

NANOSCIENCE

WITH THE CENTER FOR NANOSCIENCE

Talking *points*

KNOWLEDGE

1. How many nanometres are in a metre?
2. How wide is a strand of DNA?
3. What is nanotechnology?
4. What are optoelectronics?

COMPREHENSION

5. Why is it important to know the nanostructure and nanoscale properties of a material?
6. How does the process of DNA origami work?

APPLICATION

7. Apart from drug delivery, how else do you think nanoscience can be used in medicine?
8. How do you think metal-organic framework crystals could be used to combat droughts?
9. How might a chemist use a transmission electron microscope in their research?

ANALYSIS

10. How do nanoscientists and nanoscience research groups benefit from being part of the Center for NanoScience (CeNS)?
11. Why does CeNS want members to take their scientific discoveries to industries?

EVALUATION

12. Nanoscience is an incredibly broad and interdisciplinary field. Which of the topics mentioned in the article most interest you, and why?

Activities

1. Explore the nanoscale properties of carbon

The lead in your pencil is made of graphite, a form of carbon that has interesting nanoscale properties. Carbon is not a metal, so you may expect it to act as an electrical insulator. Yet in some forms, it will conduct electricity.

Using a battery, a lightbulb and some wires, create an electrical circuit that lights up the bulb. Then, alter your circuit so the electricity must also flow through graphite. DO NOT use the lead contained within a wooden pencil as this will cause a fire hazard! Either use a stick of graphite (e.g., lead for a refillable pencil) or draw heavily on a small strip of paper with pencil so it is covered in a layer of graphite. What happens to the lightbulb when the current must flow through graphite?

Carbon also exists in other forms, such as diamond and charcoal, and these have different properties. If available, test the electrical conductivity of different forms of carbon. DO NOT use diamond jewellery unless you have permission from the owner! You could use diamond sandpaper. What happens to the lightbulb when the current must flow through different forms of carbon?

Research the nanostructure of graphite. How are the individual carbon atoms arranged? How does this arrangement influence the physical and electrical properties of graphite? Why do these properties make graphite ideal for using as pencil leads? What are the other applications for graphite, and how do these depend on its nanostructure and resulting properties?

Research the nanostructure of diamond. How are the individual carbon atoms arranged? How does this arrangement influence the physical and electrical properties of diamond? Why do these properties make diamond ideal for using on sandpaper? What are the other applications for diamond, and how do these depend on its nanostructure and resulting properties?

2. Everyday uses of nanotechnology

We may not be aware of it, but we are surrounded by nanotechnology in our daily lives. From your sunscreen to your socks, from food packaging to your phone, nanoparticles are all around us. Research online to find an interesting everyday use of nanotechnology and create a poster to inform your classmates about it. Your poster should:

- Explain how nanotechnology is used in your example
- Explain why nanotechnology is used in your example
- Be engaging and eye-catching

More *resources*

The National Nanotechnology Initiative (www.nano.gov/resources/education-and-outreach/teacher-resources) and Try Nano (trynano.org/education-resources/nanotechnology-lesson-plans) have educational resources and lesson plans about nanoscience and nanotechnology.

Learn about the history of nanoscience and nanotechnology:
www.mdpi.com/1420-3049/25/1/112

Students in Munich and Bavaria can explore the following resources:

- www.muc-labs.de/muc-labs_liste.html
- www.nanowissen.bayern.de/nanolab/demonstrationslabor/index.htm
- www.nanowissen.bayern.de/nanoteach/lehrmaterialien/index.htm

Visit the team's Futurum webpage to read the article in German:
www.futurumcareers.com/examining-the-extremely-small