Mammalian Neurobiology
PSY 531
Spring 2021

Time:	Thurs 4:30-7.10pm
Room:	Online/Zoom
Instructor:	James Thompson
	Room 2056
	David King Hall
	email: jthompz@gmu.edu tel: 703-993-9356

Office Hours: Thurs 3.00pm – 4.00pm or by appointment (email only)

Required Readings:
Readings for this semester will consist of journal articles, and a couple of book chapters, that will be posted on Blackboard. There will usually be three articles per week to read, and students are expected to read all three each week ahead of class.

Additional Readings (NOT REQUIRED)
Blumenfeld H (2018). Neuroanatomy through Clinical Cases. 2nd edition. Oxford (in bookstore)
Kandel et al (2013) Principles of Neural Science. 5th edition. McGraw-Hill (not many available)
DeArmond et al (1989) The Structure of the Human Brain 3rd Edition. Oxford

Objectives: The objective of this class is to provide knowledge about the anatomy and function of the mammalian (especially human) central nervous system. We will take a systems neuroscience perspective to understanding brain anatomy and function: we will place particular emphasis on the way that nuclei and regions interconnect and work together in the service of function. The course will provide a detailed look at different sensory, motor, cognitive, and regulatory systems, including a detailed examination of the anatomy and physiology of key regions/nuclei, and connections between structures, that comprise these systems. At the end of this course I hope you will have gained the following:

1. Knowledge of the gross anatomy of the human brain

2. Be able to identify the major anatomical structures and pathways that comprise sensory, motor, cognitive, and regulatory systems

3. An understanding of the relationship between brain structure and function

Class Format: This course will consist of video lectures that I will post each week and a weekly, Zoom-based seminar. Each week I will post several questions related to each of the readings. During each zoom class, I will assign you to small breakout groups (2-3 people) to discuss ***one*** question from ***each*** the papers (so, for most weeks this will mean three questions in total for

each small group). One of you in each group will act as the scribe and will be tasked with integrating the group's answers into a couple of powerpoint slides/paper. We will then come back together as a group and discuss the papers and each groups' slides.

As many of the concepts that will be covered may be new to most of you, I expect everyone to have read the assigned papers before the class. A willingness and ability to do extensive research outside the assigned reading, seek assistance if you are finding any area difficult, and participate in class discussion, is essential.

Assessment: Assessment will consist of weekly in-class participation (56%), and a take home, open book final exam with items very similar to those covered in the weekly assignments (44%).

Technology: Zoom, Blackboard, and videos will be used to present class materials. Materials will be distributed via email, in class, and via Blackboard. You will also need to have powerpoint or similar software for presentations. LibreOffice is a free alternative to powerpoint.

Important Dates: Last day to add: Feb 1. Last day to drop Feb 16. No Spring break.

Grades: A (100-90); B (89-80); C (79-70); D (69-60); F (below 59)

Attendance: While you will not be graded on attendance, this is a graduate-level course and you are expected to attend zoom meetings each week in order to complete in class participation requirements.

Honor Code: All exams must follow the guidelines of the GMU Honor Code. George Mason University has an Honor Code, which requires all members of this community to maintain the highest standards of academic honesty and integrity. Cheating, plagiarism, lying, and stealing are all prohibited. All violations of the Honor Code will be reported to the Honor Committee. See honorcode.gmu.edu for more detailed information. Students may consult with other students and use books, notes, and other sources in preparing for exams. However, when taking exams, no books, notes, or student interaction will be allowed. Cheating and plagiarism of any sort will not be tolerated.

Students with Disabilities: If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center C(DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

Access to Computers
Students must have access to their GMU Email account. Students should feel free to communicate with me via email. Updates and notifications will be sent to the class email list using your GMU email address. If you need to use university facilities, you can find out about location and hours of university facilities at http://www.labs.gmu.edu/ or ask at the information

desk at the Johnson Center. I will ONLY use your GMU Email address to contact you. Please use and check this address frequently. You may forward your GMU email to another address if you like, but please ensure that you are receiving the email to your GMU Email address.

Cancellation Policy In case class needs to be canceled due to an unexpected event, students will be informed via email as soon as possible. Make-up sessions will be arranged for canceled classes.

SCHEDULE

Jan 28 **Introductions, Theories of Brain Organization**
Mesulam, MM. (1998). From sensation to cognition. Brain, 121, 1013–1052

Giaccio, RG (2006). The dual origin hypothesis: An evolutionary brain-behavior framework for analyzing psychiatric disorders. Neuroscience and Biobehavioral Reviews, 30, 526–550.

Feb 4 **Neural Circuits**
Mountcastle, VB. (1997). The columnar organization of the neocortex. Brain, 120, 701–722.

Harris, KD. & Shepherd, GMG. (2015). The neocortical circuit: themes and variations. Nature Neuroscience, 18, 170-181.

Halassa, MM. & Haydon, PG (2010). Integrated Brain Circuits: Astrocytic Networks Modulate Neuronal Activity and Behavior. Annual Review of Physiology, 72,335–55

Feb 11 **Visual System**
Hubel, DH. & Wiesel, TN. (1977). Ferrier Lecture: Functional architecture of macaque monkey visual cortex. Processings of the Royal Society, London, B. 198, 1-59 (focus on pages 1-43).

Ungerleider, LG. & Mishkin M. (1982). Two cortical visual systems. In DJ Ingle, MA Goodale, RJW Mansfield (eds) Analysis of visual behavior. 549-586.

