

# **Biology 410/510 Neural Basis of Cognition**

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**NOTE:** This is a tentative syllabus. The latest version is accessible via Canvas.

## **Course description**

The course will examine the neural mechanisms that mediate cognitive processes such as attention, memory and decision making. We will focus on studies that use animal models to relate the activity of single neurons to cognition. The course is intended to bridge the gap between sensory physiology and cognitive neuroscience.

The format of the course includes lectures and activities that introduce each topic, followed by analysis of primary research literature. Students are expected to have a working knowledge of basic neuroanatomy and neurophysiology.

## **Course pre-requisites**

BI353 – Sensory physiology, BI360 – Neurobiology, or equivalent.

## **Learning objectives**

1. Gain a working knowledge of modern experimental approaches for studying cognition in animal models.
2. Identify the major gaps in our understanding of the neural mechanisms of cognition.
3. Become a critical reader of scientific research articles in systems neuroscience.
4. Develop the ability to formulate hypotheses about the neural basis of cognitive processes.
5. Become proficient at designing experiments to test hypotheses about the mechanistic bases of cognitive processes.
6. Learn to give a concise and compelling oral presentation that identifies a scientific question, proposes a hypothetical answer to this question, and lays out a novel strategy to test this hypothesis.

## Course calendar

1. **Introduction**
  1. Introduction to cognition, animal models, and course overview.
  2. Methods for monitoring and manipulating neural activity.
2. **Perception and Decision-making I**
  1. Neuronal selectivity, receptive fields, Bayesian inference, perceptual illusions.
  2. Reflexes *vs.* decisions, integration of evidence, confidence.
3. First student presentations
  1. HOLIDAY
  2. *von der Heydt et al. (1984), Lee and Nguyen (2001), Conway et al. (2005)*
4. **Decision-making II**
  1. Foraging, exploration *vs.* exploitation, value.
  2. *Salzman et al. (1990), Shadlen and Newsome (2001), Kepecs et al. (2008)*
5. **Attention**
  1. Spatial attention, feature attention.
  2. *McAdams & Maunsell (1999), Moore & Fallah (2004), Zénon & Krauzlis (2012)*
6. **Multiple modalities**
  1. Multisensory integration and cross-modal attention.
  2. *Meredith et al. (1987), Steinmetz et al. (2000), Fetsch et al. (2012)*
7. **Learning**
  1. LTP/LTD, reinforcement, expectation.
  2. *Rogan et al. (1997), Hollerman & Schultz (1998), Xiong et al. (2015)*
8. **Memory**
  1. Memory engram, reactivation
  2. *Liu et al. (2012), Ramirez et al. (2013), Nabavi (2014)*
9. **Thinking**
  1. Working memory, sustained neural activity, mental rotation.
  2. *Romo et al. (1999), Crowe et al. (2004), Liu et al. (2014)*
10. **Wrap up**
  1. *Additional student presentations*
  2. Wrap-up: assessment of course objectives.

## **Students with disabilities**

If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me. Please request that the Counselor for Students with Disabilities send a letter verifying your disability.

## **Academic Honesty**

Group discussions outside of class are encouraged. However, all work submitted as part of this course must be your own. The use of sources must be properly acknowledged. Copying or paraphrasing information from any source without citation is plagiarism. For more information, see <http://library.uoregon.edu/guides/plagiarism/students/index.html>

The consequences of academic dishonesty will be taken seriously (e.g., an 'F' in the course and a report to the Office of Student Conduct) and are noted on student disciplinary records. If you are in doubt regarding any aspect of these issues, please come and speak with me.