

# Systems Neuroscience

## Department of Psychology & Neuroscience

PSYO/NESC 2470.03 Winter 2024

*Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.*

*Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.*

### Course Instructor(s)

| Name                       | Email                | Office Hours                                    |
|----------------------------|----------------------|---|
| Ian Weaver<br>(Instructor) | ian.Weaver@dal.ca    | Tuesdays, 13:30 - 15:30,<br>LSC 3340 and online |
| Lamisa Rahman<br>(TA)      | lamisa.rahman@dal.ca |   |
| Can Sozuer<br>(TA)         | cn631547@dal.ca      |   |

### Course Description

CREDIT HOURS: 3

This lecture class examines the brain's role in controlling experience and behaviour in both animals and humans. The course will focus on the functional anatomy of several psychological systems, in particular the brain pathways involved in sensation, perception, movement, motivation, mood, memory, sleep, emotion, and language. There will be emphasis on recent research findings and understanding methodology for asking questions in neuroscience.

**FORMAT: ALL content is delivered asynchronously** through Brightspace including lectures, quizzes, discussions, exams, announcements, and grades. Ensure you check it and your Dalhousie email often.

LECTURE HOURS PER WEEK: 3

### *Course Prerequisites*

Full year (two terms) of Introductory Psychology with minimum B-. This course is restricted to Psychology & Neuroscience majors unless special permission is granted.

CROSS-LISTING: PYSO 2470.03, NESC 2470.03

## **Student Resources**

**Office Hours: Tuesdays, 13:30– 15300;** Room 3340, Life Sciences Centre (Psychology Wing) and online (<https://outlook.office365.com/owa/calendar/OfficeHours4@dalu.onmicrosoft.com/bookings/>)

See end of document for additional resources available to students (resource centers, etc.).

## **Course Structure**

### *Course Delivery*

**In-person**, lectures will also be recorded and posted on Brightspace. This course follows a **flipped classroom approach**, in that most contact time with the instructor and TA(s) is devoted to **active** learning, with more passive learning (reading and watching lectures) done outside of class. **Lectures are delivered asynchronously** through Brightspace, announcements are posted regularly. Class time, whether in-person *or* online, will focus on study strategies to prepare for exam questions. Activity format could include creating summary tables, identifying structures from images, and critically evaluating neuroscience research. **If Covid restrictions prevent in-person classes, they will be online (see Brightspace). If in-person is permitted, alternative online options will still be available in case students cannot attend, for any reason. CHECK BRIGHTSPACE ANNOUNCEMENTS DAILY.**

### *Lectures*

**Tuesdays**, 11:35 - 12:55; Room 1028, Kenneth C Rowe Management Building (Studley Campus)

**Thursdays**, 11:35 - 12:55; Room 1028, Kenneth C Rowe Management Building (Studley Campus)

## **Course Materials**

**Required textbook:** Bear, M.F., Connors, B.W., and Paradiso, M.A. (2016). Neuroscience: Exploring the Brain, Enhanced 4th ed. Jones & Bartlett Learning. E-book and paper copy versions available through the Dal Bookstore link on the class Brightspace page.

## Assessment

You will be tested on material from the **1)** readings, **2)** lecture recordings, **3)** other materials posted online (TED talks, websites). Format for exam questions will be multiple choice, multi-select, interpreting images, short answer format. Content is not cumulative from exam to exam. Format for quiz questions will vary and could include multiple choice, multi-select, interpreting images. Exams and quizzes will both be open book, see schedule for due dates. The lowest two quiz marks will be dropped (including missed quizzes; if you miss more than two, contact me).

