USC Dornsife College of Letters, Arts and Sciences

Syllabus (version 1.0) for *Brain Architecture* *(BISC424)*
Units: 4
Spring Semester 2022 (Tu/Th 9-10:50 am)
Location: Hedco Neurosciences Building, Auditorium (100); 3641 Watt Way

Instructor: Larry Swanson: larrywswanson.com
Office: HNB428
Office hours: Almost any time; arrange phone call, FaceTime, or Zoom by email
Contact info: 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 systems 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*, 2nd edition. (New York, Oxford University Press). **WARNING: THE FIRST EDITION WILL NOT WORK!**
- One research article each week; assigned the previous week (posted on Blackboard).
- Recommended: Nieuwenhuys, R., Voogd, J., and Chr. van Huijzen (2008) *The human central nervous system*, 4th edition (New York: Springer). Find a cheap copy online (also available from USC library for free!) This is the most recent authoritative neuroanatomy textbook.

Description and Assessment of Assignments:

14 WEEKLY QUIZZES will be given (10 minutes each; take any time 24 hours before class on Tuesday, on Blackboard; starting January 18th) on the required reading for the current (upcoming) week; your 4 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. You are on your honor to take the test "closed book". Their purpose is to encourage you to read and understand the assigned materials before the corresponding lectures--learn general principles and the vocabulary necessary for that understanding. *There will be no makeup quizzes: those you miss will be counted among the 4/14 that are dropped.*

FINAL ESSAY (no final exam): A 5-page single-spaced essay will be due through *Turnitin* (Blackboard) at 10am LA time on May 10 (when final exam for this course is scheduled to end). 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. You can get all of the necessary references online from the USC Library. PubMed is probably the best source of references (try looking for review articles first).

Grading Breakdown:

Weekly quizzes	100 points	80% of grade
Final essay	025 points	20% of grade
	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 through ***Turnitin*** (Blackboard); it will not be accepted after 10am LA time on May 10th (when the final exam for this course is scheduled to end). Instead, a score of 0 will be assigned for this assignment.

Lecture schedule (subject to some change depending on class interest):

Date	#	Topic	Reading*
Jan 11 (Tu)	1	Getting a perspective: views from Antiquity & Renaissance	Preface, Ch. 1
Jan 13 (Th)	2	How microscopes and the cell theory changed everything	Ch. 2
Jan 18 (Tu)	3	How the nervous system (NS) evolved: simple animals	Ch. 3
Jan 20 (Th)	4	Vertebrate evolution and early development: the basic plan	Ch. 4
Jan 25 (Tu)	5	Early development of CNS parts: simple & clear	Ch. 5
Jan 27 (Th)	6	Development of the peripheral nervous system (PNS)	Ch. 6 to p. 94
Feb 1 (Tu)	7	Cellular development of spinal cord and brain	Ch. 6 to p. 103
Feb 3 (Th)	8	Lessons from development: architectural principles	Ch. 6 finish
Feb 8 (Tu)	9	Imaging the living human brain	MRI Wikipedia
Feb 10 (Th)	10	Conceptual framework for systems neuroscience	Ch. 7
Feb 15 (Tu)	11	The motor system: types of responses produced by the NS	Ch. 8 to p. 148
Feb 17 (Th)	12	Somatic motor system: motor hierarchy & motivation	Ch. 8 pp. 148-56
Feb 22 (Tu)	13	Somatic motor system: circuit analysis methodology	Ch. 8 pp 156-62
Feb 24 (Th)	14	The autonomic motor system: control of bodily functions	Ch. 8 pp. 162-67
Mar 1 (Tu)	15	The neuroendocrine motor system: master gland (pituitary)	Ch. 8 pp. 167-71
Mar 3 (Th)	16	Neuroendocrine motor system: stress & reproduction	Ch. 8 pp. 167-71
Mar 8 (Tu)	17	Somatic motor system: motor learning & cerebellum	Ch. 8 pp. 171-81
Mar 10 (Th)	18	The behavioral state system: circadian rhythms	Ch. 9 to p. 189
Mar 15 (Tu)	SPRING BREAK		
Mar 17 (Th)	SPRING BREAK		
Mar 22 (Tu)	19	Behavioral state system: sleep & reproductive rhythms	Ch. 9 finish
Mar 24 (Th)	20	The cognitive system: thinking & voluntary behavior	Ch. 10 to p. 212
Mar 29 (Tu)	21	Cognitive system: the cerebral cortex, layers & cell types	Ch. 10 pp.212-18
Mar 31 (Th)	22	Cognitive system: the cerebral cortex, circuitry; c. nuclei	Ch. 10 pp. 218-end
Apr 5 (Tu)	23	The sensory system: introduction	Ch. 11 to p. 242
Apr 7 (Th)	24	Sensory system: vision	Ch. 11 pp 242-47
Apr 12 (Tu)	25	Sensory system: hearing	Ch. 11 pp 242-47
Apr 14 (Th)	26	Sensory system: smell and taste	Ch. 11 pp 242-47
Apr 19 (Tu)	27	Sensory system: touch; pain & pleasure; mood & emotion	Ch. 11 pp 247-55
Apr 21 (Th)	28	Modifying architecture: learning, stress, & damage repair	Ch. 12
April 26 (Tu)	29	Genome and connectome	Ch. 13
April 29 (Tu)	30	Getting a perspective: wrap up	Preface, Ch. 1

May 10 (Tu 10am) *Final paper due: NO EXCEPTIONS ON SUBMISSION TIME (PLAN AHEAD!)*

*Pages listed for *Brain Architecture, 2nd Edition (1st Edition doesn't work—don't use!)*; plus assigned research article (see Blackboard announcements).

Statement on Academic Conduct and Support Systems (Check Blackboard for most recent version)

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 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.htmlprovides 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 wi20ll be continued by means of blackboard, teleconferencing, and other technology.