

**Read the text below to answer the question number 13 to 17**

Students sometimes pull an all-nighter to prepare for an exam. However, research has shown that sleep deprivation is bad for your memory. Now, University of Groningen neuroscientist Robbert Havekes discovered that what you learn while being sleep deprived is not necessarily lost, it is just difficult to recall. Together with his team, he has found a way to make this 'hidden knowledge' accessible again days after studying whilst sleep-deprived using optogenetic approaches, and the human-approved asthma drug roflumilast.

Havekes, associate professor of Neuroscience of Memory and Sleep at the University of Groningen, the Netherlands, and his team have extensively studied how sleep deprivation affects memory processes. 'We previously focused on finding ways to support memory processes during a sleep deprivation episode', says Havekes. However, in his latest study, his team examined whether amnesia as a result of sleep deprivation was a direct result of information loss, or merely caused by difficulties retrieving information. 'Sleep deprivation undermines memory processes, but every student knows that an answer that eluded them during the exam might pop up hours afterwards. In that case, the information was, in fact, stored in the brain, but just difficult to retrieve.'

To address this question, Havekes and his team used an optogenetic approach: using genetic techniques, they caused a light-sensitive protein (*channelrhodopsin*) to be produced selectively in neurons that are activated during a learning

experience. This made it possible to recall a specific experience by shining light on these cells. 'In our sleep deprivation studies, we applied this approach to neurons in the hippocampus, the area in the brain where spatial information and factual knowledge are stored', says Havekes.

First, the genetically engineered mice were given a spatial learning task in which they had to learn the location of individual objects, a process that heavily relies on neurons in the hippocampus. The mice then had to perform this same task days later, but this time with one object moved to a novel location. The mice that were deprived of sleep for a few hours before the first session failed to detect this spatial change, which suggests that they cannot recall the original object locations. 'However, when we reintroduced them to the task after reactivating the hippocampal neurons that initially stored this information with light, they did successfully remember the original locations', says Havekes.

The molecular pathway set off during the reactivation is also targeted by the drug roflumilast, which is used by patients with asthma or COPD. Havekes: 'When we gave mice that were trained while being sleep deprived roflumilast just before the second test, they remembered, exactly as happened with the direct stimulation of the neurons.' As roflumilast is already clinically approved for use in humans, and is known to enter the brain, these findings open up avenues to test whether it can be applied to restore access to 'lost' memories in humans.

At this time, Havekes is not directly involved in such studies in humans. 'My interest lies in unravelling the molecular mechanisms that underlie all these processes', he explains. 'What makes memories accessible or inaccessible? How does roflumilast restore access to these 'hidden' memories? As always with science, by addressing one question you get many new questions for free.'

**13. According to Havekes on the article above, lack of sleep can cause ...**

- a. permanent loss of prior knowledge.
- b. hidden knowledge to be accessible.
- c. increasing usage of asthma drugs.
- d. difficulty in regaining knowledge.
- e. sleep deprived keeps happening.

**14. Havekes believes that the memory and knowledge are kept in the brain, because ....**

- a. Students can remember the answer of their exam few hours after the exam finishes.
- b. Students can answer the exam but they are not really sure with the elaboration.
- c. Students can retrieve information they have learned as soon as they start the exam.
- d. Students can be encouraged to increase their knowledge level in sleep deprived episode.
- e. Students can maintain their ability to remember every information when they study.



15. The main idea of paragraph 4 is ....
- how Havekes and his team investigates human's hippocampus
  - observation to some parts of neuron affected by sleep deprivation.
  - the process of Havekes' research on effect of sleep deprivation.
  - how the team found that mice contributes the effect of sleep.
  - how Havekes is able to reactivating hippocampus after sleep.
16. The paragraph that tells about role of asthma drug to Havekes experiments is ...
- Paragraph 1
  - Paragraph 2
  - Paragraph 3
  - Paragraph 4
  - Paragraph 5
17. "When we gave mice that were trained while being sleep deprived roflumilast just before the second test, they remembered, exactly as happened with the direct stimulation of the neurons"
- The underlined word above refers to ...
- Researchers
  - Neurons
  - Stimulations
  - Mice

**Read the following text to answer question number 17 to 20 !**

The asteroid impact that caused a mass extinction 66 million years probably also triggered the collapse of forests worldwide, a new investigation of the plant fossil record concludes. Needing trees and extensive plant cover for nesting or food could have been a fatal drawback for winged dinosaurs, including some ancient birds. Reconstructing the ecology of ancient birds suggests that modern fowl descended from species that survived because they could live on the ground.

The shock wave from the strike probably flattened trees within a radius of 1,500 kilometers, Field says. Wildfires ignited around the planet and then came the acid rain. Clouds of ash and dust may have darkened the sky for several years, and researchers suspect that photosynthesis waned. Yet some lucky birds, but no other dinosaurs, survived the hellcape.

For clues to what made a survivor, researchers turned to fossilized pollen from before and after the fiery impact. Abundant kinds of flower-bearing and cone-bearing plants left pollen just before the asteroid hit and again starting about a thousand years afterward. In between those times of diversity, however, ferns dominated, the team notes. A kind of "disaster flora," ferns (making spores instead of flowers and seeds) do well at recolonizing land. Seed plants, however, weren't thriving.

Analyzing evolutionary histories of modern birds supports the idea of tree dependence as a vulnerability for the earliest fowl, the researchers say. Specialists in bird evolution now generally agree on the lowest, oldest branches of the bird family tree, Field says. The bottommost one, for instance, includes such modern species as ground-dwelling ostriches and smaller, flight-capable birds called tinamous, which might be more like the ancient birds that dodged extinction.

18. According to information mentioned on paragraph 1, many dinosaurs and ancient birds ...
- migrated to find of trees.
  - evolved because of needs.
  - competed to be survivors.
  - covered their nest by trees.
  - depended food on their nest.

19. Disaster flora means ....

- a. spores evolved to flowers or seeds
- b. produced spores made great colony.
- c. seed plants could make spores.
- d. fern dominated because of flower.
- e. pollen turned into fossilized spores.

20. *The bottommost one, for instance, includes such modern species as ground-dwelling ostriches and smaller, flight-capable birds called tinamous, which might be more like the ancient birds that **dodged** extinction.*

The underlined word on the text above has similar meaning with ...

- a. Accepted
- b. Delivered
- c. Evolved
- d. Avoided
- e. Changed