



# Physiology of memory

*BRinging STEM into Active agING – BRAIN*

*Erasmus+ 2020-1-PL01-KA204-081805*

*Partner name: WSEI University*



*This material is created in the framework of BRAIN project “BringING STEM into Active AgING” (GRANT AGREEMENT 2020-1-PL01-KA204-081805. This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.*





# Types of Memory

## Declarative (“What”)

Facts and events linked to time & place  
(sister’s birthday, last dr appointment)

You have to actively think about it/recall it



## Procedural (“How”)

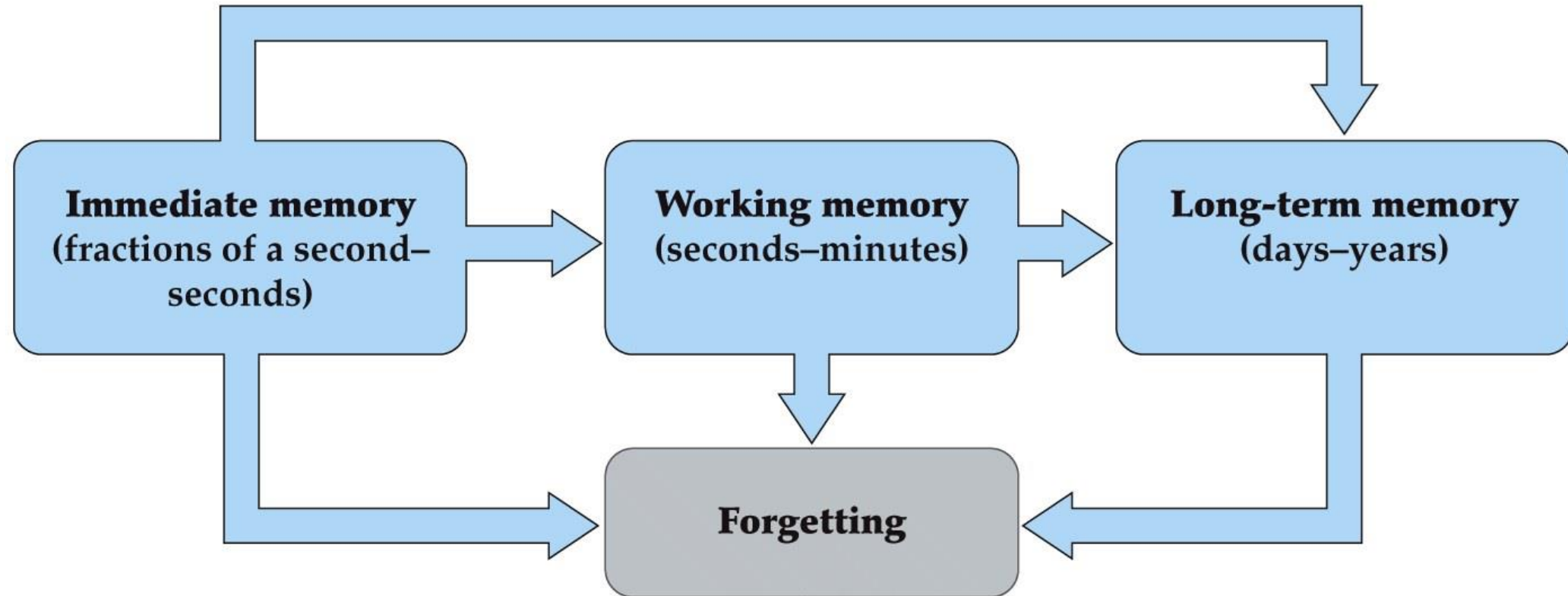
General skills & operations (how to ride a  
bike, drive a car)

Don’t actively think about it, just remember  
how to do it





# Phases of Memory



**NEUROSCIENCE 5e, Figure 31.2**  
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# How did scientists learn about memory in the brain?

