THE UNIVERSITY OF NEW SOUTH WALES

School of Medical Sciences

Faculty of Medicine

NEUR3101

Muscle and Motor Control

Semester 1, 2011
Course Outline

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Course details

Credit Points: 6 UOC

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 Vista (see below in COURSE RESOURCES section) 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. Sessions will be structured to encourage your participation in activities and discussions designed to enhance your learning. In most cases, you will benefit most if you do some preparation prior to attending the session. This is especially the case in sessions designed to help you prepare for the exams and assignment.

Expert Seminars – Expert seminars will be delivered in four (4) of the tutorial slots throughout the session. The purpose of these seminars is to expose students to the latest research questions and techniques in muscle and motor control, and to provoke thought about the core material in the course as well as future directions in the field. Attendance of these seminars is compulsory and the content of the expert seminars is broadly examinable.

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.

Assessment

Assessment of your learning in the course will be achieved through examinations and a research assignment. 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 research assignment will assess your ability to access and interpret the scientific literature in the field of muscle and motor control, and to communicate concisely in a written report the main findings and limitations of a related series of scientific articles. You will 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 , such as with a particular neural disorder, or present a scientific case for using a particular training method

Summary of Assessment	**% Total Marks**	**Due Date**
ASSESSMENT TASK 1 - ONLINE QUIZZES	**5%**	week 3 week 5 week 9 week 12
ASSESSMENT TASK 2 - PROGRESS EXAMINATION	**25%**	week 6 Friday 8th April
ASSESSMENT TASK 3 - END OF SESSION EXAMINATION	Multichoice: **25%** Short answer: **25%**	Exam period
ASSESSMENT TASK 4 - REPORT ON SCIENTIFIC PAPERS	**20%**	Week 11 Monday 23rd May by 9am

ASSESSMENT TASK 1 *- ONLINE QUIZZES*
Marks for this component of course assessment are awarded simply for attempting each of the online quizzes arising from the tutorials or labs. There will be 4 online quizzes will throughout the course.

ASSESSMENT TASK 2 *- PROGRESS EXAMINATION*
The purpose of this exam is to test your understanding of the concepts covered in the course during weeks 2 – 6 (lectures 1 – 13, laboratories 2 - 4). The format will be both multiple choice and short answer questions. The exam will be held during the lecture timeslot, thus all students are required to attend on this day. A practice exam will be available on Blackboard a week prior to the progress exam.

ASSESSMENT TASK 3 *- END OF SESSION EXAMINATION*
The purpose of this exam is to test your understanding of the concepts covered in the course, including the ENTIRE COURSE (including weeks 2 - 6). The format will be multiple choice, short answer questions. The exam will be held during the end of session exam period in 2 separate sessions. A practice exam will be available on Vista in the final week of the teaching session.

ASSESSMENT TASK 4 *- REPORT ON SCIENTIFIC PAPERS*
As described below.

Report on Scientific Papers

You are to independently summarise and critique a sequence of three (3) scientific articles, starting with a review article from a set list, then an original article that is cited in the review - but not by the review author(s) - and finally an original article cited in the first selected original article (this time from any author). You are required to submit a written report on these three (3) papers, along with pdf files (or computer scanned copies) of the two (2) selected articles, using the turn-it-in feature of Vista. The written report should not exceed 6 pages in total (i.e. 2 pages for each article), with 1 page dedicated to the summary of each article and a second page for the assessment of the strengths and

weaknesses of each article. A workshop for this assignment task will be held in the tutorial session in week 8. Pay close attention to the marking criteria below when planning and writing this assignment.

