

## USC Dornsife College of Letters, Arts and Sciences

### Syllabus for *Brain Architecture* (BISC424)

Units: 4

Spring Semester 2017 (Tu/Th 9-10:50 am)

**Location:** Joyce J. Cammilleri Hall, Brain & Creativity Institute [dornsife.usc.edu/bci/](http://dornsife.usc.edu/bci/)

**Instructor:** Larry Swanson [larryswanson.com](http://larryswanson.com)

Office: HNB428.

Office hours: Tu 11am-3pm (best to prearrange before or after class, or by email)

Contact info: [larryswanson10@gmail.com](mailto:larryswanson10@gmail.com)

**Course Description:** This course is designed for advanced undergraduates and graduate students interested in the basic structure-function organization of the brain—how it controls mind and behavior from a neuroscience perspective.

The outline of lectures and discussion sessions is given below. Basically the course is divided into a four-part sequence: an historical overview, then two approaches to overall brain architecture that are especially illuminating because they start with a simple state and follow progressive differentiation to a much more complex state (evolution and embryonic development), and finally an overview of basic functional systems or circuits (divided into four basic parts: motor, state, cognitive, and sensory). Throughout the course, examples of how to interpret relevant human brain imaging data (mostly MRI) will be provided and discussed.

**Learning Objectives:** The goal of this course is to understand the general principles of nervous system organization, from the structural, functional, and molecular points of view—in humans and in animals. This knowledge will be used to probe how the brain mediates cognition, emotion, and behavior, and how abnormalities in its circuitry may lead to a wide range of psychiatric, neurological, and metabolic diseases. It can also be used to stimulate new approaches to hardware and software design in computer science. An historical approach is taken so that participants gain an appreciation for how scientists actually analyze and think about brain structure and function in the laboratory.

**Prerequisites.** None

**Recommended Preparation:** An introductory course in biology is very helpful.

**Course Notes:** The lecture PowerPoint presentations will be posted on Blackboard, usually before the lecture. Also see <https://blackboard.usc.edu/> for reading assignments, announcements, and other info.

### Required Reading and Supplementary Materials:

- Required: Swanson, Larry W. (2012) *Brain Architecture: Understanding the Basic Plan*, 2<sup>nd</sup> edn. (New York, Oxford University Press).
- One research article each week; assigned the previous week.
- Recommended: Nieuwenhuys, R., Voogd, J., and Chr. van Huijzen (2008) *The human central nervous system*, 4th edition (New York: Springer).

**Description and Assessment of Assignments:** There will be 14 weekly quizzes (10 minutes each Tuesday at the beginning of class) on the required reading for the current (upcoming) week; your 3 lowest scores will be dropped and total points (10 tests) will be graded on a curve. The tests will be short answer type with 10 points per test. Their purpose is to encourage you to read the assigned materials before the corresponding lectures.

Instead of a final exam, a 5-page single-spaced essay will be due by email by 5pm on May 9. For a topic pick your favorite part of the nervous system and discuss critically what is known about its location in various animals, the neural circuitry it is part of, and what its basic function seems to be. Proper references to the literature (this excludes Wikipedia and the like) are required and included in the 5 pages. Do not use illustrations or tables; just text.

### Grading Breakdown:

Weekly quizzes	100 points	75% of grade
<u>Final essay</u>	<u>025 points</u>	<u>25% of grade</u>
	125 points	100% of grade (to be graded on a curve)

**Assignment Submission Policy:** The final essay is due on the day scheduled for the final exam; they will not be accepted after 5pm on May 9. Instead, a score of 0 will be assigned for this assignment.

### Lecture schedule:

Date	#	Topic	Reading*
Jan 10 (Tu)	1	Getting a perspective: views from Antiquity & Renaissance	Preface, Ch. 1
Jan 12 (Th)	2	How microscopes and the cell theory changed everything	Ch. 2
Jan 17 (Tu)	3	How the nervous system (NS) evolved: simple animals	Ch. 3
Jan 19 (Th)	4	Evolution of the vertebrate nervous system: the basic plan	Ch. 4
Jan 24 (Tu)	5	Early development of the nervous system: simple & clear	Ch. 5
Jan 27 (Th)	6	Development of nervous system's basic parts	Ch. 6 to p. 94
Mar 31 (Tu)	7	Development of nerve cells and neural circuitry	Ch. 6 to p. 103
Feb 2 (Th)	8	Lessons from development: architectural principles	Ch. 6 finish
Feb 7 (Tu)	9	Thinking about the human brain: interpreting MRIs	MRI Wikipedia
Feb 9 (Th)	10	Brain & behavior: Holy Grail—the basic wiring diagram	Ch. 7
Feb 14 (Tu)	11	The motor system: types of responses produced by the NS	Ch. 8 to p. 148
Feb 16 (Th)	12	The somatic motor system: central pattern generators	Ch. 8 pp. 148-56
Feb 21 (Tu)	13	Somatic motor system: drive and motivation	Ch. 8 pp 156-62
Feb 23 (Th)	14	The autonomic motor system: control of bodily functions	Ch. 8 pp. 162-67
Feb 28 (Tu)	15	The neuroendocrine motor system: master gland (pituitary)	Ch. 8 pp. 167-71
Mar 2 (Th)	16	Neuroendocrine motor system: stress & reproduction	Ch. 8 pp. 167-71
Mar 7 (Tu)	17	Somatic motor system: motor learning & cerebellum	Ch. 8 pp. 171-81
Mar 9 (Th)	18	The behavioral state system: circadian rhythms	Ch. 9 to p. 189
Mar14-16		<i>Spring Recess</i>	
Mar 21 (Tu)	19	Behavioral state system: sleep/wake & reproductive rhythms	Ch. 9 finish
Mar 23 (Th)	20	The cognitive system: thinking & voluntary behavior control	Ch. 10 to p. 212
Mar 28 (Tu)	21	Cognitive system: the cerebral cortex, layers & cell types	Ch. 10 pp.212-18
Mar 30 (Th)	22	Cognitive system: the cerebral cortex, circuitry	Ch 10 pp. 218-19
Apr 4 (Tu)	23	Cognitive system: the cerebral nuclei (basal ganglia)	Ch. 10 finish
Apr 6 (Th)	24	The sensory system: introduction	Ch. 11 to p. 242
Apr 11 (Tu)	25	Sensory system: vision	Ch. 11 pp 242-47
Apr 13 (Th)	26	Sensory system: hearing	Ch. 11 pp 242-47
Apr 18 (Tu)	27	Sensory system: smell and taste	Ch. 11 pp 242-47
Apr 20 (Th)	28	Sensory system: touch; pain & pleasure; mood & emotion	Ch. 11 pp 247-55
Apr 25 (Tu)	29	Modifying architecture: learning, stress, & damage repair	Ch. 12
April 27 (Th)	30	Overview of the course and final discussion	Ch. 13

May 9 (Tu 5pm) Final paper due

\*Pages in *Brain Architecture* listed, plus assigned research article.

## Statement on Academic Conduct and Support Systems

### Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct/>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu/> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage [sarc@usc.edu](mailto:sarc@usc.edu) describes reporting options and other resources.

### Support Systems:

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* [http://sait.usc.edu/academicsupport/centerprograms/dsp/home\\_index.html](http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html) provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu/> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.