

UNIVERSITY OF BRITISH COLUMBIA - SCHOOL OF KINESIOLOGY

2024W Term 1

KIN 415: Sensorimotor Neuroplasticity in Movement and Exercise

Land Acknowledgement

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwm̓əθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

Instructor: Dr. Tania Lam

Tel: (604) 675-8807

Email: tania.lam@ubc.ca

Office Hours: by appointment (please email to schedule)

Teaching Assistant: Xueqing Zhou (see Canvas for email contact)

Lectures:

General Course Information and Learning Outcomes

In this course, we will study concepts in neuroplasticity related to sensorimotor control of movement and exercise. Students will gain a broad perspective of plasticity in the neuromuscular system, from cellular and synaptic mechanisms underlying plasticity to systems-level adaptations, using examples from animal and human studies. The focus will be on plasticity (both adaptive and maladaptive) that arises as a result of either training or injury/non-use as it relates to movement control and exercise.

This course is designed for upper level Kinesiology students who have completed core coursework in human anatomy and physiology.

Prerequisite(s): KIN110, KIN131, 3rd-year standing

Corequisite(s): None

Required Textbook:

There are no required textbooks for this course. Class notes will be available through the course website (canvas.ubc.ca). Assigned readings and other resources from the peer-reviewed literature will be provided through the UBC Library Course Reserves page.

Specific Learning Objectives

By the end of this course, you should be able to:

1. Explain the mechanisms underlying sensorimotor plasticity from the cellular to systems level, with examples from different levels of the nervous system involved in the control of movement.
2. Discuss the effects of injury and inactivity/disuse on (mal)adaptive changes in the nervous system affecting movement.
3. Discuss the effect of experience and training on sensorimotor plasticity in both healthy and injured states.
4. Critically analyze basic and clinical research findings on the effects of exercise and training interventions on sensorimotor and neuromuscular plasticity in either the healthy or injured nervous system.
5. Work as a collaborative team member to summarize and communicate research evidence to your peers.

Learning Activities

We will meet in class every Monday and Wednesday for lectures and in-class activities. There will be 1-2 journal club articles assigned almost every week to introduce students to a range of classic and recent papers in the field. In-class, small-group discussion will provide opportunities for interpretation and critique of scientific literature.

Lecture materials, including reading resources, will be updated on a weekly basis on Canvas.

There is a major term project in which students will work in teams to pursue a specific topic related to neuroplasticity, culminating in a mini-lesson to be delivered over the last few weeks of the term. (See **Term Project Guidance** section below for more details.)

Class Schedule

Week	Topic	Journal Club Article/Reading
1	Introduction and historical perspective Searching for and critiquing peer-reviewed research literature	Ramachandran (2000) <i>Phantom Limbs and Neural Plasticity</i> , Arch Neurol. Raff (2014) <i>How to read and understand a scientific article</i> 10.13140/2.1.2665.4086
2	Plasticity In Somatosensory System to Sensory Deprivation	Kambi (2014) <i>Large-scale reorganization of the somatosensory cortex following spinal cord injuries is due to brainstem plasticity</i> , Nat Commun.
3	Use/Experience-Dependent Plasticity in Somatosensory System (animal and human/clinical models) Cellular/Synaptic Mechanisms of Plasticity (induction of long-term potentiation)	Wang (1995) <i>Remodelling of hand representation in adult cortex determined by timing of tactile stimulation</i> , Nature. Flesher (2016) <i>Intracortical microstimulation of human somatosensory cortex</i> , Sci Transl Med.
4	Long-Term Potentiation and Depression; Induction vs. Expression of LTP/LTD Spike-Timing Dependent Plasticity	UBC Library Reserves, Ch. 67. Prefrontal Cortex, Hippocampus, and the Biology of Explicit Memory Storage (Principles of Neural Science)
5	Neurophysiological Techniques in Humans; Paired-Associative Stimulation	Wolters (2005) <i>Timing-dependent plasticity in human primary somatosensory cortex</i> , J Physiol.
6	Test #1 (Thanksgiving weekend)	--
7	Mechanisms of Motor Cortex Plasticity and Motor Skill Training Clinical application: constraint-induced movement therapy (CIMT)	Butefisch (2000) <i>Mechanisms of use-dependent plasticity in the human motor cortex</i> , PNAS. Corbetta (2015) <i>Constraint-induced movement therapy for upper extremities in people with stroke</i> , Cochrane Database Syst Rev.
8	Sensory Input and Motor Plasticity; LTP in M1	Iriki (1989), <i>Long-term potentiation in the motor cortex</i> , Science. Ridding (2000) <i>Changes in muscle responses to stimulation of the motor cortex induced by peripheral nerve stimulation in human subjects</i> , Exp Brain Res.
9	Spinal Cord Plasticity in reflex and locomotor pathways Clinical application: spinal cord stimulation	Wagner (2018) <i>Targeted neurotechnology restores walking in humans with spinal cord injury</i> , Nature.
10	Exercise and Neuroplasticity Test #2	Skriver (2014) <i>Acute exercise improves motor memory: Exploring potential biomarkers</i> , Neurobiol Learn Mem.
11	Midterm Break	
12	Special Topics: Student-Led Mini-Lessons (final term project group presentations)	
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Assessment

