQ 612.76/152
- Rothwell JC. (1994). *Control of Human Voluntary Movement* (2nd Ed), Chapman and Hall, UK. ISBN: 0412477009 Library call no. MB 612.8252/7
- Jones DA, Round JM. (1990). Skeletal muscle in health and disease. Manchester University Press, NY, USA. ISBN 0719031648 Library call no. MB 612.74/24

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 classic paper assignment will assess your ability to access and interpret the scientific literature in the field of muscle and motor control, and to demonstrate your understanding of the material by designing your own hypothetical experimental paper. You may be required to perform similar tasks in many professional settings within exercise physiology practice or medical research. For example, you will refer to the scientific literature to inform clinic exercise prescription.

Summary of Assessment	**% Total Marks**		**Due Date**
ASSESSMENT TASK 1 - PROGRESS EXAMINATION (1 HOUR)		**25%**	Week 7 Thursday 13th April
ASSESSMENT TASK 2 – CLASSIC PAPER ASSIGNMENT	**Paper**	**20%**	Assessment task due in Sunday 7th May
ASSESSMENT TASK 3 – BLENDED LEARNING ASSIGNMENT	**Project**	**10%**	Saturday May 20th
	Participation in peer marking	**5%**	Saturday May 27th
ASSESSMENT TASK 4 - END OF SESSION EXAMINATION (2 HOURS)	**MCQ :**	**20%**	Exam period
	Short answer:	**20%**	

ASSESSMENT TASK 1 – Progress Examination

The purpose of this exam is to test your understanding of the concepts covered in the course during weeks 1-6 (lectures 1 – 12) and the first practical which is also discussed during the tutorial. The format will be a mixture of multiple choice and short answer questions. No Classic Paper questions will be included. The exam will be held during one of the laboratory timeslots on Thursday, 13th of April 10am-12pm (see the Course Schedule table) in the **Old Main Building** room K-K15-149. **Student with clashes** should sit the exam on the same day at 2:30pm in **WW116 laboratory**. The exam will have 20 MCQ and you will have to choose 2 out of 4 short answer questions to answer.
A practice exam will be available on Moodle a week prior to the progress exam.

ASSESSMENT TASK 2 – Classic Paper assignment

Classic paper assessment component

In the tutorial on week seven, students will be assigned one of the four classic papers presented in the tutorials weeks 2 to 6. The papers will be assigned randomly and is important that students make sure they attend all the classic paper tutorials. Attendance at the tutorials is compulsory. A role may be taken.

Section 1 This will be 50% of this assessment.

For the written classic paper assignment students will provide a synopsis of the assigned classic paper both from their reading of the paper and the notes they made on the discussion which will take place during the tutorial. It is in the student's best interests to ensure that they are prepared for each tutorial and participate in the discussion either directly or by active listening. This section must be no longer than 1000 words. Any text beyond this limit will be deleted. This section is structured to include:

1. Background of physiological context (10% 200 words)
2. Experimental approach, including techniques used and data analysis (10% 200 words).
3. Principal findings (10%, 200 words)
4. Statement of why this is a "classic" paper i.e. uptake and development of the field from this point (20%, 400 words).

Section 2 This will be 50% of this assessment.

In the second section of the assignment students will use the paper as the foundation in order to design an experiment to advance the hypothesis and findings laid out in the classic paper, extending the research.

1. This should be in the format of an experimental aim (15% 300 words).
2. Provide an experimental design and methods designed to test their aim (15% 300 words).
3. Finally the students should undertake a thought experiment and predict the type of data they would expect to generate in their hypothetical experiments. The data in this section should be in the form of Tables, diagrams or graphs, students need to put some thought into the best way of analysing their data and they can use either one or a combination of these formats including figure legends – pay particular care to the labelling of the diagrams and figures (20% 400 words).

Assignment Marking Criteria

Classic Paper	High Distinction	Distinction	Credit	Pass	Fail	Mark
Section 1 • Background of physiological context • Experimental approach, including techniques used • Principal findings and data analysis • Statement of why this is a "classic" paper	Well presented, Clearly written, Concise, Comprehensive overview	Neatly presented, Clearly written Concise, Good overview	Neatly presented Acceptable written expression Good	Neatly presented, Some errors in written expression Adequate overview	Incorrect length, Untidy, Poorly written Incomplete overview	10
Section 2 • an experimental aim • experimental design and methods designed to test their aim • thought experiment	Clearly written, Concise Insightful critique Including original ideas	Clearly written, Concise critique. Including some original ideas	Clearly written, Possibly with original ideas	Some errors in written expression acceptable summary but lacking original thought	Poorly written Inadequate Unable to demonstrate understanding of the task	10

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.

ASSESSMENT TASK 3 – Blended learning assignment

The project

For the project students will choose one of the motor control mechanisms reviewed during the Motor control discussion tutorial. Project may be also based on relevant literature research. It is expected that students will produce a short educational video or use any widely accessible audio-visual means and animations to explain the underlying principles and demonstrate it 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 group may name one student coordinating the narrative, one student coordinating the screenplay and one or two students coordinating the video editing.

The videos should be no longer than 3 minutes. It is idea that counts, video quality should not matter while 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 allowing to save presentations as 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. Students will receive marks for participation in the peer marking 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 Assignment 3

- To work as an effective member of a multimedia educational team.
- To improve your ability to present complex scientific ideas in a straightforward manner using a video style format.
- To understand and engage in the process of Peer assessment using Moodle.