Nassi, JJ. & Callaway, EM. (2009). Parallel processing strategies of the primate visual system. Nature Reviews Neuroscience. 10, 360-372.

Feb 18 **Auditory System**
Oertel D. (1999). The role of timing in the brain stem auditory nuclei of vertebrates. Annual Review of Physiology. 61, 497-519.

Brainard MS. (1994). Neural substrates of sound localization. Current Opinion in Neurobiology. 4, 557-562

Brewer AA. & Barton B. (2016). Maps of Auditory Cortex. Annual Review of Neuroscience. 39, 385-407**.**

Feb 25 **Somatosensory System**

Johnson KO. (2001). The roles and functions of cutaneous mechanoreceptors. Current Opinion in Neurobiology. 11, 455-461.

Willis WD. (2007). The somatosensory system, with emphasis on structures important for pain. Brain Research Reviews. 55, 297–313.

Kaas JH, Nelson RJ, Sur M, Merzenich MM. (1979). Multiple Representations of the Body Within the Primary Somatosensory Cortex of Primates. Science. 204, 521-523.

Mar 4 **Smell & Taste**

Sullivan SL, Ressler, KJ, & Buck LB. (1995). Spatial patterning and information coding in the olfactory system. Current Opinion in Genetics and Development, 5, 516-523.

Chandrashekar J, Hoon MA, Ryba NJ, Zuker CS. (2006). The receptors and cells for mammalian taste. Nature. 444, 288-294.

Peng Y, Gillis-Smith S, Jin H, Trankner D, Ryba NJ, Zuker CS. (2015). Sweet and bitter taste in the brain of awake behaving animals. Nature. 527, 512-515.

Mar 11 **Motor Systems**

Lemon R. (2008). Descending pathways in motor control. Annual Review of Neuroscience. 31, 195-218.

Latash ML. (2010). Motor synergies and the equilibrium-point hypothesis. Motor Control. 14, 294-322.

Rizzolatti G. & Luppino G. (2001). The cortical motor sysem. Neuron. 31, 889-901.

Mar 18 **Prefrontal Systems**

Ongur D, & Price JL (2000). The Organization of Networks within the Orbital and Medial Prefrontal Cortex of Rats, Monkeys and Humans. Cerebral Cortex. 10, 206-219.

Petrides M. & Pandya DN. (2001). Comparative cytoarchitectonic analysis of the human and the macaque ventrolateral prefrontal cortex and corticocortical connection patterns in the monkey. European Journal of Neuroscience. 16, 291-310.

Petrides M. & Pandya DN. (1999). Dorsolateral prefrontal cortex: comparative cytoarchitectonic analysis in the human and the macaque brain and

corticocortical connection patterns. European Journal of Neuroscience. 11, 1011-1036.

Mar 25 **Parietal Systems**

Lewis JW, Van Essen DC. (2000). Corticocortical Connections of Visual, Sensorimotor, and Multimodal Processing Areas in the Parietal Lobe of the Macaque Monkey. Journal of Comparative Neurology. 428, 112-137.

Andersen RA. & Buneo RA. (2002). Intentional maps in posterior parietal cortex. Annual Review of Neuroscience. 25, 189-220**.**

Apr 1 **Cerebellum and basal ganglia**

Ramnani N. (2006). The primate cortico-cerebellar system: anatomy and function. Nature Reviews Neuroscience. 7, 511-522

Bostan AC. & Strick PL. (2018). The basal ganglia and the cerebellum: nodes in an integrated network. 19, 338-350

Alexander GE, DeLong MR, & Strick PL (1986). Parallel organization of functionally segregated circuits linking basal ganglia and cortex. Annual Review of Neuroscience. 9, 357-381.

Apr 8 **Amygdala and hippocampus**

Sah P, Faber ESL, Lopez de Armentia M, Power J (2003). The Amygdaloid Complex: Anatomy and Physiology. Physiological Review. 83, 803-834.

Amaral DG. (1993). Emerging principles of intrinsic hippocampal organization. Current Opinion in Neurobiology. 3, 225-229.

Moser EI, Kropff E, Moser M-B. (2008). Place cells, grid cells, and the brain's spatial representation system. Annual Review of Neuroscience. 31, 69-89.

Apr 15 **Thalamus and neuromodulation**

Halassa MM. & Sherman SM. (2019). Thalamocortical Circuit Motifs: A General Framework. Neuron. 4, 762-770

Poe GR, Foote S, Eschenko O, Johansen, JP, Bouret S, Aston-Jones G, Harley CW, Manahan-Vaughan D, Weinshenker D, Valentino R, Berridge C, Chandler DJ, Waterhouse, & Sara SJ (2020). Locus coeruleus: a new look at the blue spot. Nature Reviews Neuroscience. 21, 644-659.

Blumenfeld (2018) Ch7 pp 282-287; Ch 14 pp 630-640;

Apr 22	**Spine and brainstem** Marder E & Blocher D. (2001). Central pattern generators and the control of rhythmic behavior. Current Biology. 11, 986-996 Pearson KG (2000). Neural adaptation in the generation of rhythmic behavior. Annual Review of Physiology. 62, 723-753. Blumenfeld (2018) Ch6 pp 224-240; Ch 8 pp 321-327; Ch 12 pp 494-538
Apr 29	**Hypothalamus** Guyunet PG (2006). The sympathetic control of blood pressure. Nature Reviews Neuroscience. 7, 335-346. Blumenfeld (2018) Ch17 pp 791-797
May 3	Take home final exam distributed
May 10	Take home final exam due