NRO C69F The Synaptic Organization of the Brain

Fall, 2004; Room BV260; M 5-7 p.m.

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Office Hours: T 5-6, TH 5-6, M 2-3 or by appointment
NOTE: T and TH, I teach in S309 until 5:00 p.m. and may be detained there by students asking questions.

COURSE DESCRIPTION

Synaptic organization may be defined as the study of principles underlying the organization of neurons and synapses into circuits that mediate the functional operations of different brain regions. It is a multidisciplinary subject, requiring the integration of results from studies in molecular neurobiology, neuroanatomy, neurophysiology, neurochemistry, neuropharmacology, development and behavior, as well as theoretical studies of computational neural models and neuronal networks. It is also a multilevel subject, beginning with the properties of the individual synapse and building up through microcircuits and neurons to the local circuits characteristic of a given region and finally, to the interactions between various circuits that form a given system, and even to system-system interactions. Such multi-system interactions must surely underlie complex thought processes such as art, music and science appreciation, analytical thinking, creativity and self-awareness!

TEXT

The Synaptic Organization of the Brain. Fifth Edition. Gordon M. Shepherd (ed.), Oxford University Press, New York, 2004. NOTE: The 4th edition used last year is still fine for the course.

ORGANIZATION

The course will meet weekly for two hours and will consist of lectures by the instructor and extensive class discussions. The textbook will be the major source of information, supplemented by illustrations and concepts provided by the instructor in class. Lecture notes will be available on the intranet but do not really substitute for the more extensive explanations given in lecture.

EVALUATION

***Midterm Exam** - Week of Oct. 18, TBA by Registrar, 2hrs — 30%
(multiple choice, short answer, label diagrams, draw circuits)

***Final Exam** - Final exam period, TBA by Registrar, 3hrs. — 40%
(same format as midterm; emphasis placed on material after midterm)

***Exam questions will be taken from both the book and the lectures**

Term Paper - Due Dec. 1 (Last day of class) — 30%
Fifteen pages, not including references, topic of your choice approved by instructor. Possible topics will be provided. Format will be provided

2004 NRO C69F
Schedule of Topics

DATE :			TOPIC :
M	Sept.	13	Introduction to the course Begin **Chapter 1: Introduction to synaptic circuits**
M		20	Chapter 1
M		27	**Chapter 2: Membrane properties and neurotransmitter actions**
M	Oct	4	Chapter 2: (cont'd.)
M		11	Chapter 2 : (cont'd.)
M		18	**Chapter 5: Olfactory Bulb**
			MIDTERM: week of Oct. 18, TBA by Registrar, 2hrs
M		25	Chapter 5 : (cont'd.)
M		1	**Chapter 7: Cerebellum**
M	Nov	8	Chapter 7: (cont'd.)
M		15	**Chapter 11: Hippocampus**
M		22	Chapter 11: (cont'd.)
M		29	Chapter 11: (cont'd.)
M	Dec.	1	**Last day of class, Term paper due**
Th	Dec 9 - 21		Final exam period, date TBA 40% of grade

Topics for term papers in NRO C69F

Other topics are welcome for approval!

Detailed structure and functions of different regions in the:

- Prefrontal cortex
- Frontal cortex
- Parietal cortex (ex: rodents and plasticity)
- Temporal cortex (ex: owls and plasticity)
- Occipital cortex (ex: primates or kittens and plasticity)
- Cerebellum (ex: rabbits and plasticity)
- Hippocampus (ex: anatomy and physiological plasticity)
- Amygdala (ex: seizures)

Structure, projections and functions of the:

- Locus coeruleus
- Raphe nuclei
- Substantia nigra
- Caulustrum
- Other?

Pain: various pathways, fiber types, neurotransmitters, peptides, etc.

Different locations of classes of receptors and their functions:

- DA (about 7 subtypes now)
- Several peptides (CCK, SS, leu-enk, met-enk, etc.) (endorphins) : Locations and functions
- 5HT
- NE
- Glutamate
- Aspartate
- Adenosine
- GABA and glycine
- Pick a structure and delineate the location and function(s) of <u>all</u> known peptides found there

Cellular/molecular mechanisms of:

- Color perception
- Smell
- Learning
- Neuromodulation
- New neuron chnnels – subtypes and functions:
  Survey <u>SCIENCE</u> for the last couple of years – there are <u>lots</u> to choose from; try to pick a <u>theme</u>, not just a paper!

- Various drug actions – again pick a theme; drugs for epilepsy/ depression/ pain/ hallucinations/ other…

Evolution of the:

- Neocortex - when it first appears, how its structure, size, and functions change
- Hippocampus – as above: this structure has homologues as far back as reptiles!
- Corpus callosum and/or anterior commisure – also include or focus on mechanisms of development and plasticity
- Cerebellum and plasticity