Learning Outcomes for the Assignment

- 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 communicate effectively in the format of a written report

Assignment Marking Criteria

	High Distinction	Distinction	Credit	Pass	Fail	Mark
Summary • Purpose • Experiment design and statistics • Techniques/methods • Results and conclusions	Well presented, Clearly written, Concise, Comprehens-ive overview of each paper	Neatly presented, Clearly written Concise, Good overview of each paper	Neatly presented Acceptable written expression Good overview of each paper	Neatly presented, Some errors in written expression Adequate overview of each paper	Incorrect length, Untidy, Poorly written Incomplete overview of each paper	10
In depth review (including discussion of the accuracy of citation of the two original articles by the source articles)	Clearly written, Concise Insightful critique of the strengths and weaknesses of the paper. Including original ideas	Clearly written, Concise critique of the strengths and weaknesses of the paper. Including some original ideas	Clearly written, critique of the strengths and weaknesses of the paper. Possibly with original ideas	Some errors in written expression acceptable summary of the strengths and weaknesses of the paper, but lacking original thought	Poorly written Inadequate summary of the strengths and weaknesses of the paper. Unable to demonstrate understandin g of the articles	10

Nominally 3 points out of 10 for the summary or in depth review of each article, with 1 point for overall integration

Submission of Assessment Tasks

Assignments are to be submitted electronically through Turnitin via Blackboard.

Penalties for late submission of assignments – In cases where an extension has NOT been granted, the following penalties will apply: For assignments submitted after **9:00am** on the 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.

Academic honesty and plagiarism

Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft and is regarded by the university as academic misconduct. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. The University has adopted an educative approach to plagiarism and has developed a range of resources to support students. The Learning Centre can provide further information via http://www.lc.unsw.edu/plagiarism.

Week	Date	Laboratory Mon WW2O2: 9-12 Mon WW202: 2-5pm	Lecture 1 Thursday 11-12 Mathews D	Lecture 2 Friday 9-10 Biomed C	Lecture 3 Friday 10-11 Biomed C	Tutorial /Seminar Friday 12-1 Mathews D
2	7 Mar		L1 – Course introduction ***CL***	L2 – Muscle: mechanisms of force generation (incl. mechanics) ***SH***	L3 – Muscle: mechanisms of force generation (incl. EC coupling) ***SH***	Tutorial ***SH***
3	14 Mar	EMG – motor unit activation, EMG:force relation **3hrs** ***BB***	L4 – Motor Unit recruitment and control. The size principle. ***BB***	L5 – Motoneurones (tests of the size principle, synaptic integration, PICs,) ***BB***	L6 – Brain control of movement (the ascending and descending tracts) ***CL***	Tutorial ***BB,*** (including EMG)
4	21 Mar	Isolated mammalian muscle - force-fusion, Slow and fast twitch Note **4hrs** ***SH***	L7 – Neuromuscular junction ***AM***	L8 – Spinal control of movement – muscle and cutaneous afferents and reflexes ***CL***	L9 – Spinal control of movement – different pathways (e.g. reciprocal 1a-inhibition, presynaptic inhibition) ***BB***	Tutorial ***CL***
5	28 Mar		L10 – Rhythmic movement: CPGs & locomotion ***BB***	L11 – CPGs, Spinal plasticity and motor learning ***BB***	L12 – Motor units and microneurography ***PM***	Tutorial ***BB***
6	4 Apr	EMG – Hoffmann Reflex **3hrs** ***CL***	L13 – The genetics of speed and endurance in skeletal muscle ***SH***	L14 – Cortical control of movement 1 ***JM***	L15 – Cortical control of movement 2 ***JM***	**Progress Exam**

