

# Brain Areas involved in Different Types of Memory

*Jeanette J. Norden, Ph.D.*

*Professor Emerita*

*Vanderbilt University School of Medicine*

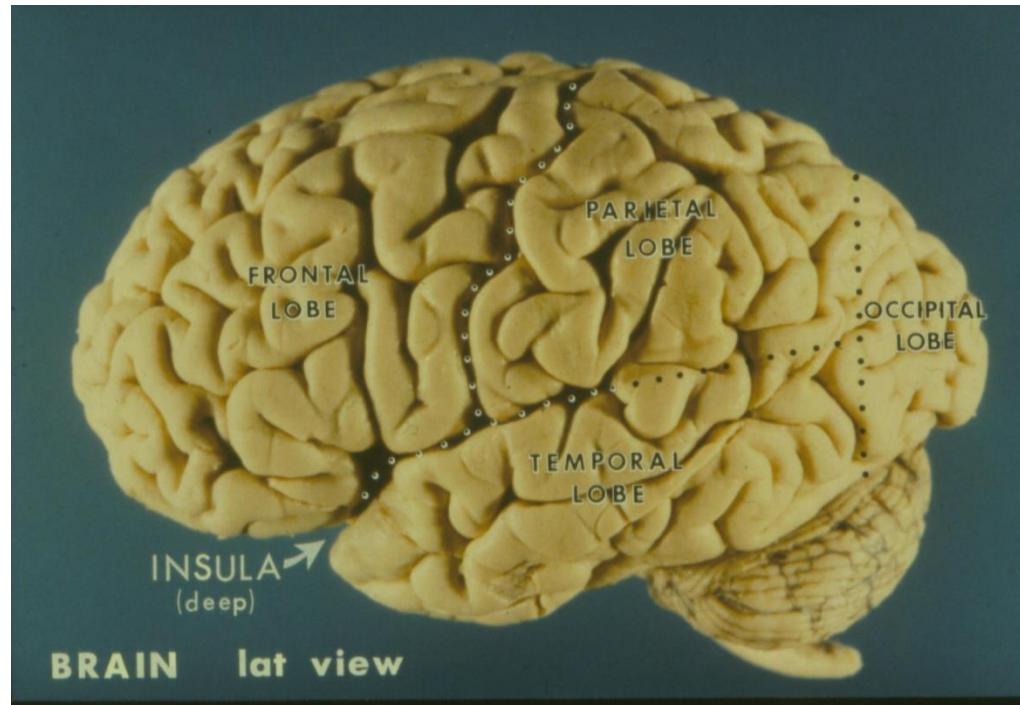
# REVIEW 😊

- Different areas of the brain control different functions; thus, damage to a given area causes a specific loss of function