Scientists learned from people who  
had brain injuries or disorders

Video about patient HM

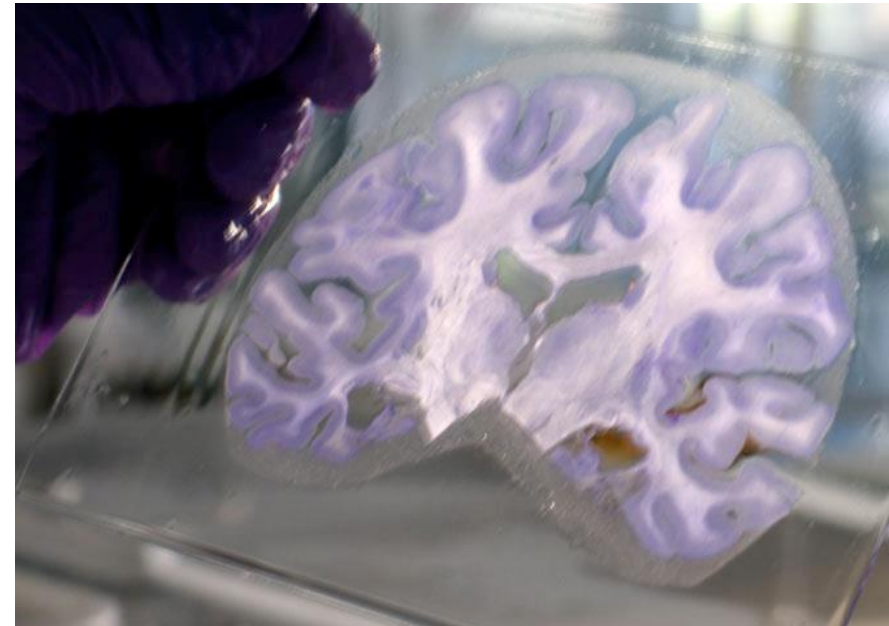


# What did we learn from HM?

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- What was wrong with HM?
- What types of memory did he still have?
- What conclusion did this lead scientists to?





# Where are memories stored?

## Strengthening signals & new synapses ...

... are stored in Hippocampus:  
turns STM into LTM

The hippocampus (named after its  
resemblance to the seahorse , from  
the Greek hippos meaning "horse"  
and kampos meaning "sea monster")

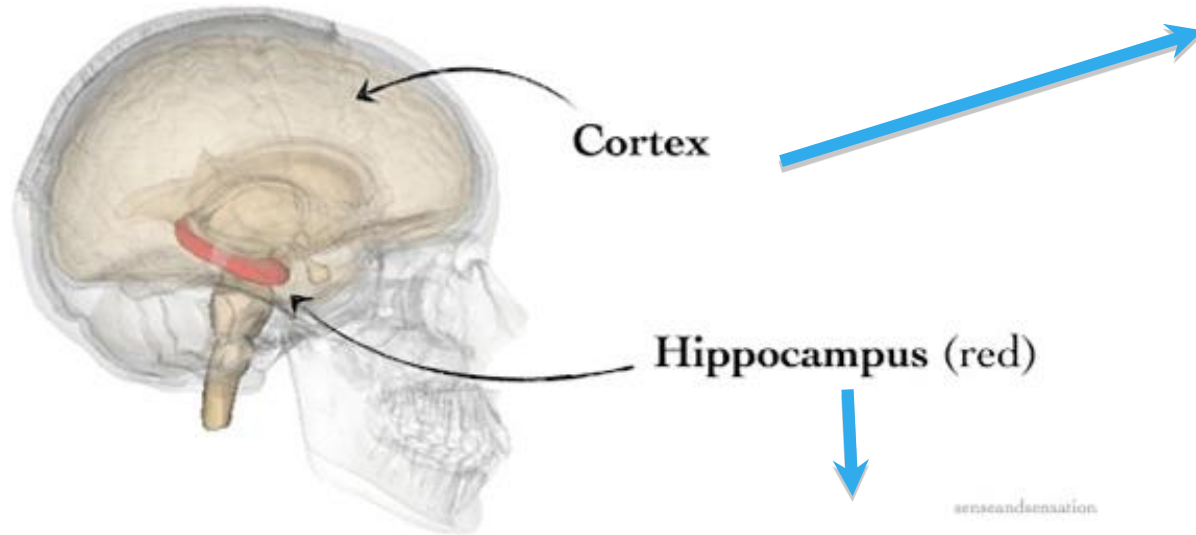






# What's happening in the brain when we learn?

Two important parts of the brain (for establishing memory)



