



THE UNIVERSITY OF NEW SOUTH WALES

**School of Medical Sciences
Faculty of Medicine**

NEUR3101 Muscle and Motor Control

UNITS OF CREDIT: 6

Session 1, 2009

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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 motoneurons, 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.

How the course relates to the exercise physiology profession (for students in program 3870 – Health and Exercise Science). 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. 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 musculo-skeletal rehabilitation courses later in the program.

Course Pre-requisites / Assumed Knowledge

PHPH2501 or NEUR2101

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

- 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

Teaching Strategies and Suggested Approaches to Learning

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

Assessment Item	% Total Marks	Due Date
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 <u>4 online quizzes</u> will throughout the course.	5%	week 2 week 4 week 7 week 9
PROGRESS EXAMINATION The purpose of this exam is to test your understanding of the concepts covered in the course during weeks 1 – 7 (lectures 1 – 21). The format will be both multiple choice and short answer questions. The exam will be held during the lecture timeslot, thus <u>all</u> students are required to attend on this day. A practice exam will be available on Vista a week prior to the progress exam.	25%	week 8 Wednesday 6 th May
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 1-7). 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.	Multichoice: 25% Short answer: 25%	Exam period
REPORT ON SCIENTIFIC PAPERS As described below.	20%	week 11 Monday 25 th May <u>by 9am</u>

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 (see below), 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 <ul style="list-style-type: none"> • Purpose • Experiment design and statistics • Techniques/methods • Results and conclusions 	Well presented, Clearly written, Concise, Comprehensive 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 understanding 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

Articles for the Assignment

1. Anderson JL, Head SI, Rae C, Morley JW (2002) Brain function in Duchenne muscular dystrophy. *Brain* 125: 4-13.
2. Allen DG, Lamb GD, Westerblad H (2008) Skeletal muscle fatigue: cellular mechanisms. *Physiol Rev* 88: 287-332.
3. Taylor JL, Gandevia SC (2008) A comparison of central aspects of fatigue in submaximal and maximal voluntary contractions. *J Appl Physiol* 104: 542-550.
4. Grillner S (2003) The motor infrastructure: from ion channels to neuronal networks. *Nat Rev Neurosci* 4: 573-586.
5. Faisal AA, Selen LP, Wolpert DM (2008) Noise in the nervous system. *Nat Rev Neurosci* 9: 292-303.
6. Wolpaw JR (2006) The education and re-education of the spinal cord. *Prog Brain Res* 157: 261-280.

Course Schedule

NEUR3101 session 1, 2009

Week	Date	Practical Mon 1-5 or Wed 2-6 Wallace Wurth M210	Lecture 1 Wednesday 10-11 Mathews D	Lecture 2 Thursday 11-12 Mathews D	Lecture 3 Thursday 12-1 Mathews D	Tutorial /Seminar Friday 1-2 Mathews D
1	9 Mar		L1 – Course introduction and the concept of constraints in motor control BB	L2 – Ageing and movement disorders CL	L3 – Muscle: mechanisms of force generation (incl. EC coupling) SH	Tutorial SH
2	16 Mar	EMG – motor unit activation, EMG:force relation 3hrs BB	L4 – Motor Unit recruitment and control. The size principle. BB	L5 – Motoneurons (tests of the size principle, synaptic integration, PICs.) BB	L6 – Electromyography BB	Expert seminar Dr Penelope McNulty Motor units and microneurography
3	23 Mar	Isolated mammalian muscle - force-fusion, Slow and fast twitch 4hrs SH	L7 – Muscle: mechanisms of force generation (incl. mechanics) SH	L8 – Muscle: Sarcopenia and the slowing of muscle in old adults SH	L9 – Muscle: e.g. a gene for speed SH	Tutorial SH
4	30 Mar		L10 – Muscle plasticity (genes, muscle growth and repair) SH	L11 – Muscle plasticity (genes, muscle growth and repair) SH	L12 – Myopathies, Duchenne muscular dystrophy SH	Expert seminar Dr Anthony Kee Muscle and genes
5	6 Apr	EMG – fatigue and control 3hrs SH and BB	L13 – Muscle damage and muscle pain SH	L14 – Muscle fatigue: mechanisms of force generation (incl. histochemistry, enzymes) SH	L15 - Neural basis of muscle fatigue BB	Public Holiday
Mid-session break						
6	20 Apr		L16 – Spinal control of movement - muscle afferents, and the stretch reflex CL	L17 – Spinal control of movement – fusimotor drive, reciprocal 1a-inhibition, presynaptic inhibition CL	L18 – Spinal control of movement – recurrent inhibition, 1b-inhibition BB	Tutorial BB & CL