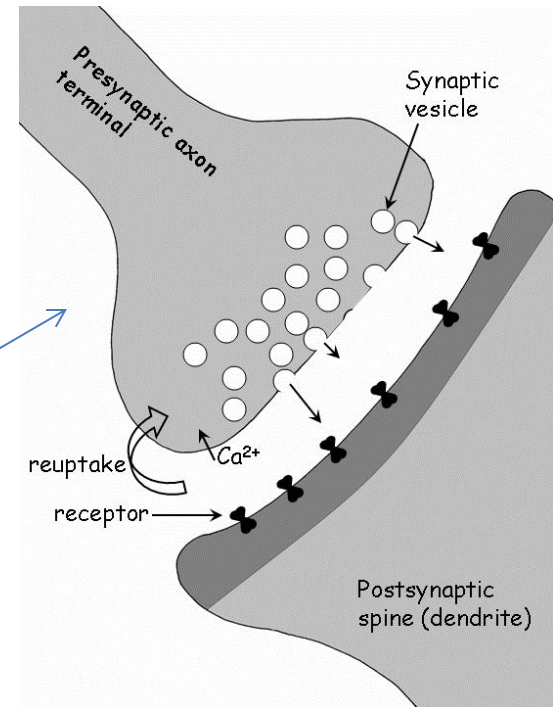
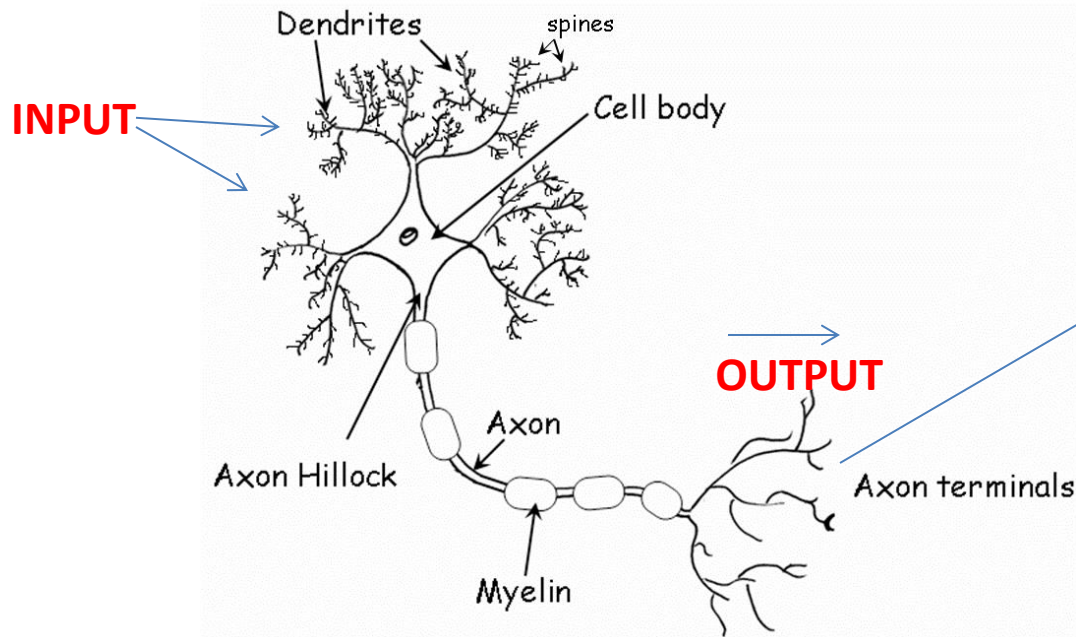
# REVIEW (😊)

- The cortex is involved in “higher-order” functioning, e.g., voluntary thought and movement and subjective experience



# REVIEW (😊)

- **Neurons** are the fundamental cell of the nervous system; neurons communicate with each other at **synapses**; communication is “electro-chemical”

