AUG 28,30
OVERVIEW OF THE COURSE.
THERE ARE SEVERAL TYPES OF LONG-TERM MEMORY, AND THEY DEPEND ON DIFFERENT BRAIN REGIONS
Memories lost and spared in an amnesic patient, H.M. Two types of long-term memory, procedural and declarative, show differential sparing in amnesiacs. Short-term memory is retained. Squire’s model of memory.
A monkey model of temporal lobe amnesia, Mishkin and Squire's lesion experiments.
Readings:
Introduction and Chapter 1 from Notes.
(Milner, Squire, Kandel, 1998)
On the web download H.M’s brain… (NPR), Brain of the most studied… (SD), H.M. an unforgettable Amnesiac (NY Times).

SEP 4,6
RELATIVE CONTRIBUTIONS OF HIPPOCAMPUS AND OVERLYING CORTEX TO LONG-TERM MEMORY
Memory in children with hippocampal damage.
Clive Wearing, a modern H.M.
The hippocampus is important in episodic memories.
Readings:
Chapter 2, (5) from Notes.

SEP 11,13
THE HIPPOCAMPUS AND SPATIAL MEMORIES
IMAGING
The hippocampus is important in spatial memories. Morris water maze.
Films of John and Clive Wearing
Readings:
Chapter 5: MM Ch 2.II; Ch 6.


SEP 18, 20
THE ROLE OF THE CEREBELLUM AND BASAL GANGLIA IN MEMORY, SEARCH FOR THE ENGRAM
Lashley's and Penfield's work.
Classical conditioning in rabbits and humans.
The basal ganglia may provide a “back up” system.
Readings:
Chapter 4: MM Ch 2.III
(Snowden et al, 1997)
Topics for Student presentations due

SEP 25, 27
EMOTIONAL MEMORIES, ROLE OF THE AMYGDALA & HIPPOCAMPUS.
METHODS OF ANIMAL RESEARCH
The amygdala is important in emotional memories. Some memories must be actively extinguished. The prefrontal lobe inhibits the amygdala. (LTP) Reconsolidation.
Fear conditioning in animals.
The Morris Water maze, Place cells, Novel Object recognition, Fear conditioning, etc.
Readings
Chapter 3: MM Ch 4; 5. II
Calendar for student presentations

OCT 2, 4
ROLE OF THE FRONTAL LOBES
The frontal lobes are largest in humans. They are responsible for some forms of memory and affect others.
Readings:
Chapter 6: MM Ch 1.II B, C

OCT 11
Monday Oct 8, is a holiday, Monday classes are held on Tuesday, there will be no class on the 11th.
STRESS MAY IMPAIR MEMORY PROCESSES
Readings

OCT 16,18  SFN
HUMAN MEMORY DEFICITS
Readings
Chapter 7.
Oct 16, no class.
Oct 18, Memory impairments in alcoholism, Michael Anderson, guest lecturer.

OCT 23, 25 HUMAN MEMORY DEFICITS, REVIEW
Alzheimer's disease, interaction with stroke
Readings:
Chapter 7: MM Ch12.

OCT 30, NOV 1
EXAM OCT 30 th
LEARNING INVOLVES STRENGTHENING SYNAPTIC CONNECTIONS.
Some types of learning can be studied in simple animals. *Aplysia Californica* show habituation dishabituation, sensitization and classical conditioning, which model non-declarative learning in humans.
Higher order conditioning in invertebrates, *Hermisenda* and *drosophila*.

Readings:
Chapters 8, (9): MM Ch 3.III

NOV 6, 8
SHORT-TERM MEMORY. FROM SHORT-TERM TO LONG-TERM MEMORY.
Chemical pathways associated with learning and memory were discovered in *A. californica* and *Drosophila*; second messenger systems. Morphological changes are seen with long-term learning, which requires protein synthesis i.e. gene expression is changed when long-term memories are formed.