	% of Grade
1. Tests	
Test #1 – Monday October 7, 2024	20%
Test #2 – Wednesday November 6, 2024	20%
2. Term Group Project	50%
3. Course Participation	10%

1. Tests

- There will be 2 tests during the term. Each test covers material from the previous weeks. The tests are not cumulative.

There is **no final exam** in this course.

2. Term Project

- Please see Guidance section on the next page for more details.

3. Course Participation

- This component includes completion marks for some tasks in the Term Project (see Guidance section) as well as participation in the student-led mini-lessons held over the last 3 weeks of term. At the end of each mini-lesson, there will be an opportunity to complete a two-minute paper reflecting on the mini-lesson, and to help formulate any questions you may have for the group. (Two submissions per day.) These will be submitted at the end of each day and graded for completion/reflection.

Policy on Late/Missed Assessments

Any late submissions on assignments will be subjected to a **5% per day** deduction of that assessment's grade.

All tests will be written during class time. Any missed assessments will be assigned a score of zero unless academic concession is obtained (e.g. medical or family emergency with university-approved documentation). In the case of such approved absences, a make-up test will be scheduled.

TERM PROJECT - GUIDANCE

The main objective of your **Term Project** is to provide you with an opportunity to delve more deeply into an area of neuroplasticity and teach that topic to your classmates. The specific learning outcomes from this project will provide you with:

- experience working effectively within a team
- instructional and communication skills suitable for a specialized audience
- practice in identifying, interpreting, and critiquing scientific articles

You will work in a group of 4. You may assemble your own group, otherwise we will assign you to a group.

Special Topics

Each group can choose the Special Topic they will teach to the class during the final weeks of the term. The following provides a list of possible areas to explore related to plasticity.

- Effect of sleep
- Hypoxia and plasticity
- Cortical plasticity in people with spinal cord injury
- Mechanisms and treatment for dystonia
- Aerobic exercise in neurorehabilitation
- Application of principles of neuroplasticity to rehabilitation of a neurological disorder (you can choose which disorder to focus on)

You can choose to pursue a focused area from the list provided on Canvas, or come up with your own (subject to approval by the instructor). Final group topics need to be approved by the instructor (Task #2 below).

Specific Tasks

Your Term Project consists of a series of tasks to take you step-by-step through this project. The table below provides a timeline and marks breakdown of the tasks you will need to complete as part of this term project. Please see Canvas for more details about each assignment.

Due Date	Task	Submission Type	% of Final Grade
Sep 27	1. Group Contract	group	-- (participation)
Sep 27	2. Special Topic identification, Literature Search Strategy, preliminary reference list	group	3
Oct 18	3. Preliminary Literature Review, draft Mini-Lesson Outline, and Work Plan	group	8
Oct 18	4. Interim Self- and Peer-Evaluation*	individual	-- (participation)
Nov 1	5. Rough draft presentation (video file)	group	-- (participation)

Nov 8	6. Peer Review	individual	5
Nov 17	7. Final Presentation	group	25
Dec 5	8. Response to Reviews	group	4
Dec 5	9. Final Self- and Peer-Evaluation*	individual	-- (participation)
	10. Peer Evaluation Score	individual	5
		TOTAL:	50

Use of AI

Some of the tasks listed above require the use of AI. Explanations of how to integrate AI is provided in the rubric for the task (please see Canvas for more details).