ASSESSMENT TASK 4 – End of Session Examination

The purpose of this exam is to test your understanding of concepts not tested in the progress exam: lectures11-22, flipped classroom topics - sarcopenia, practicals 2-5 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.

Submission of assessment tasks

Classic paper reports are to be submitted electronically through Turnitin via Moodle (**NO HARD COPY**).
Blended learning assignment should be uploaded to *YouTube.* ***Dr Ingvars Birznieks*** will confirm details during the first Tutorial dedicated to the Blended learning assignment.

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.

Course Schedule

NEUR3101 session 1, 2017

Week	Date	TUTORIAL /SEMINAR Tuesday 2-3 pm Colombo Theatre C	LECTURE 1 Tuesday 3-4 pm Colombo Theatre C	LECTURE 2 Tuesday 4-5 pm Colombo Theatre C	LABORATORY Thursday WW116: 10-1pm Thursday WW116: 2-5pm
1	27 Feb	Levels of assumed knowledge plus discussing the Classic paper concept ***SH***	L1 – Course introduction ***SH***	L2 – Skeletal muscle: mechanisms of force generation ***SH***	Isolated mammalian muscle; contractile properties of slow and fast twitch muscle fibre types ***SH/CL***
2	6 Mar	Classic Paper 1 analyses and discussion ***CL***	L3 – The history of muscle fibre typing and new techniques ***SH***	L4 – Muscle growth injury and regeneration ***SH***	Isolated mammalian muscle; contractile properties of slow and fast twitch muscle fibre types ***SH/CL***
3	13 Mar	Classic Paper 2 analyses and discussion ***CL***	L5 – Muscle pain: neural mechanisms; motor neuron neuropathy during normal aging ***SH***	L6 – Muscle building drugs and performance supplements (we use clenbuterol and creatine as our examples) **SH**	Grip force, fatigue, EMG and muscle pain ***IB***
4	20 Mar	Muscle kinetics and drug action; **SH**	L7 – Muscular dystrophy(the 2nd most common fatal genetic disease); Sarcopenia (flipped classroom approach) ***SH***	L8 – The genetics of speed and endurance; evolution of the ACTN3 polymorphism ***SH***	Grip force, fatigue, EMG and muscle pain ***IB***
5	27 Mar	Classic Paper 3 analyses and discussion ***IB***	L9 – Motor unit and motoneuron recruitment and control; the size principle ***IB***	L10 – Spinal control of locomotion – muscle and cutaneous afferents and reflexes **IB**	EMG – motor unit activation, EMG: force relation ***IB***
6	3 Apr	Classic Paper 4 analyses and discussion ***IB***	L11 – Muscle fatigue; the price of sporting success **SH**	L12 – Muscle cramp in the young and old; causes and treatments (Tonic water?) **SH**	EMG – motor unit activation, EMG: force relation ***IB***

Week	Date	TUTORIAL /SEMINAR Tuesday 2-3 pm Colombo Theatre C	LECTURE 1 Tuesday 3-4 pm Colombo Theatre C	LECTURE 2 Tuesday 4-5 pm Colombo Theatre C	LABORATORY Thursday WW116: 10-1pm Thursday WW116: 2-5pm
7	10 Apr	EMG clinical applications **CL**	L13 – Brain and movement (the ascending and descending tracts) ***IB***	L14 –- Cortical control of movement - recorded lecture; no classroom attendance required ***JM***	**Thursday April 13th** **PROGRESS EXAM** **10am - 12pm** **Old Main Building** **room K-K15-149 - OMB149** **Students with clashes are permitted instead to sit the exam at 2:30pm in the WW116 laboratory**
14th to 23rd April: Mid-semester Recess					
8	24 Apr	***ANZAC DAY (No tutorial, no lectures)***			EMG – Hoffmann reflex ***CL/IB***
Classic paper essay due in via Turnitin on Sunday May 7th end of week 9					
9	1 May	Assessments -reflexion and instructions: progress exam, classic paper, video project ***IB***	L15 – Sensorimotor control – voluntary movement, feedback and feed-forward control ***IB***	L16 – Motor learning and internal models (1) ***IB***	EMG – Hoffmann reflex ***CL/IB***
10	8 May	Blended learning 1 ***IB***	L17 – Motor learning and internal models (2) ***IB***	L18 – Cerebellum and motor control: learning & disorders ***IB***	Pathology of motor control including Parkinson's ***IB***
Blended learning (video project) due in on Saturday May 20th end of week 11					
11	15 May	Motor control discussion ***IB***	L19 – Sensorimotor control of dexterous manipulation in humans ***IB***	L20 – Basal Ganglia in motor control, including Parkinson's disease ***IB***	Pathology of motor control including Parkinson's ***IB***
Blended learning peer assessment due on Saturday May 27th end of week 12					

Week	Date	TUTORIAL /SEMINAR Tuesday 2-3 pm Colombo Theatre C	LECTURE 1 Tuesday 3-4 pm Colombo Theatre C	LECTURE 2 Tuesday 4-5 pm Colombo Theatre C	LABORATORY Thursday WW116: 10-1pm Thursday WW116: 2-5pm
12	22 May	Blended learning 2 ***IB***	L21 – Plasticity and adaptation to training and disuse ***IB***	L22 – Stroke and rehabilitation ***IB***	
Study Period 3-8 June; Exam period 9-26 June					

SH – A/prof Stewart Head; IB – Dr Ingvars Birznieks; CL – A/prof Cindy Lin; JM – Prof John Morley