Readings:
Chapter 10, 11: MM Ch 3, IV, V, VI

Student presentations begin

NOV 13, 15
FROM SHORT-TERM TO LONG-TERM MEMORY, CREB, A MASTER SWITCH, LEARNING IN DROSOPHILA
Mechanisms of long-term memory are conserved in long term memory across species.
Readings
Chapters 11, 12, MM Ch 10.LLL.
Frank and Greenberg. CREB: a mediator of long-term memory from mollusks to mammals. Cell. 79:5-8. 1994
(Time, Love Memory; Weiner, 1999. Chapters 10, 16)
(The Pursuit of Memory. (chaps 16-19); Kandel, 2007, Chap 19)

NOV 20
NEURONAL CHANGES ASSOCIATED WITH LEARNING IN THE MAMMALIAN BRAIN.
THANKSGIVING
Long term potentiation (LTP) in the hippocampus, a Hebbian synapse. Role of the
different glutamate receptors.
Hebbian synapses in *Aplysia*
Readings:
Chapter 13: MM Ch 7, 8, 9, 10.II
Baer et al., Discovering LTP. In *Neuroscience.*

NOV 27, 29
LTP CONTINUED.
DUMB FLIES AND SMART MICE
Genetic manipulations can change how animals learn; drosophila and knock-out mice. The environment interacts with the genome. Implications for human memory. The brain is most plastic during neo-natal sensitive periods in order to fine-tune the brain.
However, neurogenesis also takes place in the adult mammalian brain.
Readings:
Chapter 13,14. MM Ch 10.IV

DEC 6, 8
NEUROGENESIS AND LEARNING,

DEC 11 PAPERS DUE
DEC 14 TAKE HOME FINAL DUE.
Grading Policy:
35% midterm exam
35% final exam
7% presentation
8% paper (on the same topic as the presentation)
10% quizzes
5% recent paper
Office Hours: Tu 3-4, TH 4:30-5 DKH 2022
Call 993-4107 or 370-1406 for an appointment at other times.
E-MAIL jflinn@gmu.edu

Each student needs to give a presentation on a topic related to the field of learning and memory and to write a paper on the same topic. This should not be narrowly your MA/PhD topic. Undergraduate students should preferentially work in pairs (due to class size).

Graduate students should select 2 recent papers and undergraduates should select one paper (2011 or 2012) that presents recent work on a topic discussed in class. Please choose a topic after the 1st class. If you do not select topics, I will assign them.

There will be a quiz most weeks on one of the assigned papers.

The goal of this course is to examine the tremendous strides that have been made in understanding the biological bases of memory in the last 50 years. The first part of the course examines the role of various structures in the mammalian brain in memory formation and retention. The second part of the course describes the basic neuronal mechanisms that underlie learning and the formation of memories. This is covered extensively in the text Memory Mechanisms.

Students with disabilities should present documentation to me and appropriate arrangements will be made.

Readings are from class notes, from How We Remember and from assigned readings. Additional/alternative research articles may be assigned.

Strongly recommended for Graduate students, Memory mechanisms, D. Sweatt. Readings from this are indicated by MM.

Recommended (Get on Amazon)
Time, Love, Memory, by J. Weiner. 1999. Describes the early work on genetics and discusses the genetic bases of memory. (Chapters 10,16))
The Pursuit of Memory, E. Kandel. Kandel won the Nobel prize for his work on memory. This is his autobiography.
Forever Today. Wearing, D. (2005) The first few chapters read like a “true Romance” paperback. However, this book does make very clear the devastating consequences of damage to the hippocampus. Unfortunately the Mason bookstore cannot order it due to copyright issues, however you may obtain it via Amazon etc. At least 2 copies will be on reserve in the library.

Each of the last three books are worth reading in full and not expensive. Students are expected to follow the GMU Honor code.
Supplementary Readings:
Benton, The prefrontal region, its early history. In Levin et al. Frontal lobe function and dysfunction. (E reserves)


Goldman Rakic  Science paper


Raichle imaging paper


