

PSYCHOLOGY 209H
BRAIN AND BEHAVIOR
Fall Semester, 2019
Tuesdays and Thursdays, 8:30 – 9:50 am
Room 119 Psychology Building

Instructor: Antonio Nunez Ph.D.
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office hours: by appointment

Text: THE MIND'S MACHINE: FOUNDATIONS OF BRAIN AND BEHAVIOR, BY NV
WATSON AND SM BREEDLOVE; SINAUER PRESS (3RD EDITION)

Course Objectives:

To become familiar with contemporary principles of Neuroscience and to prepare for advanced courses in the areas of Cognitive and Behavioral Neuroscience.

To develop skills for working in teams and communicating scientific findings to general audiences.

Class meetings: Reading assignments from **THE MIND'S MACHINE** are given in the class schedule (below). In class, we will elaborate on the reading assignments using a combination of lecture and class/group discussion. You are expected to have completed the reading assignments **before** coming to class so that you can participate actively in the discussion (see class schedule for target dates for completing the readings). Attending all class meetings is a non-negotiable expectation; notify the instructor in advance of any anticipated schedule conflicts.

Group Projects (20% of your grade): Groups of 4 or 5 members will be formed early in the semester and each group will select a chapter from the text book and update its content by bringing in new information that was not available to the authors at the time the book was written. These updates will be presented by the groups to the class on November 21st and 26th (see class schedule below). For this component of your grade, 15 % will come from the actual presentation, and 5% will be based on completion of "pre-presentation" products, stemming from group activities scheduled for **September 24th and October 22nd** (more details below). The length of the presentation must not exceed 25 minutes to permit some questions/discussion.

Exams (80% of your grade): There will be four exams in this course (see class schedule below). Each exam will test your knowledge and comprehension of material covered

since the last exam. Exams will be a combination of multiple choice and short-answer essay questions, which will be based on the text, lectures, and discussions. **In the event that a request for a make-up exam is approved, it will be substantially different from the in-class exam and it will be administered during the time scheduled for the final exam of this class, which is December 10, 8:30 am (see class schedule below).**

Grading: You will have an opportunity to earn 200 points in this course. 80 % can be earned on exams. The remaining 20 % will be based on the group presentations and related work. Final course grades will be determined according to a standard grading scale:
≥90% =4.0, 85-89% =3.5, 80-84% =3.0, 75-79%= 2.5, 70-74% = 2.0 etc.

SCHEDULE OF CLASSES and READINGS:

August 29- September 5 -- Introduction Ch.1 (read by 9/4)

September 10-19 -- Foundations I: Ch. 2 (read by 9/9) & 3 (read by 9/17)

September 24– Review/Group work

September 26th: Exam 1 (20%)

September 24th: Class time devoted to working on group presentations – A finalized statement of the scope of the presentation is due on October 1 (2%)

October 1st– 10 Foundations II: Ch. 4 (read by 10/3) & 5 (read by 10/8)

October 15– Review

October 17th: Exam 2 (20%)

October 22nd: Class time devoted to working on group presentations – Product of the meeting: A sentence outline of the presentation with at least one key reference, due the next class meeting (October 24th --- 3%)

October 24 – 31st – Hormones and Behavior; Homeostasis; Rhythms: Ch. 8 (read by 10/23) 9 (read by 10/25) & 10 (read by 10/30)

November 5 – Review

November 7th: Exam 3 (20%)

November 12—19– Cognitive Neuroscience: Ch. 13 (read by 11/11) & 14 (read by 11/19)

November 21st and 26th: CLASS PRESENTATIONS, One-page Summaries and Accountability Statements (15%)

December 3 Review

December 5th: Exam 4 (20 %)

Thursday December 10, 8:30 am: time reserved for make-up exams for all 4 exams.

Group Presentations of Chapters' Updates:

Format of the Presentation:

Here each group has the freedom and opportunity to explore different ways to present your updates. Possibilities include, but are not limited to: PowerPoint, videos, class exercises, inviting and interviewing a local expert in front of the class or on video.

Sources of Information for the updates:

Here again there are many ways to go. Using the peer-reviewed literature is probably the most reliable approach, but keep in mind that MSU is home for many world-class neuroscientists, and using them as sources is perfectly appropriate.

What you have to provide in addition to the actual presentation:

Content: A one-page summary of the highlights of the updates with references (including personal communications) to support your claims is due the day of the presentation, and copies will be distributed to all class participants. Even if there are several updates provided by the group, a single one-page summary is expected from each group.