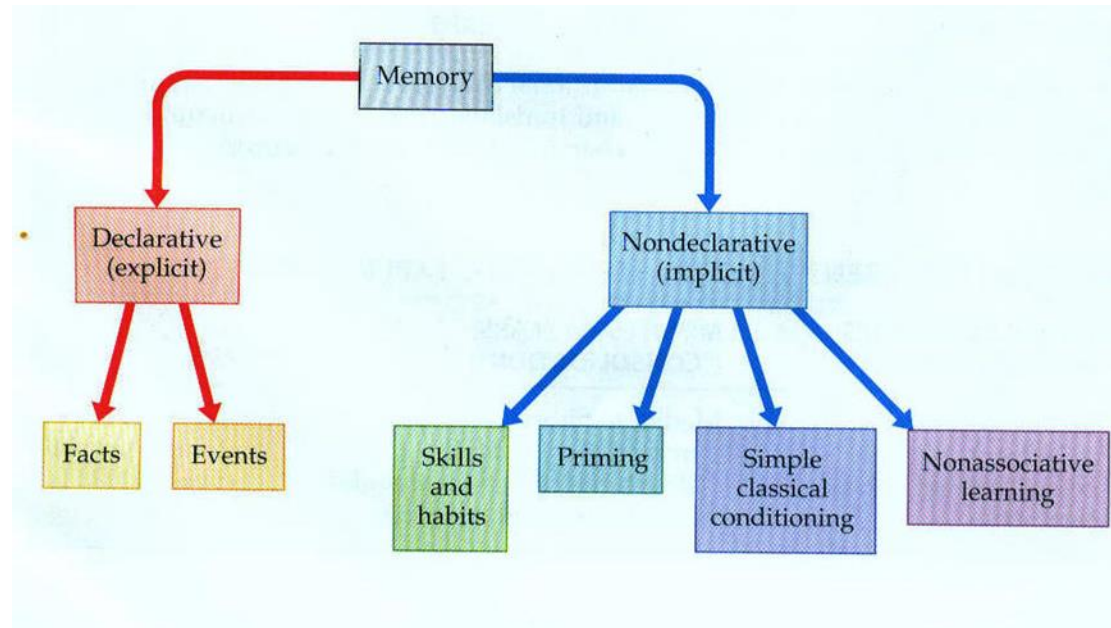


# Memory

- *There are many different types of memory*
- *Specific cortical (both old and new) and non-cortical areas process different types of memory – or different aspects of memory*
- *Learning and memory occur over time and involve many different individual events, for example attending, encoding (learning), and retrieving (the memory)*
- *All memory involves changes occurring as a result of experience (learning) that allow the organism to alter future behavior based on past experience*
- *Memory is not a snapshot of an event, but an electrically encoded representation*
