

Educational record: the synaptic homeostasis hypothesis of sleep

Papex Labs

Hypothesis · Neuroscience · Sleep

Signed 5 October 2026

Papex PXH-1W8VPPP3V9D8 · version 1

Keywords: sleep; synaptic homeostasis; slow-wave sleep; plasticity; memory

Claim

Sleep restores synaptic homeostasis: wakefulness produces a net increase in synaptic strength, and slow-wave sleep renormalises it, which saves energy and improves signal-to-noise for memory (the synaptic homeostasis hypothesis, SHY).

Why it matters

SHY is one of the most tested explanations of why sleep exists. Stating it as a record with clear falsification criteria makes it easy to follow the evidence for and against it.

What would falsify this?

Measures of synaptic strength (for example spine size or synaptic AMPA receptor levels) do not decrease across sleep compared with matched wake periods in the same animals.

Methodology

This educational record summarises the hypothesis of Tononi and Cirelli (2014). Tests compare synaptic markers, ultrastructure and cortical responses after sleep versus matched wake in animal models and humans.

Expected outcomes

Net synaptic markers higher after wake than after sleep, with the largest changes in cortical regions that show strong slow-wave activity.

Research setup

System or population Mammalian cortex across sleep–wake cycles

Variables Synaptic strength markers; sleep/wake state

Parameters Matched sleep and wake periods

Observer or reference frame Within-subject: each measurement after sleep is compared with a matched wake period in the same animals or participants.

Assumptions and scope Markers reflect net synaptic strength

Units Marker-specific units

Tolerance or uncertainty Effect direction across studies

Research mode Mixed

Known limitations Several studies report region-specific or opposite changes; the hypothesis remains debated.

Purpose Educational

Prior evidence Contested

Files

- Evidence reading list: synaptic homeostasis hypothesis — Supplement · PXA-X4MZY9A6T9PW v1 · 5.7 KB

Lets a reader check the record's summary against the main published evidence on both sides.

- README.md · Markdown · 848 B · 0xa971...e068
- evidence.csv · CSV · 4.9 KB · 0x82d2...d6b5

Preparation

Method Agent-prepared

Application launch-loader 1 (self-reported)

Model claude-opus-5-5 (self-reported)

Field	Origin
Claim	Agent-researched, human-accepted
Why it matters	Agent-researched, human-accepted
What would falsify this?	Agent-researched, human-accepted
Methodology	Agent-researched, human-accepted
Expected outcomes	Agent-researched, human-accepted
System or population	Agent-researched, human-accepted
Variables	Agent-researched, human-accepted
Parameters	Agent-researched, human-accepted
Observer or reference frame	Declared by author
Assumptions and scope	Agent-researched, human-accepted
Units	Agent-researched, human-accepted
Tolerance or uncertainty	Agent-researched, human-accepted
Research mode	Agent-researched, human-accepted
Known limitations	Agent-researched, human-accepted
Purpose	Agent-researched, human-accepted
Prior evidence	Agent-researched, human-accepted

References

- [1] Giulio Tononi, Chiara Cirelli. Sleep and the Price of Plasticity: From Synaptic and Cellular Homeostasis to Memory Consolidation and Integration. *Neuron*, 2014. <https://doi.org/10.1016/j.neuron.2013.12.025>
Builds on

Generated by Papex from the signed record (research-record/v8). The signature covers the record's content, not this PDF file. Check it at <https://papex.org/verify/PXH-1W8VPPP3V9D8?version=1>. Cite as <https://papex.org/id/PXH-1W8VPPP3V9D8/v/1>.