| <b>Component</b>        | <b>Weight (% of final grade)</b>  | <b>Date</b>                   |
|-------------------------|---|-------------------------------|
| <b>Exams</b>            | 2 ONLINE Exams, 39 marks each (78% total), OPEN BOOK (Multiple choice, multi-select, interpreting images, short answer format. Content is not cumulative.)  |                               |
|                         | 1) <b>Chapters 1, 7, 9, 10-12, &amp; 14</b>   | Thursday Feb 15, 2024         |
|                         | 2) <b>Chapters 16, 18-20, 22-24 (+ parts of 7 and 25)</b>   | <i>Scheduled by Registrar</i> |
| <b>Quizzes</b>          | Best 8 of 10 ONLINE Quizzes, 2.5 marks each (20% total), OPEN BOOK (Multiple choice, multi-select, FITB. Lowest two marks dropped, including missed quizzes). There are no make-ups for missed quizzes. |                               |
|                         | 1) History  | Friday Jan 12, 2024           |
|                         | 2) Neuroanatomy   | Friday Jan 19, 2024           |
|                         | 3) Vision   | Friday Jan 26, 2024           |
|                         | 4) Audition   | Thursday Feb 1, 2024          |
|                         | 5) Somatosensation  | Friday Feb 9, 2024            |
|                         | 6) Motivation   | Friday Mar 1, 2024            |
|                         | 7) Emotion  | Friday Mar 8, 2024            |
|                         | 8) Sleep  | Friday Mar 15, 2024           |
|                         | 9) Mental Illness   | Thursday Mar 28, 2024         |
|                         | 10) Memory  | Friday April 5, 2024          |
| <b>Discussion Posts</b> | Best 4 Discussion Posts, 0.5 marks each (2% total), on topics related to lessons. Do not exceed word limit (see Brightspace for details).   |                               |

### *Other course requirements*

None

Conversion of numerical grades to final letter grades follows the

Dalhousie Grade Scale

|             |            |            |           |
|-------------|------------|------------|-----------|
| A+ (90-100) | B+ (77-79) | C+ (65-69) | D (50-54) |
| A (85-89)   | B (73-76)  | C (60-64)  | F (0-49)  |
| A- (80-84)  | B- (70-72) | C- (55-59) |           |

### **Course Policies on Missed or Late Academic Requirements**

Grades are final at the end of term and cannot be 'bumped up' with extra work. **There will be no make-ups for missed quizzes.** Exams must be taken at the scheduled time. **Missed exams** due to illness or exceptional circumstances **must** be communicated to the instructor immediately. An alternative make-up will only be considered with a DECLARATION OF ABSENCE, completed, signed, and emailed to [ian.weaver@dal.ca](mailto:ian.weaver@dal.ca) within 24 hours of the missed exam.

**Quiz Post-mortems:** A review of common tricky questions is available as a recorded video after each quiz (posted the day after the due date). Reviewing individual submissions as a 'self post-mortem' is encouraged; some quiz questions are recycled for exams. Because questions are available after each quiz ends, it isn't possible to offer make-ups (in the interests of academic integrity).

### **Course Policies related to Academic Integrity**

Students are allowed to discuss general concepts with each other, but each assignment submitted **must** be 'individual work'. Plagiarism detection tools will assist in detecting textual similarities between compared works as well as generative AI and large language models (ChatGPT etc).

### **Learning Objectives**

By the end of the course students should be able to:

1. Identify the major anatomical divisions of the brain and spinal cord
2. Explain how lesioning and neuroimaging determine function of specific brain areas
3. Describe how sensory information is represented from receptor to cortex
4. Describe the role of the nervous system in voluntary and involuntary movement
5. Explain neural mechanisms involved in motivated behaviour such as feeding and addiction
6. Explain how the nervous system controls sleep and wakefulness

7. Identify areas of the brain involved in emotional processing
8. Explain how brain function influences to mental illness and explain treatment approaches
9. Describe how the nervous system develops from undifferentiated embryonic tissue
10. Explain the role of different brain areas in different types of memory