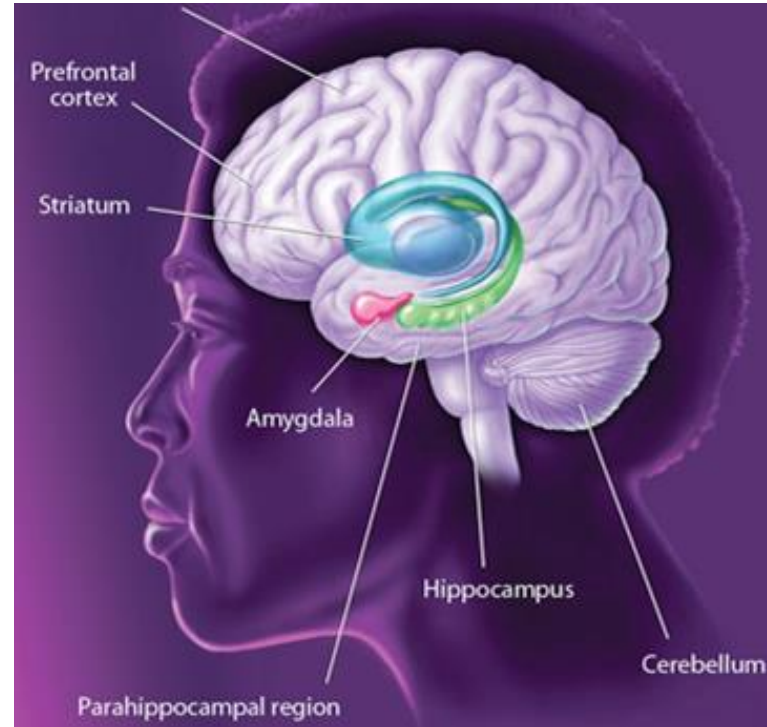
**Cortex:** Conscious thinking & processing information in **working memory (learning)**