7	27 Apr	L19 – Spinal control of movement - cutaneous afferents and reflexes CL	L20 – Rhythmic movement: CPGs & locomotion BB	L21 - Rhythmic movement: CPGs & locomotion BB	Expert seminar Dr Janet Taylor Central Fatigue
8	4 May	EMG – Hoffmann Reflex 3hrs CL	L22 – Spinal Cord injury, Stroke and rehabilitation CL	L23 – Brain control of movement (overview incl. the ascending and descending tracts) CL	Tutorial BB (includes exam review and workshop on journal article interpretation for the assignment)
9	11 May	Progress Exam	L24 – Cortical control of movement (M1, PM, SMA) BB	L25 – Sensorimotor control - voluntary movement, feedback and feedforward control (e.g. reach to grasp or catching, homunculus) RV	Expert seminar Dr Richard Fitzpatrick Balance
10	18 May	L27 – Cerebellum in motor control BB	L28 – Cerebellar disorders in motor control (e.g. Duchenne muscular dystrophy, incl. LTP & LTD) JM	L29 – Basal Ganglia in motor control, including Parkinson's disease BB	Parkinson's disease video SH
Assignment due via turn-it-in Monday 25th May at 9am i.e. start of week 11					
11	25 May	Motor learning lab (self-directed via home personal computers, with associated readings) BB	L30 – Motor learning – generalisation and transfer, practice and feedback BB	L31 – Cortical reorganisation with motor learning BB	L32 – Motor learning and internal models BB
12	1 Jun	L33 – Neural adaptations to strength training and disuse BB	L34 – Muscle adaptations to strength training and disuse SH	L35 – Muscle building drugs – clinical applications SH	Course review BB & SH

COURSE RESOURCES

Vista

Information about the course and a number of electronic study resources can be accessed via the UNSW WebCT system. Vista is an internet-based set of Course Tools designed to enable online learning. You access the system from the following site:

<http://vista.elearning.unsw.edu.au/webct/entryPageInns.dowebct>

You can use Vista 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. Please see the lecturer if you would like more information to help you to make the most of this resource.

Textbooks

Enoka, RM (2008). *Neuromechanics of Human Movement*. 4th edition. Human Kinetics Publishers, Champaign IL: USA.

ISBN: 0736066799

Library call no. MBQ 612.76/160

Students in Advanced 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

Jones DA & Round JM (1990). *Skeletal muscle in health and disease: a textbook of muscle physiology*. Manchester University Press New York: USA.

ISBN: 071903163X

Library call no. MB 612.74/24

Shumway-Cook and Woollacott (2007). *Motor Control: Translating research into clinical practice*. 3rd Edition. Lippincott Williams and Wilkins Philadelphia, PA, USA.

ISBN: 9780781766913

Library call no. MBQ 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, Champaign 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. Champaign IL, USA.

ISBN: 0880115009

Library call no. MB 152.334/24 F

Pierrot-Deseilligny E & Burke D (2005). *The Circuitry of the Human Spinal Cord: Its role in motor control and movement disorders*. Cambridge University Press. NY, USA.

ISBN: 10 0-521-82581-4

Library call no.

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

ADMINISTRATIVE MATTERS – for additional detail, refer to the *STUDENT HANDBOOK*

CONSULTATION HOURS

The lecturers will be available for consultation in designated office hours throughout the teaching session. Outside these hours, e-mail is the preferred means of contact.

UNIT ATTENDANCE

Attendance is expected at all lectures, practicals, tutorials and expert seminars for this course. **Attendance at practicals and the expert seminars will be recorded.** Students who do not participate in these practicals or expert seminars 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 are important to attend.

CONDUCT IN PRACTICAL (LABORATORY) CLASSES

All students must come prepared for active participation in laboratories. No open footwear is permitted. No consumption of food is permitted in class. Laboratory coats are required for the practical in week 3.

APPLICATIONS FOR SPECIAL CONSIDERATION FOR MISSED ASSESSMENTS / EXAMS

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 an examination in a course will only be considered in 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.

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.

PENALTIES FOR LATE SUBMISSION OF ASSIGNMENTS

In cases where an extension has NOT been granted, the following penalties will apply: 1) assignments submitted after **9:00am** on the due date, a penalty of 50% of the maximum marks available for that assignment will be incurred, 2) Assignments received two (2) or more 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

The School of Medical Sciences will not tolerate plagiarism in submitted written work. The University regards this as academic misconduct and imposes severe penalties. Students who submit the work of others as their own will fail the unit and risk expulsion from the university. It is your responsibility to ensure you understand what constitutes plagiarism and eliminate it from your submissions.

What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one's own.* Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
- paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle

† Adapted with kind permission from the University of Melbourne.

Course Evaluation and Development

NEUR3101, Muscle and Motor Control, was developed to strengthen undergraduate courses in 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 PPHP3502 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.