### Course Content

| Class | Date   | Lesson                  | Recorded Lectures<br>(watch before class)  | E-book or Enhanced 4 <sup>th</sup> Ed Readings   | Quizzes<br><i>Due 11:59pm</i>                    |
|-------|--------|-------------------------|--|--|--|
| 1     | Jan 9  | Introduction            | Course Tour  | None   |  |
| 2     | Jan 11 | History of Neuroscience | History of Neuroscience  | Ch 1: 3-14                                       | <b>QUIZ 1: History</b><br><i>January 12</i>      |
| 3     | Jan 16 | Neuroanatomy I          | Neuroanatomical Directions;<br><b>Neuroimaging</b> , Organization of the Nervous System;<br>Subcortical Structures | Ch 7: 179-91                                     |  |
| 4     | Jan 18 | Neuroanatomy II         | Cortical Appearance, Cortical Organization & Function  | Ch 7: 183-86 +<br>Ch 7: Appendix 205-46 (images) | <b>QUIZ 2: Neuroanatomy</b><br><i>January 19</i> |
| 5     | Jan 23 | Vision I                | Retinal Organization, Retinal Receptive Fields, Retinofugal Pathway  | Ch 9: 304-11;<br>320-26 +<br>Ch 10: 333-38       |  |
| 6     | Jan 25 | Vision II               | LGN, Retinopy, Striate Cortex Receptive Fields, Dorsal and Ventral Streams   | Ch 10: 338-54;<br>356-62                         | <b>QUIZ 3: Vision</b><br><i>January 26</i>       |
| 7     | Jan 30 | Audition                | Nature of Sound, Auditory System Structure, Encoding Sound, Sound Localization                                     | Ch 11: 370-402                                   |  |

|    |        |                           |  |  |   |
|----|--------|---------------------------|--|--|---|
| 8  | Feb 1  | Somatosensation I         | Body Senses, Nerves and the Spinal Cord  | Ch12: 416-30                             | <b>QUIZ 4: Audition</b><br><i>February 1</i>        |
| 9  | Feb 6  | Somatosensation II        | Somatosensory Cortex, Pain and Nociception   | Ch12: 430-48                             |   |
| 10 | Feb 8  | Motor Systems I           | Movement, Descending Spinal Tracts   | Ch13: 457, 477 + Ch 14: 483-91           | <b>QUIZ 5: Somatosensation</b><br><i>February 9</i> |
| 11 | Feb 13 | Motor Systems II          | Motor Cortex, The Direct Pathway, Cerebellum   | Ch 14: 491-514                           |   |
|    | Feb 15 | <b>EXAM 1</b>             |  | <b>Chapters 1, 7, 9, 10-12, &amp; 14</b> |   |
|    |        | <b>Winter Study Break</b> |  |  |   |
| 12 | Feb 27 | Motivation I              | Basic Motivations, Set Value and Leptin, Hypothalamus and Feeding                                      | Ch 16: 552-60                            |   |
| 13 | Feb 29 | Motivation II             | Regulation of Feeding, Motivation and Reinforcement, Dopamine and Reinforcement, Marijuana and Feeding | Ch 16: 561-72                            | <b>QUIZ 6: Motivation</b><br><i>March 1</i>         |
| 14 | Mar 5  | Emotion I                 | Theories of Emotion, Unconscious Emotion, Basic Emotions   | Ch18: 616-19; 625-28                     |   |
| 15 | Mar 7  | Emotion II                | Amygdala and Emotion, Fear, Anger and Aggression   | Ch18: 624-25; 633-35                     | <b>QUIZ 7: Emotion</b><br><i>March 8</i>            |
| 16 | Mar 12 | Sleep I                   | EEG, Sleep Deprivation   | Ch19: 646-66                             |   |
| 17 | Mar 14 | Sleep II                  | Neuroscience of Sleep, Biological Rhythms  | Ch19: 666-79                             | <b>QUIZ 8: Sleep</b><br><i>March 15</i>             |
| 18 | Mar 19 | Language I                | Nature of Language, Language Ability in  | Ch20: 686-94                             |   |