Accountability: A summary detailing the particular contributions of each group member is due the day of the presentation. **This statement needs to be approved and signed by all group members.** The description could be individualized or the statement could read: "All group members contributed equally to the group project"

Group dynamics:

In addition to the group projects, the groups that we form at the beginning of the semester will be used for other class activities.

Study Questions for Each Exam

Foundations 1 (Exam one)

What is the "*neuron doctrine*" why is it call also "*Cajal's doctrine*"?

What is the functional link with respect to neuronal morphology? (i.e., multipolar, bipolar and unipolar)

What is a synapse? How are they related to dendritic spines?

Name three types of glial cells

What is the functional deficit associated with myelin degeneration?

How does immunocytochemistry works?

Name two methods used to determine neural activity in the human brain. What are some limitations of these methods?

What is the difference between the central and the peripheral nervous systems?

What is the primary role of the basal ganglia?

What is known as the limbic system? And why is that label of limited use in contemporary neuroscience?

What is the ventricular system?

Contrast the functions of the sympathetic and parasympathetic systems?

What is the distribution of ions inside vs outside the membrane at the resting potential of a neuron?

What happens to the membrane potential if Na⁺ ions enter the cell?

What is meant by the equilibrium potential for K⁺ ions?

What determines the threshold for excitation?

What is meant by hyperpolarizing and depolarizing stimuli?

Explain the role of voltage-gated Na⁺ channels in the mediation of an action potential.

What is saltatory conduction?

What are the mechanisms responsible for an IPSP or an EPSP?

Differentiate between axo-axonic and axo-dendritic synapses.

What are the steps in the transmission at a chemical synapse? What is the role of Ca⁺⁺?

Foundations 2 (Exam two)

Differentiate between ionic and metabotropic receptors.

Differentiate between agonists and antagonists agents for chemical synapses.

Describe three ways in which a drug could enhance synaptic transmission.

Describe three ways in which a drug could inhibit or reduce synaptic efficacy.

Differentiate between pre- and post-synaptic effects of drugs

What is the primary function of GABA?

What is the primary function of glutamate?

Identify four major chemical systems of the brain

What are neuromodulators?

What are endogenous opiates?

What are Brodmann's areas?

Why is isocortex a better term to use to describe the "*neocortex*"?

What is meant by the **what and where** of the visual system? What is meant by binding in that context?

What is the relationship between Papez' circuit and the limbic system?

What chemical system of the brain plays a key role in reward and addiction?

What is the relationship between the ventral tegmentum and the nucleus accumbens?

What is known as a receptive field? What is the functional significance of the size of sensory receptive fields?

Describe the levels of sensory processing from the periphery to the isocortex.

Describe areas of isocortex involved in sensory processing.

Describe areas of isocortex involved in motor control.

What are mirror neurons? What may be their function?

Describe the peripheral transduction of pain.

What are the ascending pathways for the pain system of the central nervous system?

What is known as the insular cortex?

What is the evidence that the brain processes physical and emotional warmth in similar fashion?

Hormones and Behavior, Homeostasis and Rhythms (Exam three)

Describe the mechanism of negative feedback that regulates the circulating levels of testosterone in male mammals. **note:** make reference to the pertinent hormones and components of this regulatory system.

Explain how testosterone could act as an estrogen.

Identify 4 regions of the mammalian brain where steroid hormone receptors are abundant

Differentiate between Motivation and Performance with respect to male sexual behavior.

Describe the circuitry involved in the control of the sexual behavior of male rats.

What are the effects of lesions of the medial preoptic area in males? What are some paradoxical effects of those lesions?

Differentiate and give examples of the **activational** and **organizational** effects of hormones

What behavioral tests are used to determine sexual motivation in female rats? What is known as female paced mating in rats?

What are clear differences between the regulation of sexual behavior in primate and non-primate female mammals?

What is the major finding of the work of Kim Wallen on the hormonal regulation of sex in female non-human primates? Are there data from women to support Wallen's conclusions?

How are hypovolemic and osmotic thirst induced? Where are the challenges associated with each type of thirst detected in the brain?

What is vasopressin? Where is it produced and where is it released into the general circulation?

What are the effects of vasopressin and why is it also called antidiuretic hormone?

What are circumventricular organs? What role do they play in water balance/thirst?

What is the renin-angiotensin system?

What are the functions of Angiotensin II?