- *Memory fails us in ways that tell us something about what it is and is not*

# ***There are many different types of memory***

- **Memory is generally divided into two broad categories: *explicit and implicit memory***



# ***Implicit or Non-Declarative Memory***

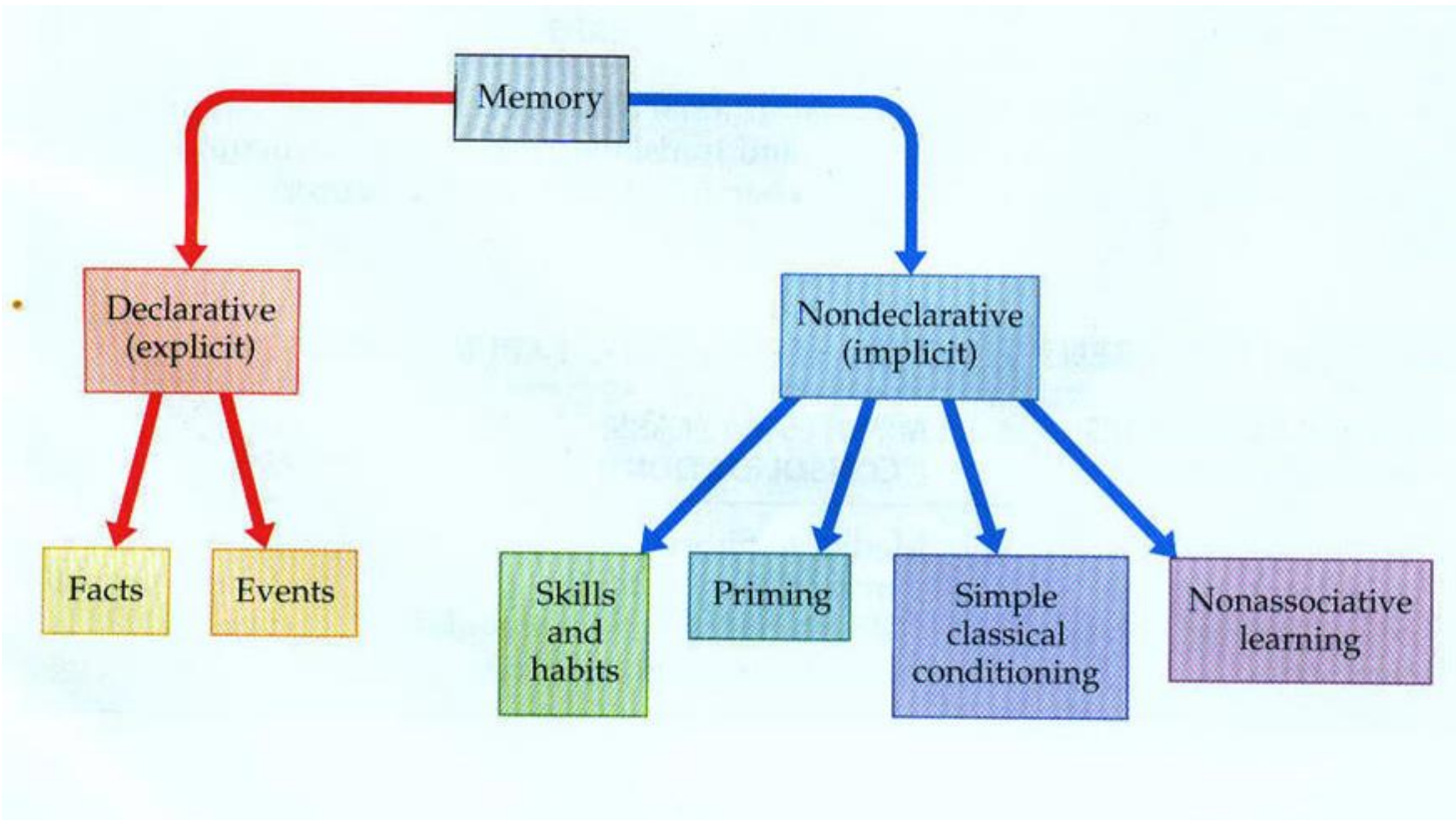
- **Memory for skills, habits and behaviors**
- **Operates without conscious awareness once learned**
- **Requires repetition and practice**
- **Less likely to be forgotten once learned**
- **Allows many types of behavior to be on “auto-pilot”**