7	11 Apr		L16 – Skeletal muscle growth and development ***SH***	L17 – Skeletal muscle damage and regeneration ***SH***	L18 – Muscular dystrophies (role of the dystrophin associated complex in muscle and CNS) ***SH***	Tutorial ***CL*** (*includes exam review and workshop on journal article interpretation for the assignment)*
8	18 Apr	EMG – fatigue **3hrs** ***BB***	L19 – Cortical reorganisation with motor learning ***AK***	***Public Holiday***	***Public Holiday***	***Public Holiday***
Mid-session break						
9	2 May		L20 – Muscle fatigue: mechanisms of force generation (incl. histochemistry, enzymes) ***SH***	L21 – Neural aspects of fatigue ***JT***	L22 – Neural aspects of fatigue ***JT***	*Expert seminar* **Dr Anna Hudson** Control of Respiratory Muscles
10	9 May		L23– Spinal Cord injury, Stroke and rehabilitation ***CL***	L24 – Cerebellum in motor control: learning & disorders I ***AK***	L25 – Cerebellum in motor control: learning & disorders 2 ***AK***	Tutorial ***SH***
11	16 May	Motor learning lab (*self-directed via home personal computers,*) ***BB***	L26 – Motor learning – generalisation and transfer, practice and feedback ***BB***	L27 – Muscle damage and muscle pain ***SH***	L28 – Sensorimotor control – voluntary movement, feedback and feedforward control (e.g. reach to grasp or catching, homunculus) ***RV***	*Expert seminar* ***Dr Anthony Kee*** Muscles and genes
Assignment due via turn-it-in Monday 23rd May at 9am i.e. start of week 12						
12	23 May		L29 – Balance and motor learning ***RF***	L30 – Basal Ganglia in motor control, including Parkinson's disease ***BB***	L31 – Aging in skeletal muscle (sarcopenia) and the nervous system ***SH***	Parkinson's disease video ***CL***
13	30 May		L32 – Neural and motor learning adaptations to strength training and disuse ***BB***	L33 – Muscle adaptations to strength training and disuse ***SH***	L34 – Muscle building drugs – clinical applications ***SH***	Course review ***CL***

COURSE RESOURCES

Blackboard

Information about the course and a number of electronic study resources can be accessed via the UNSW **Blackboard** system. Blackboard is an internet-based set of Course Tools designed to enable online learning.

You can use blackboard to download lecture notes, access your grades, find reference material in the course (such as this document), and communicate with the lecturer and your peers.

Lectopia

The Lectopia system (iLecture) provides digital audio recordings of lectures that can be accessed via streaming media over the web or as a podcast (if permitted by the lecturer). Lecture slides may be embedded in these presentations.
http://telt.unsw.edu.au/lectopia/content/default.cfm?ss=1

UNSW Library

The University Library provides a range of services to assist students in understanding how to identify what information is required for assignments and projects; how to find the right information to support academic activities; and how to use the right information most effectively.
Homepage: http://info.library.unsw.edu.au

Reserve (MyCourse)

Many items (books and journal articles) set as recommended reading for courses will be located in **Reserve**, which is on Level 2 of the Main Library. Some of the journal articles will be available in electronic format via **MyCourse**, for Medical students there will be direct links to many of these from within the Medicine program WebCT course sites or eMed Map. To search for these items, go to http://info.library.unsw.edu.au/Welcome.html and click on **MyCourse.**

Textbooks

Enoka, RM (2008). *Neuromechanics of Human Movement*. 4th edition. Human Kinetics Publishers, Champaigne IL: USA. ISBN: 0736066799 Library call no. MBQ 612.76/160

Students in Advancced Science (Neuroscience) or Medical Sciences may prefer to use the textbook:
Bear MF, Connors B and Paradiso M. (2007). *Neuroscience: Exploring the Brain*. 3rd Edition, Lippincott Williams & Wilkins: USA. ISBN-10: 0781760038 Library call no. MBQ 612.8/187 F

Suggested Reference Books

Shumway-Cook and Woollacott (2007). Motor Control: Translating research into clinical practice. Lippincott Williams and Wilkins (3rd Ed). ISBN: 9780781766913. Library call no. 612.7/24 A

Kandel ER, Schwartz JH and Jessell TM. (2001). *Principles of Neural Science.* 4th Edition. McGraw Hill. New York: USA. ISBN-10: 0838577016 Library call no. MBQ 612.8/204

Latash, ML (1998). *Neurophysiological Basis of Movement*. Human Kinetics Publishers, Champaigne IL: USA. ISBN: 0880117567 Library call no. MBQ 612.76/152