What is aldosterone? Where is it produced? Where does it act?

What would be deficient, but not completely absent, with respect to fluid balance in an animal lacking a functional sub-fornical organ?

What would be the consequences of a lesion in the lateral preoptic area?

What are baroreceptors? Where are they found? What is their role in fluid balance?

What is glucoprivic hunger? What drug is used to induce it? Where is this metabolic challenge detected?

What is lipoprivic hunger? What drug is used to induce it? Where is this metabolic challenge detected?

What are the metabolic deficits of animals that become obese after VMH lesions?

What is leptin? Where is it produced? Which hypothalamic neurons are excited by leptin? Which ones are inhibited by leptin?

What is the melanocortin system? What neurotransmitter excites these neurons? Which one inhibits them?

What are the roles of ghrelin and PYY 3-36 in the regulation of hunger?

What is CCK? What is its role in energy balance? How is its presence detected by the brain?

Differentiate: ultradian, circadian and infradian rhythms and give an example of each.

What is different between photoperiod-dependent seasonal cycles and circannual rhythms? Give an example of each.

What is the suprachiasmatic nucleus? What is the evidence to claim that it contains a circadian oscillator?

Explain Rae Silver's experiment with transplants of the suprachiasmatic nucleus.
 What are clock genes and what are clock controlled genes?
 What are extra-SCN oscillators? How do they differ from the SCN oscillator?
 What is the evidence to claim that there is a food-entrainable oscillator independent of the SCN?
 Identify similarities and differences in the circadian system of diurnal and nocturnal mammals.
 Describe the circuit that mediates the effects of light on the production of pineal melatonin.
 Describe the EEG patterns associated with the different sleep stages.
 What are PGO waves and what is muscle atonia? When are these seen during sleep?
 What are the components of the Reticular Formation?
 Across sleep stages, what is the pattern of activity of the LC, Raphe, Tuberomammillary nuclei, and the Ach systems of the LDT and PPT?
 What is the role of the IL thalamus during sleep and wakefulness?
 What is the orexin system?
 What is the role of the VLPO in sleep? How is it different from that of the median pre-optic area?
 What is adenosine? What is the role of adenosine receptors? What is the relation between adenosine and sleep pressure?

Cognitive Neuroscience (Exam four)

Describe the case of H. M. in reference to the surgical procedure and the postsurgical deficits and preserved abilities.
 Differentiate: working memory, short-term memory and long-term memory
 Differentiate: **Declarative vs. Procedural** memory
 Differentiate: **Semantic vs Episodic** memory
 What is the delay-not matching-to sample test? Why was this a significant development in comparative cognitive neuroscience? What part of the brain is essential for normal performance of this task?
 What is a radial maze and what is the difference between the win-stay and win-shift versions of this task?
 What is the Morris Water Maze? How can this be used to test either hippocampal –dependent and hippocampal-independent learning?
 What are place cells?
 What is the evidence from animal studies that the hippocampus is essential for memories about the temporal sequence of events?
 What is meant by relational learning?
 What is the role of the hippocampus in fear conditioning?
 What part of the brain mediates procedural learning and memory?
 What was the idea of a cognitive map introduced by Tolman?
 Differentiate: Overt attention vs. covert attention.
 What is known as the “cocktail party effect”?
 Differentiate between endogenous and exogenous attention
 Describe the eye to finger circuit engaged in reaction time for visual stimuli
 Explain the results of experiments that improve performance by shifting endogenous attention
 Explain the results of experiments showing the effects of peripheral spatial cuing
 What is meant by inhibition of return?
 Describe the subcortical system/circuit involved in directing visual attention
 Describe the isocortical system that mediates reflexive shifts of attention
 What is known as the binding problem in visual perception?

What is the evidence to claim that our brains decide what to do before we are conscious of the decision?

What is known as executive function? What part of the isocortex is important for normal executive function in humans?

Time Table: Important Dates

September 26th: Exam 1 (40 points; 20%)

October 3rd: Statement of the scope of the group presentation due (4 points; 2%)

October 17th: Exam 2 (40 points; 20%)

October 24th: Sentence outline and one reference for the group presentation due (6 points; 3%)

November 7th: Exam 3 (40 points; 20%)

November 21st or 26th: Class presentations, one-page summaries and accountability statements due (30 points; 15%).

December 5th: Exam 4 (40 points; 20%)

Total: 200 points (100%)

December 10th, 8:30 am 119 Psychology Building (Make-up exams)