A note about group work

- You are encouraged to assign roles to each group member. You will have the opportunity to self-reflect/self-evaluate your strengths and weaknesses, and as a group, decide in a collaborative way who is best suited to which role and develop a team contract that sets the ground rules for your group.
- The submitted work within this assignment will be based on both group and individual submissions.
- You will be evaluated not only on your work products but also on your group processes.
- Your TA and I are here to support you as guides and mentors through this group project.

Midway through the term project, you will be asked to submit a **self- and peer-evaluation** of your group's work. In this evaluation, you will score each group member's contribution (including your own, providing a clear justification for your score. Similarly, at the end of the Term Project, you will be invited to submit a **final self- and peer-evaluation**. The justified, aggregate peer review score accounts for 10% of the grade from the Term Project (see table above).

Final Group Presentation – Special Topics Mini-Lessons

Guidelines for mini-lessons:

- Each mini-lesson should be **25 minutes** with 5-10 minutes for questions.
- You must prepare and submit your presentation with PowerPoint
 - do NOT use Prezi, Keynote, or any other desktop or web-based software
- You should present as a group
- Each group member should be prepared to manage questions from the audience

Special Topics Mini-Lessons will be held over the last 3 weeks of term.

Regardless of the date of your group's presentation, your final presentation files will be due by midnight on Nov 17).

Policy on Grading Practices

1. **Graded work** in this course constitutes tests, assignments (individual and group submissions), and course participation. Students must complete tests on the scheduled date and submit assignments by the scheduled deadline. Course participation marks are awarded for work that is submitted on time. **Any late submissions will be penalized by 5% per day.** Students who miss any of these evaluations due to unauthorized absence will receive a grade of zero. Students who cannot complete a test due to an **authorized absence** will be allowed to write a make-up test.
2. **Authorized Absences:** Students who know in advance that they will be unavoidably absent should appeal for special accommodation from the instructor as early in the term as possible to determine how any missed graded work will be completed. The School of Kinesiology will not normally consider special accommodation without timely notification. **A minimum of two weeks notification is expected and documentation will be required.**
3. Where prior notification of absence from graded work is not possible (e.g. due to unforeseen illness or family crisis), students should contact the instructor as soon as possible upon their return to class. **Supportive documentation, submitted to the Undergraduate Advising Centre, will be requested.**
4. Students who plan to be absent from graded work for varsity athletics, family obligations, or other similar commitments, cannot assume they will be accommodated, and should discuss their commitments with the instructor before the official course drop date.
5. The University accommodates students with disabilities who have registered with Access & Diversity. Students whose attendance or academic performance may be severely affected by medical, emotional, or other disabilities should consult with the instructor at least 2 weeks before scheduled tests or exams to discuss any special accommodations that might be needed in order to complete course requirements. Supportive documentation from either Access & Diversity or a physician will be required by the Undergraduate Advising Office.
6. The University accommodates students whose religious obligations conflict with attendance or scheduled tests and examinations. Any accommodations should be communicated to the course instructor, preferably in the first week of class.

Course Policies

Classroom Behaviour

Students must participate in a mature fashion in class and are expected to show respect for their fellow students and the instructors. Disruptive or disrespectful behaviour will not be tolerated in the classrooms.

Academic Integrity

Students are expected to follow UBC policies for academic integrity and academic misconduct, which includes practices around plagiarism, referencing and citation, and copyright. For more

see, UBC's Learning Commons Academic Integrity resources (<https://learningcommons.ubc.ca/academic-integrity/>)

Accessibility

If you have any challenges accessing materials that will impact your success in this course, UBC's Centre for Accessibility can support your needs by providing appropriate accommodations to support you.

UBC's Centre for Accessibility website (<https://students.ubc.ca/about-student-services/centre-for-accessibility>)

Learning Analytics

Some of the learning technologies used for this course collect data to support the improvement of teaching and learning. This includes the collection of data related to overall class progress to provide personalized feedback, engagement in discussion forums to support the fostering of community within the course, and how resources are being accessed to support improvements to the course design. To learn more about learning analytics at the Faculty of Education and at UBC, see the What is Learning Analytics page (<https://ets.educ.ubc.ca/learning-analytics/students/>)

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available from the UBC Senate Website (<https://senate.ubc.ca/policies-resources-support-student-success/>).