|    |         |   |   |   |  |
|----|---------|---|---|---|--|
|    |         |   | Animals,<br>Development of<br>Language  |   |  |
| 19 | Mar 21  | Language II                               | Language<br>Lateralization,<br>Neuroimaging and<br>Language   | Ch20: 694-717   |  |
| 20 | Mar 26  | Mental Illness I                          | Treating Mental<br>Illness, Anxiety,<br>Anxiety Treatments  | Ch 22: 752-63   |  |
| 21 | Mar 28  | Mental Illness II                         | Affective Disorders,<br>Affective Disorder<br>Treatments,<br>Schizophrenia  | Ch 22: 763-79   | <b>QUIZ 9: Mental<br/>Illness</b><br><i>March 28</i> |
| 22 | April 2 | Memory I                                  | Memory and<br>Associative<br>Learning, Working<br>Memory and<br>Prefrontal Cortex,<br>Equipotentiality                            | Ch 24: 824-43   |  |
| 23 | April 4 | Memory II                                 | Memory and<br>Hippocampus,<br>Place and Grid<br>Cells, Procedural<br>Memory and Habit<br>Learning,<br>Neurochemistry of<br>Memory | Ch 24: 843-63<br>Ch 25: 874-9                                     | <b>QUIZ 10: Memory</b><br><i>April 5</i>             |
|    |         | <b>EXAM 2<br/>CHECK EXAM<br/>SCHEDULE</b> |   | <b>Chapters 16, 18-<br/>20, 22-24 (+<br/>parts of 7 &amp; 25)</b> |  |

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## University Policies and Statements

### Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or [elders@dal.ca](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at: [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

### Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

### Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: [https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

### Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre ([https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)



## **Conduct in the Classroom – Culture of Respect**

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

## **Diversity and Inclusion – Culture of Respect**

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

## **Student Code of Conduct**

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

## **Fair Dealing Policy**

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/fair-dealing-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

## **Originality Checking Software**

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html)

## **Student Use of Course Materials**

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

Faculty of Science

# Student Resources and Support

## University Policies and Programs

Important Dates in the Academic Year (including add/drop dates):

[http://www.dal.ca/academics/important\\_dates.html](http://www.dal.ca/academics/important_dates.html)

Classroom Recording Protocol:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/classroom-recording-protocol.html](https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html)

Dalhousie Grading Practices Policies:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/grading-practices-policy.html](https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html)

Grade Appeal Process: [https://www.dal.ca/campus\\_life/academic-support/grades-and-student-records/appealing-a-grade.html](https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html)

Sexualized Violence Policy: [https://www.dal.ca/dept/university\\_secretariat/policies/health-and-safety/sexualized-violence-policy.html](https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html)

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

## Learning and Support Resources

General Academic Support – Advising (Halifax): [https://www.dal.ca/campus\\_life/academic-support/advising.html](https://www.dal.ca/campus_life/academic-support/advising.html)

General Academic Support – Advising (Truro): <https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html>

Student Health & Wellness Centre: [https://www.dal.ca/campus\\_life/health-and-wellness.html](https://www.dal.ca/campus_life/health-and-wellness.html)

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): [https://www.dal.ca/campus\\_life/academic-support/On-track.html](https://www.dal.ca/campus_life/academic-support/On-track.html)

Indigenous Student Centre: [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

Indigenous Connection: <https://www.dal.ca/about-dal/indigenous-connection.html>

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at [elders@dal.ca](mailto:elders@dal.ca) or 902-494-6803:

<https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf>

Black Student Advising Centre: [https://www.dal.ca/campus\\_life/communities/black-student-advising.html](https://www.dal.ca/campus_life/communities/black-student-advising.html)

International Centre: [https://www.dal.ca/campus\\_life/international-centre.html](https://www.dal.ca/campus_life/international-centre.html)

South House Sexual and Gender Resource Centre: <https://southhousehalifax.ca/about/>

LGBTQ2SIA+ Collaborative: <https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html>

Dalhousie Libraries: <http://libraries.dal.ca/>

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Dalhousie Student Advocacy Services: <https://www.dsu.ca/dsas?rq=student%20advocacy>

Dalhousie Ombudsperson: [https://www.dal.ca/campus\\_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html](https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html)

Human Rights and Equity Services: <https://www.dal.ca/dept/hres.html>

Writing Centre: [https://www.dal.ca/campus\\_life/academic-support/writing-and-study-skills.html](https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html)

Study Skills/Tutoring: [http://www.dal.ca/campus\\_life/academic-support/study-skills-and-tutoring.html](http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html)

Faculty of Science Advising Support: <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

## **Safety**

Biosafety: <http://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <http://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Laser Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html>