***Many different brain areas play a role in implicit memory***

- **For example, nuclei deep in the hemisphere called the basal ganglia are involved in “motor” programs**
- **The cerebellum (“little cerebrum”) plays a critical role in the timing and execution of learned, skilled motor movement**



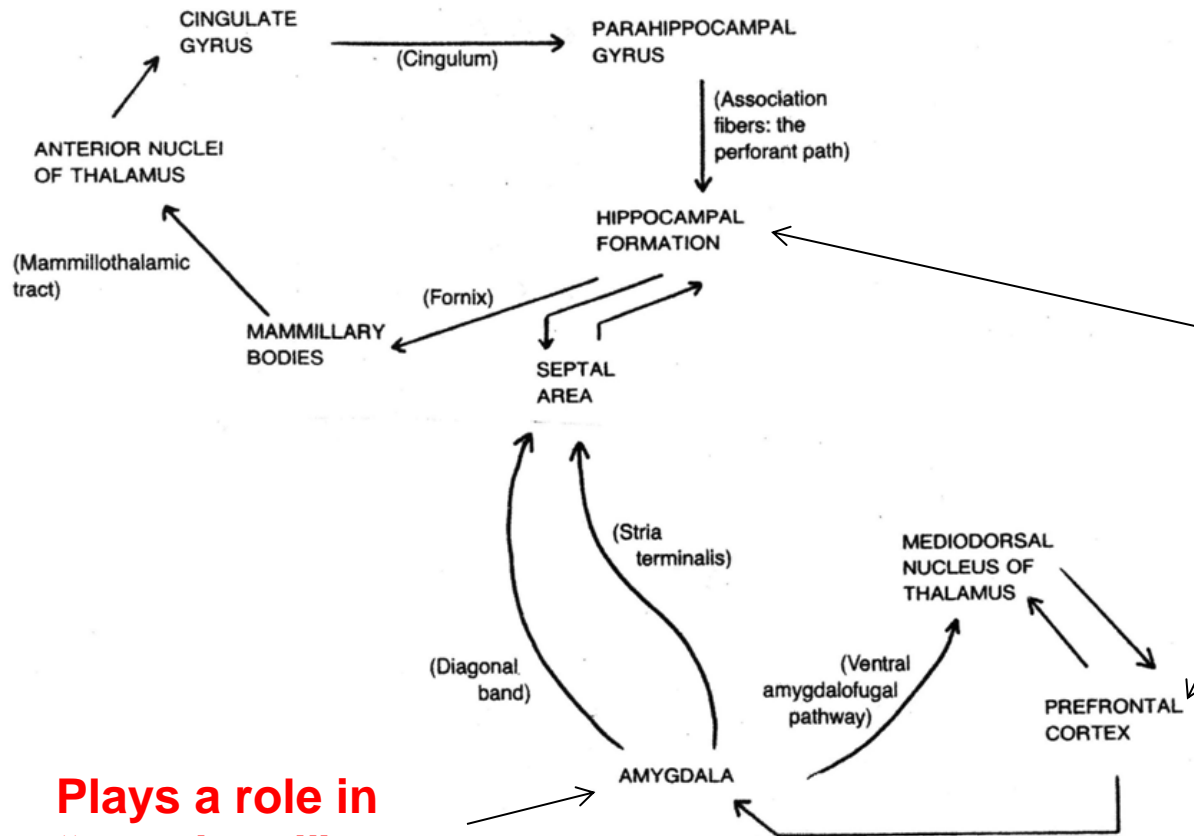
# Explicit Memory



## ***Explicit or Declarative Memory***

- Memory of “facts” or “events”; also “spatial” memory
- Can be consciously recalled
- Easy to acquire, easy to forget

# Many areas of the brain play a role in Explicit Memory (even more than shown below)



**Our focus will be on these 2 areas**

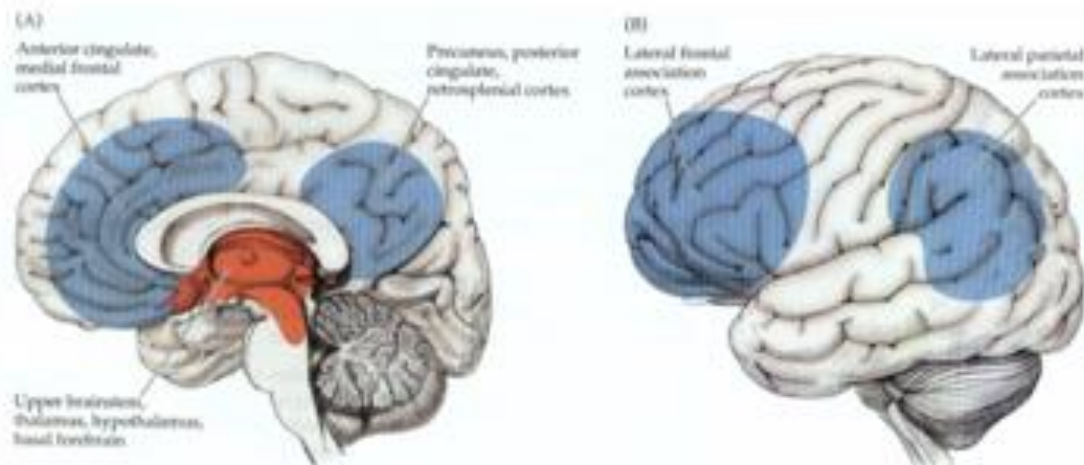
**Plays a role in "emotional" memory**

# ***Explicit Memory involves processing of information over time***

- **Time lines of memory**
  - *Less than a second: “attention to something”*
  - *Seconds to minutes: “working” memory*
  - *Minutes to years:*
    - *Short-term and Long-term memory*

