

CAPS 200 Syllabus 2022W

This course will introduce you to the concepts and essential skills in biomedical research. You are required to explore scientific literature on your own and discuss your findings with your peers as we deconstruct research seminars given by two UBC research scientists. You will be guided to think critically and creatively in the process using problem sets and group discussion facilitated by your instructors. The goal is to enable you to summarize the seminar content in written form and craft a research proposal in format of a ten-minute presentation to the class.

The instructors and the research scientists assess your proposal presentation and provide you with constructive feedback. Strong proposals continue, as research projects, should you choose to do so in the summer term. There are no examinations in this course. The time you would normally spend studying and preparing for exams is spend outside of class accumulating knowledge required to enable you to discuss, analyze and synthesize ideas. In order to succeed you must begin this process right away.

I hope you enjoy this challenging course and use the opportunity to transform your understanding of scientific research and the underlying process that allows us to create new knowledge. I am keen to hear about your experiences and open to your feedback throughout the course. Do not hesitate to discuss your concerns, suggestions and “Aha!” moments with me.

Sally Osborne / CAPS 200 course director

Learning Outcomes

Overarching Learning Outcomes

By the end of the course the students will be able to ...

1. Communicate effectively the thought process, logic, motivation, techniques and impact of a high profile current biomedical research.
2. Examine primary research-based literature focusing on the underlying questions, experimental approach, results and significance of the scientific findings and be able to articulate these in discussion sessions.
3. Formulate a research question designed to test refine and build on theories presented in class and a logical plan for data analysis as part of a research proposal for a summer directed studies.

Content Learning Outcomes

Seminar 1 Dr. Haas

How Do Brain Neurons Grow And Form Functional Neural Networks

1. Define the critical period and describe how neurons grow during early development and the factors that are important in growth of neuronal circuitry.

2. Describe the relationship between synapse formation and dendritic growth.
3. Discuss the advantage of targeted single cell electroporation and fast AOD two-photon microscopy when assessing dendritic arbor growth.
4. Explain how visual experience affects dendritic and axonal growth and how synaptic plasticity is measured in the Haas lab using two-photon fluorescence microscopy, calcium imaging and dynamic morphometrics of the visual circuit in the developing albino tadpole.
5. Describe the advantage of using in-vivo imaging and explain the mechanisms of LTP and LTD.
6. Define metaplasticity and describe evidence from the Haas lab supporting this theory.

Seminar 2 Dr. Cembrowski

Structure and function of mature neural networks

1. Describe general differences in structure and function between non-mammalian (say, *Xenopus*) and mammalian (say, mice) brains.
2. Define declarative memory, and describe how synaptic connections and plasticity of the mature brain may mediate declarative memory.
3. Identify direct and indirect ways by which neural contributions to behaviour can be assayed.
4. Compare and contrast the types of functional insight that can be obtained from observational and interventional studies.
5. Define the trisynaptic loop of the hippocampus, and define the functional contributions of each cell type in this loop to memory.
6. Discuss the limitations of characterizing the hippocampus and subiculum as a simple trisynaptic loop.

Assessment

This course is graded numerically out of 100 with the marks distributed as follows.

- Preparation & Participation 20
- Problem Sets (4) 40
- Seminar Summaries (2) 20
- Proposal Presentation 20

Assignment Due Dates

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|---------------|--------------------|---------------|-----------------------|
| • January 26 | Problem Set 1 | • March 9 | Problem Set 3 |
| • February 2 | Problem Set 2 | • March 21 | Problem Set 4 |
| • February 9 | Proposal Outline 1 | • March 23 | Proposal Outline 2 |
| • February 13 | Seminar 1 Summary | • March 27 | Seminar 2 Summary |
| | | • Apr 11 & 13 | Proposal Presentation |

All assignments are submitted through Canvas in *Word.doc* format. Late submissions of Problem Sets and Seminar Summaries will receive a 50% reduction in mark. Submission of all journal assignments is REQUIRED for completion of the course. If late, journal assignments receive a mark of zero.

Preparation & Participation

Preparation & Participation is based on your journal entries AND participation in class discussion. Journal entries are based on assigned articles and videos; these define your preparation for the course. The content of your journal serves to share your findings, questions and analysis and is necessary to drive the classroom discussion. Your journals also serve as a tool to help define your research proposal. In your journal, you must complete all the sections specified in the example below, **in point form**. The example below is of entries by a student reading their very first scientific article on a biomedical subject. You will find that with time your entries will be more specific and refined compared to the simple, rough example provided below. Use the Cell journal citation format (see: <https://paperpile.com/s/cell-citation-style/> or <https://www.cell.com/cell/authors>) For videos assigned to journal, combine all the information under the heading videos instead of providing a citation. Complete the entry for each of the subheadings under “Analysis” and treat all videos as one entity.

