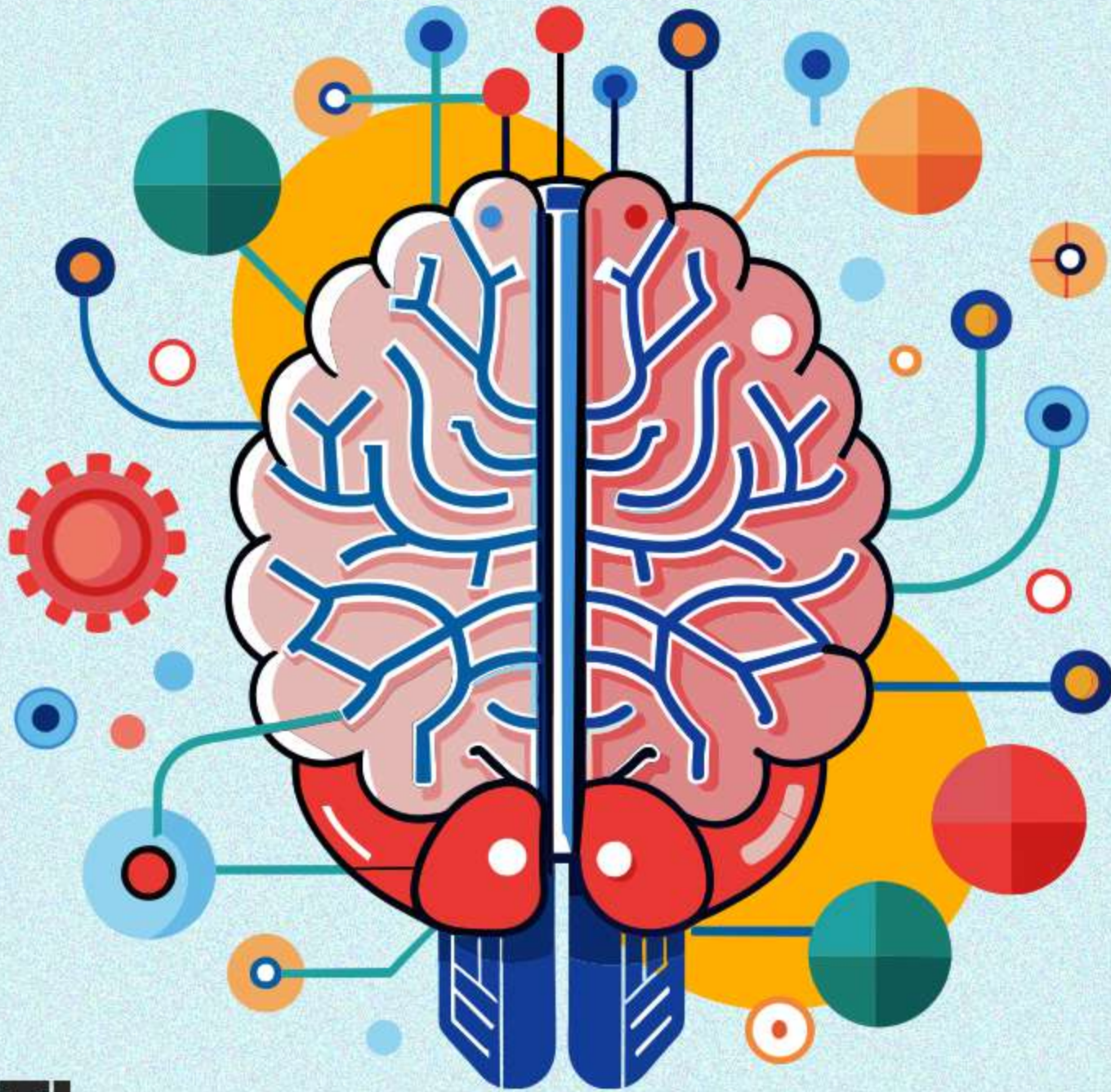


Wired to Remember



The Neurobiology of Learning & Memory

Sample MCQs for Psychology Entrance

Let's explore the kind of questions that
are often asked about this topic!

Q 1. Which brain structure is most crucial
for forming new long-term memories?