- **Immediate Memory**

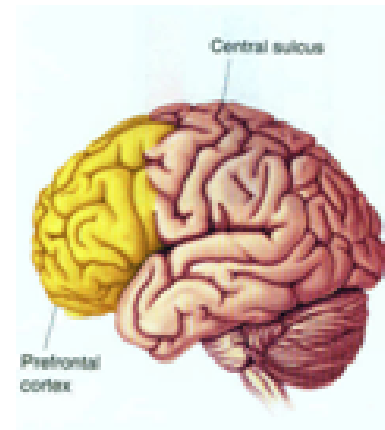
- Many different areas of the brain contribute to “attention”; these include cortical areas and also areas of the **reticular formation** – **all areas which contribute to “alertness, attention and awareness”**



Adapted from Blumenfeld, 2010

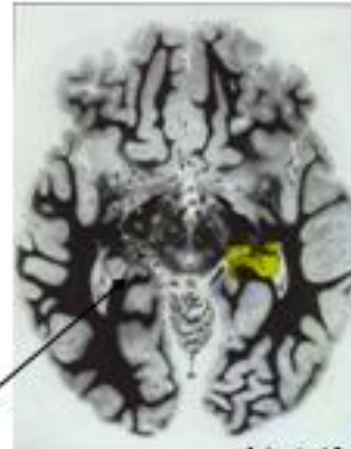
- **Working Memory**

- Temporary and vulnerable to disruption
- Very limited in capacity
- Ability to hold some piece of information in “mind” for a short period
- WM must constantly be “dumped”
- Selected for in terms of evolution because it confers great advantage for planning behavior, etc. WM was NOT selected for to allow us to remember phone numbers!
- Involves multiple areas primarily of the **Prefrontal Cortex**



- **Short-term Memory**

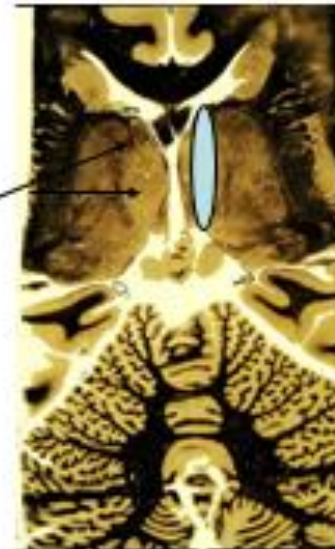
- What we used as “students”!  
(good and bad)
- Can potentially be consolidated into long-term memory
- Involves **medial temporal lobe structures**, like the hippocampus and **medial diencephalic structures**, as well as a few cortical areas



Adapted from Flix, 2008



Hippocampus or “little seahorse”



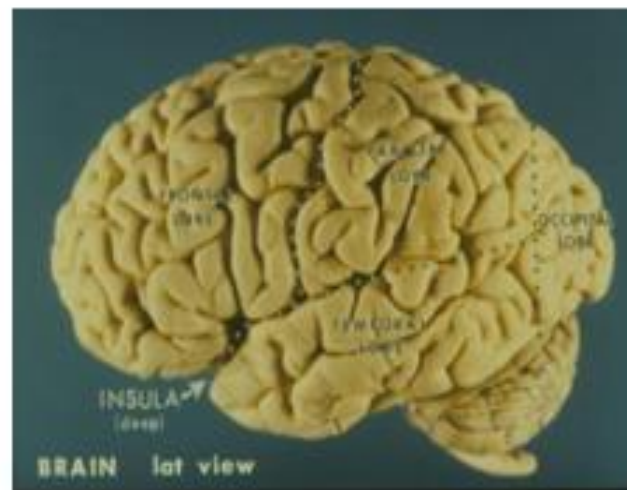
# **The hippocampus is an “old” cortical area involved in multiple aspects of memory**

- ***The LEFT hippocampus is more involved in the learning & memory of “facts”, “episodes”, “words”; it is also responsible for constructing – from episodic memory – an “autobiography”***
- ***The RIGHT hippocampus is more involved in “spatial” memory***
- ***The hippocampus compares the present experience with past experience; processing through the hippocampus is necessary for learning and for memory consolidation to occur***