Journal

Readings Citation

Haas, K., Jensen, K., Sin, W.C., Foa, L., Cline, H.T. (2002) Targeted electroporation in *Xenopus* tadpoles in vivo: from single cell to the entire brain. *Differentiation* 70, 148-154

Analysis

Three key points:

- Rapid identification of genes is outpacing ability of scientist to identify the role of genes in cell function. Creating transgenic organisms is expensive, time consuming and limited to a few species.
- Electroporation is a versatile method allowing multiple genes to be introduced into the same cell via different plasmids, leaving behind little delivery agent to cause cell damage.
- The paper discusses adaptation of current electroporation techniques for neurons at both ends of scale: large regions of the brain and single cell.

Two questions: (I need to explore with my peers or answer on my own with further research)

- This is a technique paper. I will likely learn more by doing. I get the general idea of SCE and its benefits; what I am wondering is how does two-photon microscopy work and why it is preferred to other forms of microscopy?
- What exactly is fluorescence?
- Has anyone followed up to see if morpholino oligoneucleotides introduced this way can interfere with mRNA translation?

Answers to the questions from your last journal: You should list the questions from your last journal and provide answers on those you were able to find. Provide a citation or url link to the citation.

Implications for my proposal:

- Details of electroporation technique that I need to consider for my research methods.

Problem Sets are designed to help you develop a greater understanding of key concepts, think creatively and guide group discussions. Answers to each question should not exceed 300 words. An additional single page of reference list for material consulted must accompany the problem set answers. Use the same citation format as specified for Preparation and Participation.

Seminar Summary characterizes your understanding of the research seminar. Describe the rationale for the research, research questions, experimental approaches, results, conclusions and significance of the findings. Pay close attention to the rubric below for assessment. You should conclude the summary with a minimum of two research questions for the Q&A session with the seminar speaker. If you have more than two meaningful questions, it would be stellar. Seminar summary should NOT exceed 1200 words.

Category	Outstanding	Meets Standards	Below Required Standards	%
Introduction	1 Engaging & thought-provoking, states the main topic of the seminar, previews the seminar structure, provides a clear & concise description of the research questions presented in the seminar	0.75 In complete preview of seminar structure, unclear description of the research questions	0.5 Unfocused introduction, incomplete / unclear preview of the seminar structure or the research questions	1
Experimental Approach Methods & Results	3 Clear, concise, accurate description of the methods and succinct explanation of the results	2 Clear and accurate description of methods and results	1 Methods & results are stated but are not clear and or are inaccurate	3
Significance	3 Thought- provoking, succinct explanation of the significance of the research and its future directions	2 Clear and accurate significance of the research	1 Significance of research is unclear or inaccurate	3
Questions	3 Two concise questions based on the seminar and additional material garnered outside the classroom setting	2 Two concise questions based on the findings presented in the by the seminar speaker	1 A single question related to the seminar topic	3

Research Proposal

Present a ten-minute proposal based on the research material explored in the two seminars. A five-minute Q&A period will follow. Seminar speakers will assess your proposal.

Research Proposal Assessment Criteria	Mark
<p>Format (adheres to the following format)</p> <ul style="list-style-type: none"> • Single descriptive title slide. • Introduction (2 slides) • Question/Hypothesis/Specific Aims (2 slides) • Research Plan (1-2 slides) • Significance (1 slide) • References (1 slide) same style as journal 	1
<p>Introduction</p> <ol style="list-style-type: none"> 1. Context: provides a summary and review of current literature. (1) 2. Literature selected includes at least 2 -3 articles not reviewed in the course. (1) 3. Identifies the gaps, problems or issues unresolved by the literature. (1) 	3
<p>Statement of Problem or Question (1 mark per item)</p> <ol style="list-style-type: none"> 1. States a clear, concise compelling research question. (1 marks) 2. Provides a testable hypothesis. (1 mark) 3. States the specific aims of the study. (1 marks) 	3
<p>Methodology - Research Plan (1 marks per item)</p> <ol style="list-style-type: none"> 1. Describes what and how data will be collected. 2. Describes how the data will be analyzed. 	2
<p>Novelty (2 marks per item)</p> <p>Research questions are novel and not derivative. (2 mark)</p> <p>Experimental design is uniquely tailored for the experimental question. (2 mark)</p>	4
<p>Expected Outcomes and Significance (1 mark per item)</p> <ol style="list-style-type: none"> 1. States the expected outcomes. 2. Identifies the theoretical and practical significance of the research. 3. Speculates on implications of anticipated findings 4. Provides future directions. 	4
<p>Presentation Skills (1 mark per item)</p> <ol style="list-style-type: none"> 1. Uses eye contact effectively to engage the audience; speaks clearly, confidently with suitable volume & pace without cue cards. 2. Uses smooth transitions to connect key points. 3. Shows knowledge of the subject by responding confidently & accurately to questions. 	3
<p>Total</p>	20

The information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.