**Hippocampus:** Translates information from working memory to **long-term memory (storing)**



# More details: Brain regions important for learning & memory

**Declarative Memory (events, facts):**  
Hippocampus



**Procedural Memory (motor skills):**  
Striatum, cerebellum

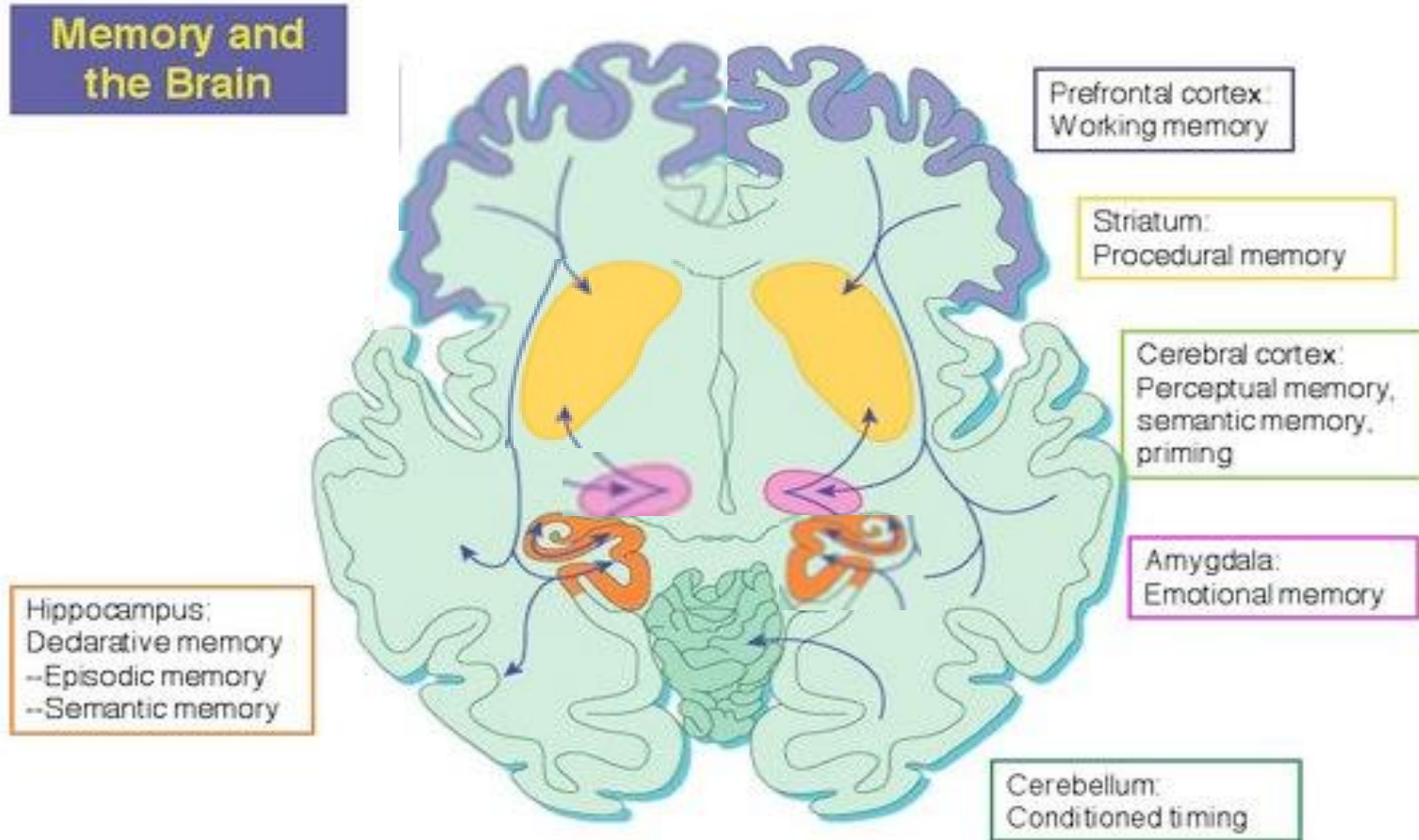
**Emotional Memory:** Amygdala





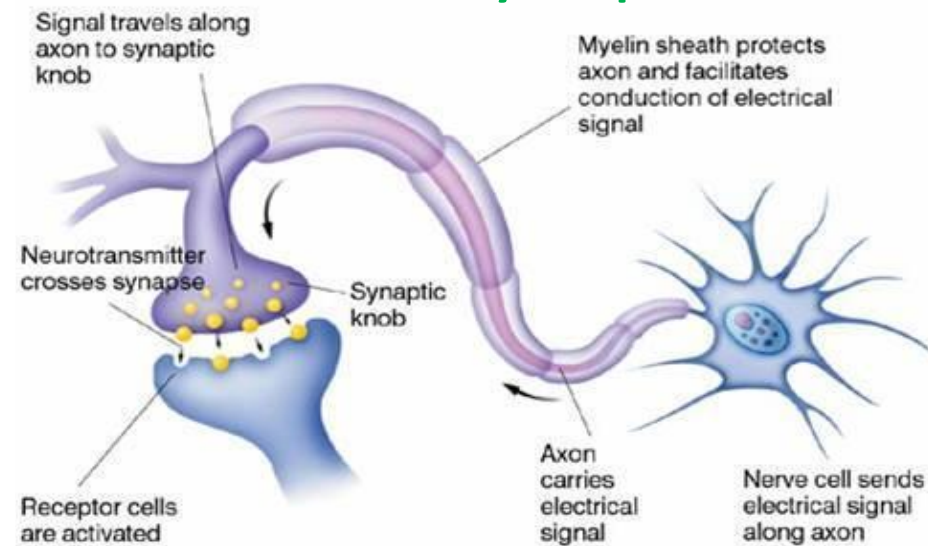
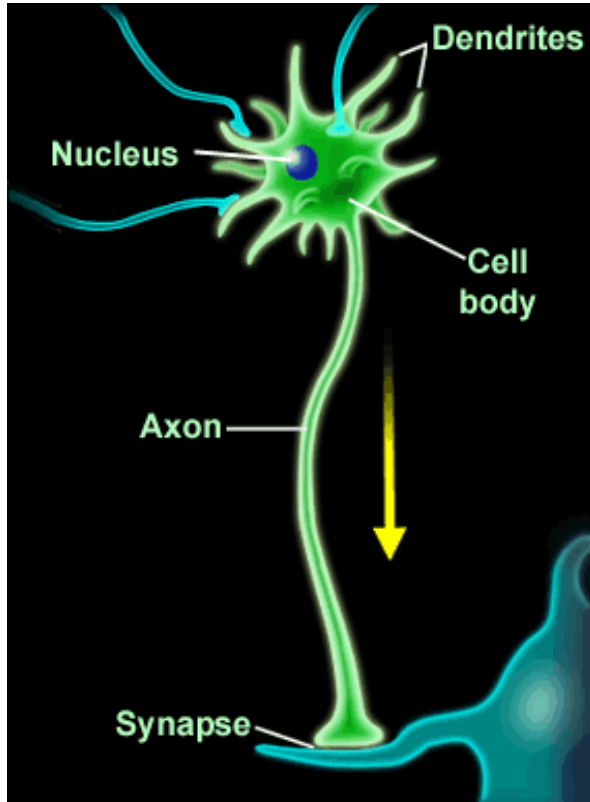
# Memories in the brain

