MATERIALS SCIENCE AND ENGINEERING WITH DISCOVER MATERIALS

TALKING POINTS

KNOWLEDGE AND COMPREHENSION

1. What scientific relationship is the key to MSE?
2. What does it mean to 'test a material to destruction', and why must materials scientists and engineers often destroy materials to learn about their properties?

APPLICATION

3. How do you think shape memory alloys will be used?
4. How many uses can you think of for bamboo? How do its properties make it suitable for each application?
5. What materials are related to your hobbies? E.g., what materials are used in your sports equipment, musical instruments, clothing, books, phone...? What properties do these materials have, and why do these make them suitable for their applications? How have the end products been manufactured from the constituent materials?

ANALYSIS

6. When designing a new material, why is it important to consider the needs of the user of the final product?
7. Why do we need materials scientists and engineers to develop new building materials and methods?

SYNTHESIS

8. How do you think more powerful computation can accelerate the discovery of materials and their properties? How do you think the field of MSE will progress in the future as technology advances?

EVALUATION

9. The extraction of raw materials (e.g., mining metals for smartphones and electric vehicle batteries) has negative environmental and ethical impacts. To what extent do you think materials scientists and engineers should consider these impacts within their work? How could they help to address these problems?

CREATIVITY

10. List three examples of structures found in nature. Imagine you are a materials scientist or engineer and propose creative ways to incorporate each structure into manufactured materials or objects.

ACTIVITY

"Chocolate is a fantastic example of how a material's microstructure affects its properties," says Chris. "Chocolate has six different phases (ways in which the atoms are arranged), depending on the ratio of cocoa powder, cocoa butter (fat), milk and sugar. Each phase has a different melting point and different mechanical properties. For example, low sugar, high cocoa chocolate is generally more brittle than high fat chocolate."

Design an experiment to test the melting point and brittleness of different chocolates. Consider:

- What types of chocolate will you investigate to sample the range of chocolate phases?
- What experimental procedure will you follow to investigate melting points?
- What experimental procedure will you follow to investigate brittleness?
- What will be the independent and dependent variables in each experiment?
- How will you control all other variables to ensure a fair test?
- What data will you record from each experiment?
- How will you analyse and display your results?
- Based on Chris' explanation, what results do you expect?

After conducting your experiment, answer the following:

- What properties did each type of chocolate have?
- Do your experimental results support what Chris says about chocolate properties?
- How could you improve the accuracy and reliability of your experiment?
- What other physical properties of chocolate could you test for?

Research online to learn more about the different material properties of chocolate and answer the following:

- Why do different types of chocolate have different melting points?
- Why do different types of chocolate have different brittleness?

MORE RESOURCES

- Become a materials scientist and engineer at home as you #TestATunnocks! **www.sheffield.ac.uk/materials/testatunnocks**
- The European Space Agency plans to build Moon bases from moondust and astronaut urine: **www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Astronaut_urine_for_building_a_Moon_base**
- Concretene could revolutionise the carbon-intensive concrete industry: **www.manchester.ac.uk/discover/news/greener-and-cheaper-graphenemanchester-solves-concretes-big-problem**
- Creating cricket bats from bamboo has benefits and challenges: **www.skysports.com/cricket/news/12123/12303505**