

NROSCI 1039**Processing in neural circuits**

Dr. Caroline A. Runyan, Department of Neuroscience

Lectures: Monday and Wednesday, 11:00 a.m. – 12:15 p.m., Langley Hall, Room A214

Office hours: M/W 1:00 p.m. – 2:00 p.m., Langley Hall, room A453 (in the bridge between Langley and Clapp)

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Week	Date	Topic	Reading
1	January 6	Introduction	
	January 8	Visual microcircuits: the retina	Chapter 18
2	January 13	Thalamus: Lateral Geniculate Nucleus	Chapter 8 (7 is optional)
	January 15	Thalamocortical Networks	Chapter 9
3	January 20	No class	
	January 22	Paper Discussion: Thalamocortical Topography	To be posted on CourseWeb: Reid and Alonso
4	January 27	No class	
	January 29	Neocortical Microcircuits	Chapters 1-2
5	February 3	Exam 1	
	February 5	Paper Discussion: Visual cortex	To be posted on CourseWeb: Ko et al
6	February 10	Visual Cortex – canonical computations, Inhibitory Interneurons	Ch 3
	February 12	Paper Discussion: Linear Integration of spine Ca ²⁺ signals in vivo	To be posted on CourseWeb: Jia et al
7	February 17	No class	
	February 19	Visual cortex –inhibition, contextual modulation of visual processing	Review article: Markram, 2004
8	February 24	Paper discussion – inhibitory neurons in V1	Khan et al., 2018
	February 26	Visual cortex III – top-down modulation, feedforward projections from V1	
9	March 2	Barrel Cortex	Ch 4
	March 4	Exam 2	
10	March 9	No class – spring break	
	March 11	No class – spring break	
11	March 16	No class	
	March 18	Information, population coding	

12	March 23	Auditory Microcircuits	Chapter 20-21
	March 25	Parietal cortex, decision making – guest lecture	
13	March 30	Working memory	Chapter 6
	April 1	Paper discussion – mixed selectivity	
14	April 6	Hippocampus	(reading to be posted on CourseWeb)
	April 8	Paper discussion – engrams	Tonegawa
15	April 13	Dynamics in cortical networks (rhythms, synchrony)	(reading to be posted on CourseWeb- Buzsaki)
	April 15	Exam 3	

Prerequisites

Neuroscience 1000 (Introduction to Neuroscience)

Recommended but not required: Neuroscience 1011 (Functional Neuroanatomy)

Course goals

Sensory information flows from the periphery through different stages of processing in the central nervous system, to the thalamus and cerebral cortex. Within the cerebral cortex, feedforward processing is strongly modulated by top-down “feedback”, with impacts on perception and decision making. The computations performed by individual neurons and networks of neurons within each region transform incoming information to produce an output that is projected to other targets in the brain. This course explores the local circuit mechanisms underlying the representation and refinement of sensory information at successive stages of the feedforward processing pathways. We will focus on the formation of receptive field properties within individual neurons, including contributions of feedforward circuitry and interactions between neurons within local circuits, and on how populations of neurons work together to encode information. An important theme of the course will also be to learn about current methodology in systems neuroscience research to study and perturb circuits. Descriptions of such experiments will be incorporated into lectures, and we will also read several primary research articles relevant to the major themes of the course.

Readings

Most readings are from the text “Handbook of Brain Microcircuits” edited by Gordon M. Shepherd and Sten Grillner. It is optional to purchase the book – copies will be placed on reserve in the Langley Library, and while it is expected that students read all required assignments, all

material covered by exams will be presented in class. Additional readings will include primary research articles and will be posted on Courseweb.

Grading policy

There will be three exams, which count for 75% of your grade (each exam is worth 25%). Exams are cumulative in that concepts will be built upon throughout the semester. No make-up exams will be given. In the case of an illness or emergency, please contact me prior to the scheduled time of the exam.

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Office of Disability Resources and Services, 140 William Pitt Union, 412-648-7890/412-383-3346 (Fax), as early as possible in the term. Disability Resources and Services will verify your disability and determine reasonable accommodations for this course.

The remaining 25% will be accounted for by class participation. For classes marked “paper discussion”, each student will be expected to have read the paper and to contribute to the discussion. Participation during lectures will also be considered.

Approximate time spent outside of class:

Students can expect to spend approximately 3-5 hours per week preparing for lectures.

Academic integrity policy

Cheating/plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity, noted below, will be required to participate in the outlined procedural process as initiated by the instructor. A minimum sanction of a zero score for the quiz, exam or paper will be imposed. (For the full Academic Integrity policy, go to www.provost.pitt.edu/info/ai1.html.)

Email communication policy

*Each student is issued a University e-mail address (username@pitt.edu) upon admittance. This e-mail address may be used by the University for official communication with students. Students are expected to read e-mail sent to this account on a regular basis. Failure to read and react to University communications in a timely manner does not absolve the student from knowing and complying with the content of the communications. The University provides an e-mail forwarding service that allows students to read their e-mail via other service providers (e.g., Hotmail, AOL, Yahoo). Students that choose to forward their e-mail from their pitt.edu address to another address do so at their own risk. If e-mail is lost as a result of forwarding, it does not absolve the student from responding to official communications sent to their University e-mail address. To forward e-mail sent to your University account, go to <http://accounts.pitt.edu>, log into your account, click on **Edit Forwarding Addresses**, and follow the instructions on the page. Be sure to log out of your account when you have finished. (For the full E-mail Communication Policy, go to www.bc.pitt.edu/policies/policy/09/09-10-01.html.)*