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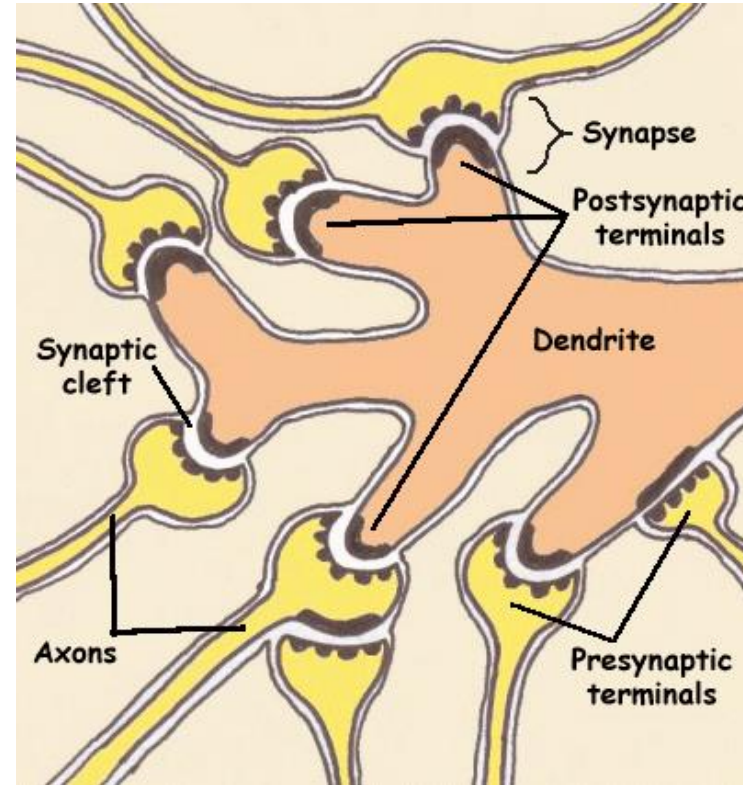
# How does the brain learn/ make memories?

## Connections Between Neurons = Synapses





We have 86 billion neurons in our brains, about the number of stars there are in the Milky Way.



A single neuron has on average 7,000 synapses.