Rothwell JC (1994). *Control of Human Voluntary Movement*., 2nd edition, Chapman and Hall: UK.ISBN: 0412477009 Library call no. MB 612.8252/7

Schmidt RA and Wrisberg CA (1999). *Motor Learning and Performance* 2nd edition, Human Kinetics Publishers. Champaigne IL, USA. ISBN: 0880115009 Library call no. MB 152.334/24 F

Suggested Reference Journals

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

Course Evaluation and Development

NEUR3101 Muscle and Motor Control has been developed in order to strengthen undergraduate courses in the brain sciences and as part of a revision of the health and exercise science curriculum. The course was formerly HESC3571 Motor Control and Dysfunction, and includes significant material from PHPH3502 Skeletal Muscle in Health and Exercise.

Student feedback is welcome and taken seriously. A Course and Teaching Evaluation and Improvement (CATEI) survey will be provided in the final weeks of the course to formally gather student feedback.

In response to feedback from previous students we have: 1) included more tutorial sessions, and 2) increased the duration of the practical sessions and expanded on the details provided in the instructions for practical classes.

Occupational Health and Safety

Class activities must comply with the NSW Occupational Health & Safety Act 2000 and the Occupational Health & Safety (OHS) Regulations 2001. It is expected that students will conduct themselves in an appropriate and responsible manner in order not to breach OHS regulations. Further information on relevant OHS policies and expectations is outlined at: http://www.hr.unsw.edu.au/ohswc/ohs/ohs_policies.html

Examination procedures and attendance requirements

Attendance is expected at all lectures, practicals and tutorials for this course. Attendance at all practicals, tutorials and clinicals will be recorded. Students who do not participate in these sessions for any reason other than medical or misadventure, will be marked absent and will be awarded a grade of FAIL for the entire course. If absent for medical reasons, a medical certificate must be lodged with the lecturer within 7 days of the time period of the certificate's expiry. No consideration will be given after this time. Although lectures will be available on ilecture, student participation is encouraged in both the lectures and the tutorials and these are important to attend.

Deferred Exams

If you miss an exam for medical reasons you must supply adequate documentation (including a medical certificate). Your request for consideration will then be assessed and a deferred exam may be granted. You cannot assume you will be granted supplementary assessment. The deferred exam may include a significant oral element.

Special consideration in the event of illness or misadventure

Please note the following Statement regarding Special Consideration. If you believe that your performance in a course, either during session or in an examination, has been adversely affected by sickness, misadventure, or other circumstances beyond your control, you should notify the Registrar and ask for special consideration in the determination of your results. Such requests should be made as soon as practicable after the problem occurs. **Applications made more than three working days after the relevant assessment will not be accepted except in TRULY exceptional circumstances.**

When submitting a request for special consideration you should provide all possible supporting evidence (eg medical certificates) together with your student number and enrolment details. Consideration request forms are available from Student Central in the Chancellery or can be downloaded from the web page linked below.

Note that normally, if you miss an exam (without medical reasons) you will be given an absent fail. If you arrive late for an exam no time extension will be granted. It is your responsibility to check timetables and ensure that you arrive on time.

Students who apply for consideration to Student Central must also contact the Course Convenor immediately.

All applications for Special Consideration will be processed in accordance with UNSW policy (see: http://my.unsw.edu.au/student/atoz/SpecialConsideration.html). If you miss an assessment and have applied for Special Consideration, this will be taken into account when your final grade is determined. You should note that marks derived from completed assessment tasks may be used as the primary basis for determining an overall mark. Where appropriate, supplementary examination may be offered, but only when warranted by the circumstances.

Student equity and diversity issues

Students requiring assistance are encouraged to discuss their needs with the course convenor prior to, or at the commencement of the course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (EADU) (9385 4734). Further information for students with disabilities is available at http://www.studentequity.unsw.edu.au/disabil.html