A) Hippocampus

B) Amygdala

C) Thalamus

D) Cerebellum

Q 2. Long-Term Potentiation (LTP) is best described as:

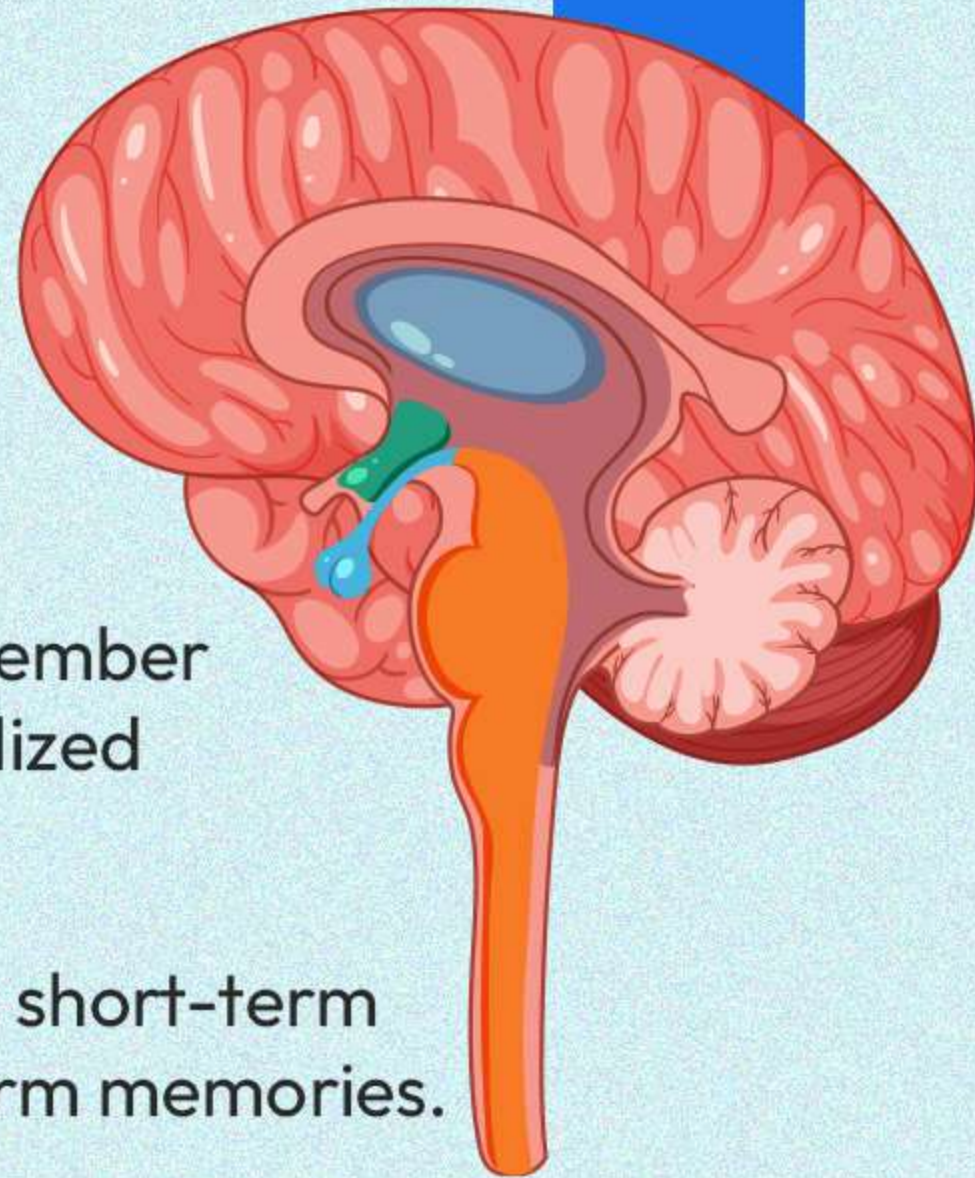
- A) Short-term increase in neural firing
- B) Strengthening of synaptic connections after repeated activation
- C) Reduction in neurotransmitter release
- D) Random neural firing during rest

Answers are revealed in the last slide, but you are encouraged to challenge yourself, read carefully, and the answer might reveal itself ;)

The Brain Behind Memory

Your ability to learn and remember relies on a network of specialized brain regions:

- **Hippocampus:** Converts short-term experiences into long-term memories.
- **Amygdala:** Adds emotional intensity to memories—especially fear, anxiety, and arousal-related responses.
- **Prefrontal Cortex:** Supports working memory, decision-making, and strategic retrieval of stored information.
- **Cerebellum:** Coordinates and stores procedural memories—skills like riding a bike or typing.