# How are the Memories Stored?

## Synaptic Changes

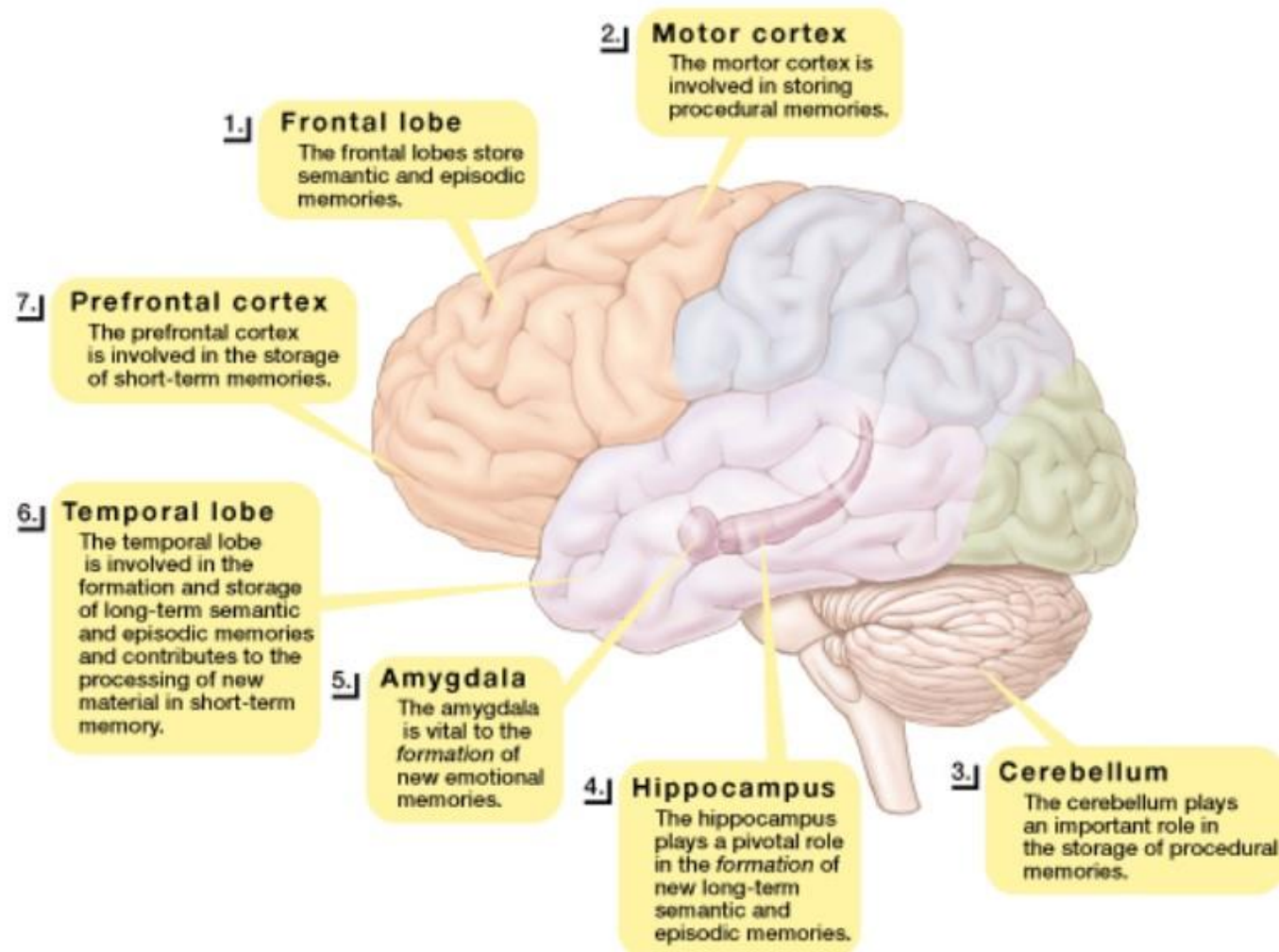
- Long - Term Potentiation (LTP) - a long-lasting change **in the structure or function** of a synapse that **increase the efficiency of neural transmission**
- Creates **Long – Term Memories (LTM)**





# Where are Long-Term Memories stored?

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# Prevention of Memory Loss

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- Exercising regularly
- Eating a healthy diet with lots of fruits and vegetables
- Getting enough sleep
- Not smoking
- Using alcohol only in moderation
- Participating in social and intellectually stimulating activities
- Getting regular check-ups
- Avoiding high levels of stress
- Protecting the head from injury





# Activities to improve memory and mental function

- Learning new things (such as a new language or how to play a new musical instrument)
- Doing mental exercises (such as memorizing lists, doing word puzzles, or playing chess, bridge, or other games that use strategy)
- Reading
- Working on the computer
- Doing crafts (such as knitting and quilting)



# Stress Hormones & Memory

- Heightened emotions (stress-related or otherwise) make for stronger memories
- Extreme stress undermines learning and later recall



# How to improve our memory?

**N-back – confirmed results, however it should be used with different types of stimuli because transfer is limited:**

- Use your smartphone:
- [https://play.google.com/store/apps/details?id=science.eal.n\\_backmemorytraining&hl=en\\_US&gl=US](https://play.google.com/store/apps/details?id=science.eal.n_backmemorytraining&hl=en_US&gl=US)
- **Play online – use BRAIN Project app and / or:**
- [https://www.braingymmer.com/en/brain-games/n\\_back/play/](https://www.braingymmer.com/en/brain-games/n_back/play/)
- <https://www.brainturk.com/dual-n-back>



# Do you want to know more?

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- Videos:
- Normal and Abnormal Aging and the Brain
- [https://www.youtube.com/watch?v=B6fVtA6X\\_sk](https://www.youtube.com/watch?v=B6fVtA6X_sk)
- Brain and Behavior - Learning and Memory: Basic Distinctions
- <https://www.youtube.com/watch?v=cChvNQIAzyU>
- [https://www.youtube.com/watch?v=NhqbECy7\\_xQ](https://www.youtube.com/watch?v=NhqbECy7_xQ)

## Much more?

- Reading:
- <https://www.msmanuals.com/home/brain,-spinal-cord,-and-nerve-disorders/symptoms-of-brain-spinal-cord-and-nerve-disorders/memory-loss>
- <https://arxiv.org/ftp/arxiv/papers/2112/2112.05362.pdf>



***THANK YOU FOR YOUR ATTENTION***