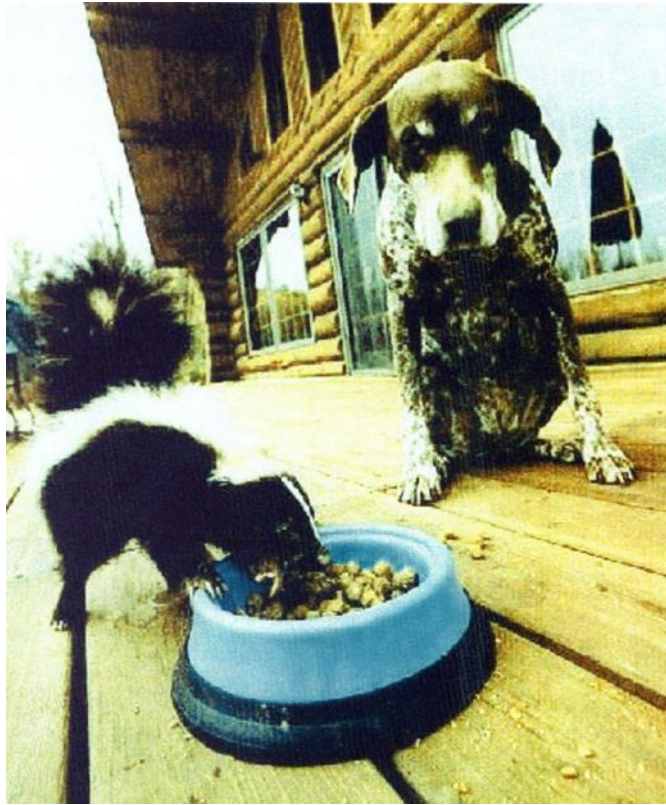


- ***Long-term Memory***

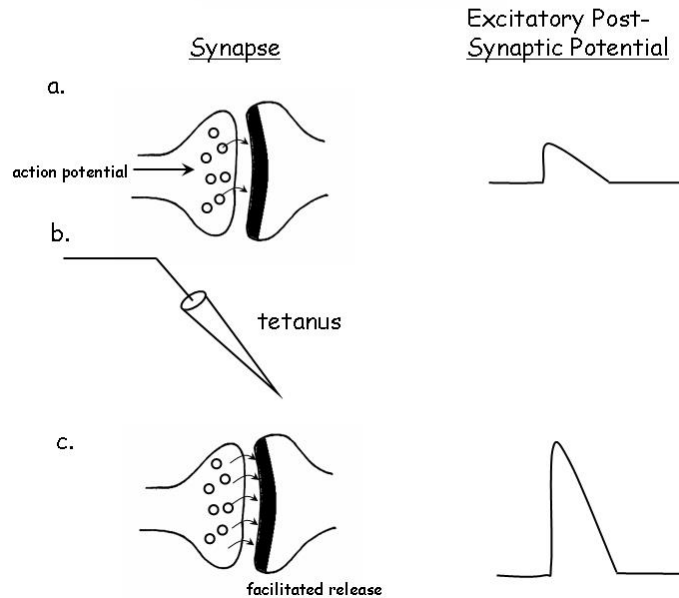
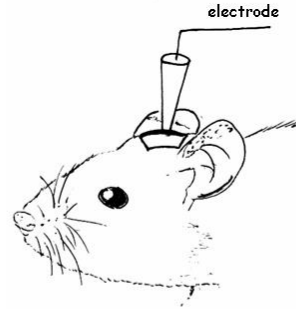
- The recollections of our lives
- Involves **widespread areas of the cortex**
- Can “fade”, but widespread loss is rare



***Memory involves changes occurring as a result of experience (learning) that allow the organism to alter future behavior based on past experience***



# *Memory involves changes at the cellular and molecular levels – for example, synapses can become more “efficacious”*



# ***Or New Synapses can be made as the result of Experience***