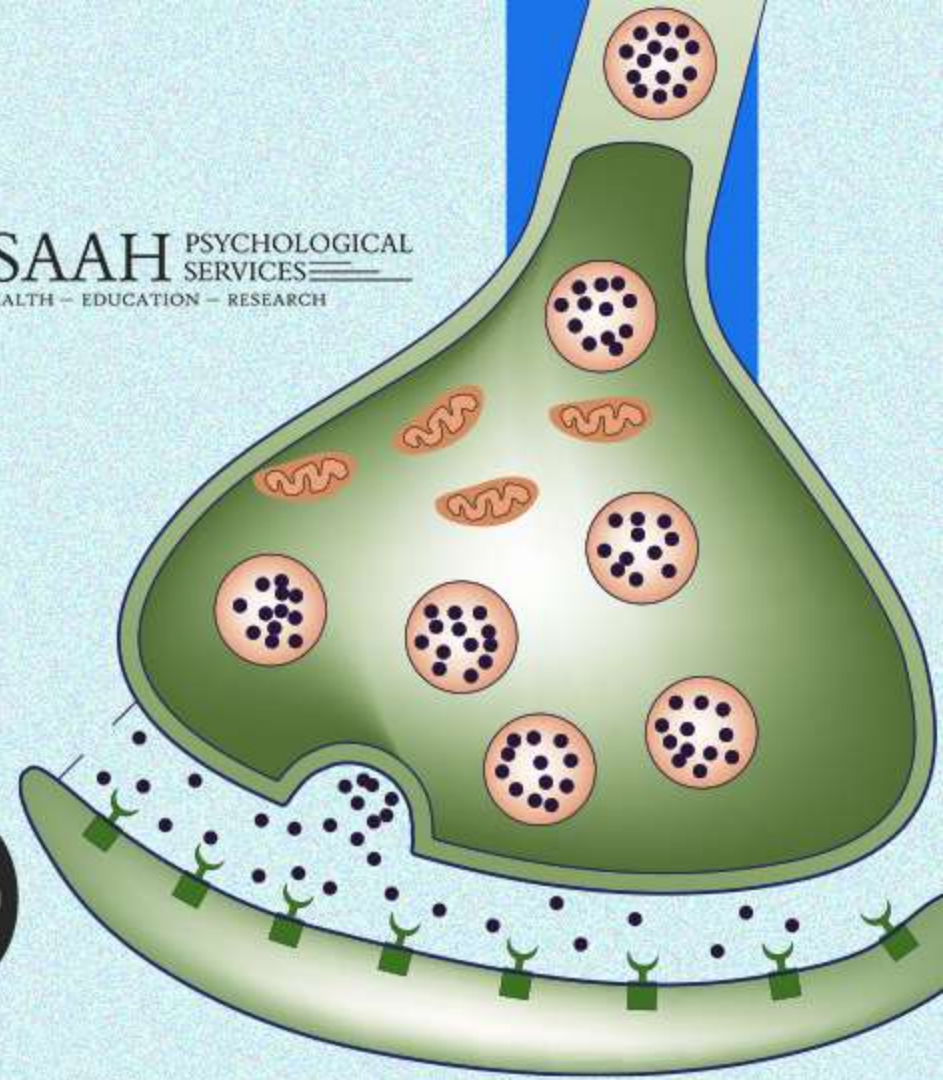
The Process of Learning

Every time you learn, your neurons talk more efficiently.

- Repeated use of a neural pathway strengthens its connections — this is synaptic plasticity.
- According to Hebb's Rule: "Neurons that fire together, wire together."
- With practice, signals flow faster and more easily — that's your brain learning.



