

# Biochemistry

with Dr Graham Diering and  
Dr Shenée Martin

## Talking points

### Knowledge & Comprehension

1. What is a synapse?
2. How and when does cerebrospinal fluid address toxic byproducts in the brain?
3. How does sleep affect our memories?
4. Does poor sleep lead to Alzheimer's disease, or does Alzheimer's disease lead to poor sleep?

### Application

5. To what extent do you think the differences the team observed between male and female mice are likely to also be applicable to male and female humans? What would be the next research steps to investigate this?
6. Graham says that further research is needed to understand the links between sleep disruption and Alzheimer's susceptibility. What are three specific hypotheses that future research could address?

### Analysis

7. The typical way of measuring sleep in model mice is to surgically implant an electrode in their brain. Why do you think the team did not take this approach?
8. What qualities do you think a next-generation sleep medicine would need? How might it function at the biochemical level?

### Evaluation

9. Annual deaths from Alzheimer's disease reportedly doubled between 2000 and 2019. Why do you think this might be the case? Consider a range of possible reasons in your answer and suggest which are the most probable.
10. Graham notes that demand for biochemists in the pharmaceutical and biotechnology sectors is growing. These sectors are sometimes criticised for patenting their products such as new drugs, which keeps prices high and may prevent those who could benefit from new products from accessing them. One counterargument is that, without a financial incentive, there would never be the investment to develop these products in the first place. What do you think? Defend your opinion.

## Activities

Begin by summarising the team's main research findings as explored in the article.

Graham and Shenée both mention that there are still a number of unanswered questions surrounding the link between sleep, the toxic Tau protein, and the development of Alzheimer's disease. Choose one of these questions – either one that is explicitly mentioned in the article, or one that you identify by yourself.

Now, design an experiment that could answer this question. Write down:

- Your hypothesis
- Methodology
- Resources needed
- The reason for doing the experiment

Shenée mentions the importance of writing and science communication to secure grant funding. Write a short speech to present to funders to secure funding to perform the experiment you have outlined. You will need to make clear:

- What the experiment is trying to answer
- Why you have chosen the methods and materials that you have
- How the experiment's results could benefit the real world
- What could still be gained if the experiment gave unexpected results.

Present your speech to your class and answer any questions they might have. Do they seem convinced? Which aspects of your presentation do you think you could improve?

## More resources

- North Carolina DNA Day ([ncdnaday.org](http://ncdnaday.org)) is an annual event where scientists from across the state visit high schools to present interactive lessons about genetics, genomics, and biotechnology. The DNA CONNECT programme ([ncdnaday.org/connect](http://ncdnaday.org/connect)) is an extension of this where scientists run sessions with students throughout the year, helping them learn more about research and science careers.
- This article summarises a study linking lack of sleep in middle age to dementia risk later in life: [www.nih.gov/news-events/nih-research-matters/lack-sleep-middle-age-may-increase-dementia-risk](http://www.nih.gov/news-events/nih-research-matters/lack-sleep-middle-age-may-increase-dementia-risk) What parallels can you see with Graham's and Shenée's research?
- This video from SciShow explains why we need sleep and what happens to our bodies during sleep deprivation:  
[www.youtube.com/watch?v=pwNMvUXTgDY](https://www.youtube.com/watch?v=pwNMvUXTgDY)