Long-Term Potentiation (LTP)



LTP is the cellular process that makes learning stick.

- When two neurons are repeatedly activated together, their connection strengthens.
- This occurs mainly in the **hippocampus**, a key player in memory formation.
- Involves **glutamate**, **NMDA receptors**, and **calcium ions (Ca^{2+})** entering the neuron. This leads to insertion of AMPA receptors and structural synaptic changes that stabilize learning.
- Stronger synapses = easier activation next time = better recall.

Types of Memory

Memory isn't one thing—
it's a system of systems:

■ Declarative (Explicit):

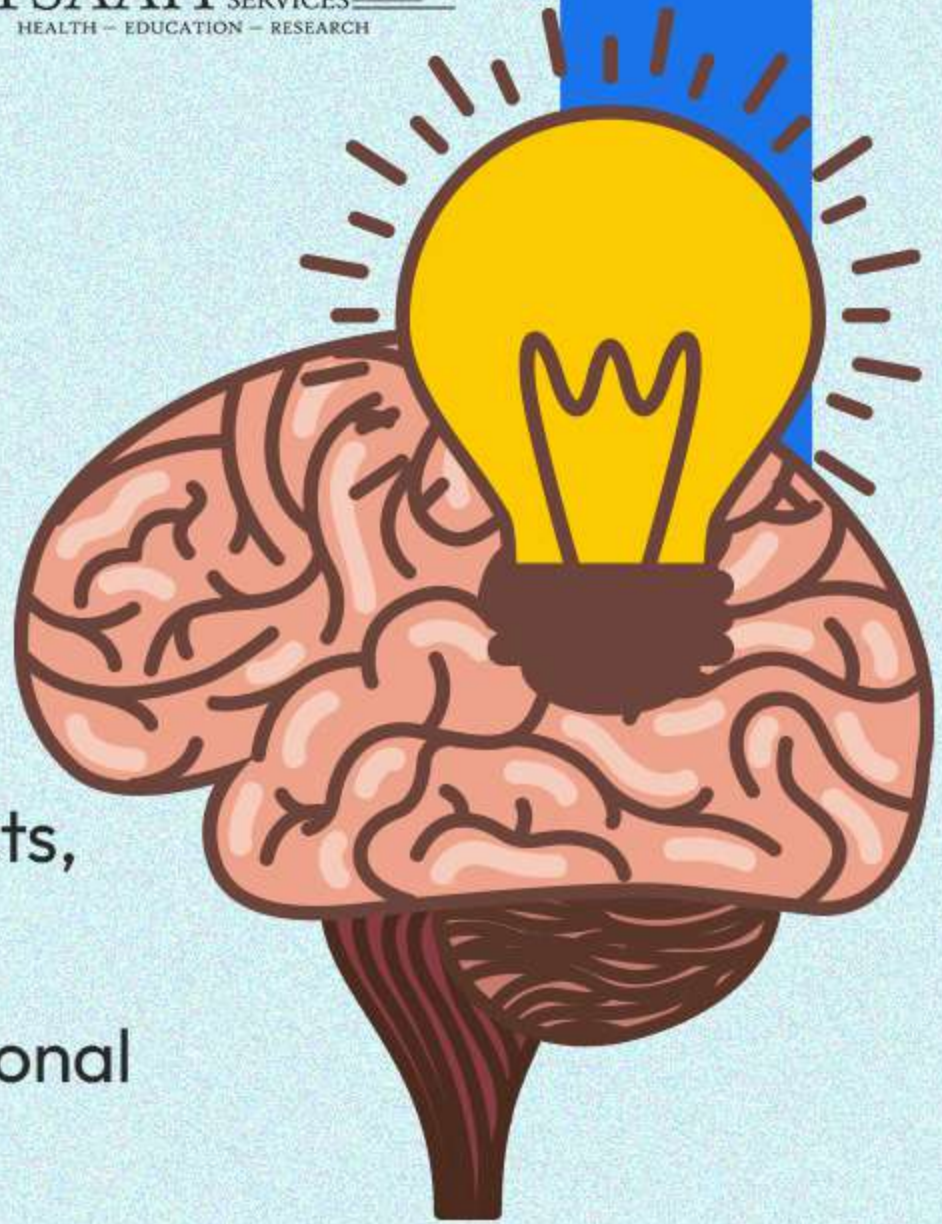
- Semantic memory: Facts, knowledge, concepts
- Episodic memory: Personal experiences
- Dependent on hippocampus

■ Procedural (Implicit):

- Skills, habits, and conditioned responses
- Mediated by cerebellum, basal ganglia, and motor cortex

■ Working Memory:

- Short-term storage & mental manipulation
- Managed by prefrontal cortex

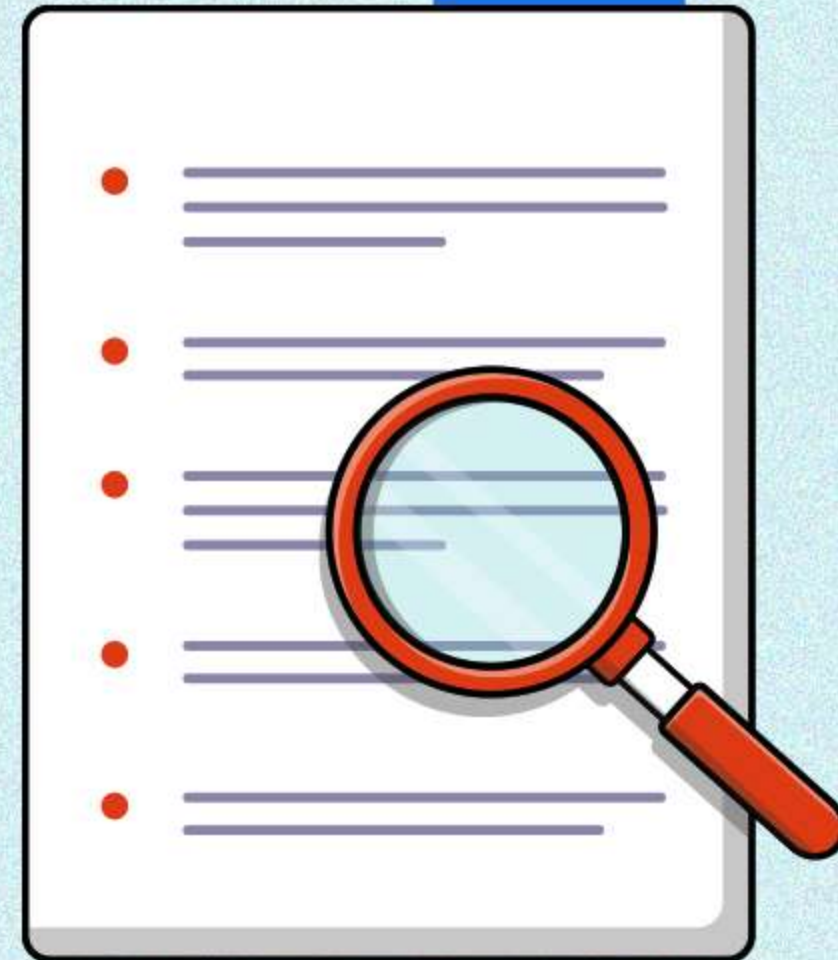


Memory Consolidation

After learning, memories need time to stabilize — this is **consolidation**.

- The **hippocampus** replays neural activity to “train” the **neocortex**. This replay often occurs during slow-wave sleep through hippocampal–neocortical communication.
- Over time, memories shift from temporary to long-term storage.
- **Sleep**, especially deep and REM sleep, enhances this process.
- Without consolidation → memory fades or fragments (e.g., Patient H.M.).





Historical & Research Insights

- **Patient H.M. (1953):** Hippocampus removal → amnesia → foundation of modern memory research.
- **Bliss & Lømo (1973):** Discovered LTP in rabbit hippocampus.
- **Eric Kandel (2000 Nobel):** Studied memory in sea slug *Aplysia*; revealed molecular basis.

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The correct answers are:

Q.1 A) Hippocampus

Q.2 B) Strengthening of synaptic
connections after repeated activation