Smart materials

Unit 2 · Energy, materials, systems and devices · matches the "Smart materials" lesson slides (about 60 minutes)

Teacher notes for someone teaching this lesson without a Design and Technology background, including a cover or supply teacher standing in for the usual class teacher.

IF YOU ONLY DO ONE THING (RUSHED COVER LESSON)

If you only do one thing: make sure every pupil can say what "Smart material" means in their own words before the lesson ends. A material whose properties change in response to an external stimulus and can change back. Ask two or three pupils to explain it back to you - do not just ask "does that make sense?".

Key facts in plain language

These are the facts this lesson depends on. They are written in plain English, not subject jargon, so you can say them in your own words while you teach.

Smart material:
A material whose properties change in response to an external stimulus and can change back.

Shape memory alloy:
A metal (such as nitinol) that returns to a set shape when heated.

Thermochromic pigment:
Changes colour with temperature.

Photochromic pigment:
Changes colour with light, such as UV.

Piezoelectric:
Produces a voltage when squeezed, or moves when a voltage is applied.

Stimulus:
The change (heat, light, force, electricity) that triggers a response.

Common misconceptions

Drawn from the wrong answers pupils pick in this lesson's own question bank, paired with the explanation that is already written for the right answer.

Pupils may think: "It combines two materials for better properties" is correct.
Why it is wrong: the correct answer is "It reacts to a stimulus and can change back". Smart materials react to a change in their surroundings, such as heat or light, and the change is reversible.

Pupils may think: "Shape memory alloy" is correct.
Why it is wrong: the correct answer is "Thermochromic pigment". Thermochromic pigments respond to temperature.

Pupils may think: "Piezoelectric crystal" is correct.
Why it is wrong: the correct answer is "Photochromic pigment". Photochromic materials darken in response to UV light.

Pupils may think: "Sunglass lenses that darken in bright light" is correct.
Why it is wrong: the correct answer is "Glasses frames that return to shape after bending". Nitinol frames return to their set shape after bending. The other uses are thermochromic, photochromic and piezoelectric.

Pupils may think: "Thermochromic" is correct.
Why it is wrong: the correct answer is "Piezoelectric". Squeezing a piezoelectric crystal produces a voltage, creating a spark.

Talking points to follow the slide deck

The slide deck for this lesson follows the usual DT Classroom shape: a retrieval starter, then each key term below in turn, worked examples, exam-style practice, then an exit ticket. Use these lines as you reach each part - they are the same facts as above, just phrased as something you can say out loud.

When the deck reaches "Smart material": say — A material whose properties change in response to an external stimulus and can change back. Ask: "can someone give me an example?"

When the deck reaches "Shape memory alloy": say — A metal (such as nitinol) that returns to a set shape when heated. Ask: "can someone give me an example?"

When the deck reaches "Thermochromic pigment": say — Changes colour with temperature. Ask: "can someone give me an example?"

When the deck reaches "Photochromic pigment": say — Changes colour with light, such as UV. Ask: "can someone give me an example?"

When the deck reaches "Piezoelectric": say — Produces a voltage when squeezed, or moves when a voltage is applied. Ask: "can someone give me an example?"

When the deck reaches "Stimulus": say — The change (heat, light, force, electricity) that triggers a response. Ask: "can someone give me an example?"

Worked answers to this lesson's questions

The same question bank used for this lesson's knowledge organiser self-check and worksheet exam practice. Use this page as the answer key, or cover the right-hand explanation and hand out the questions as a silent task (see the cover lesson box below).

1. What makes a material "smart"?

a) It combines two materials for better properties, b) It is programmed by a microcontroller to respond, c) It reacts to a stimulus and can change back, d) It is engineered at the nanometre scale

Answer: c) It reacts to a stimulus and can change back. Smart materials react to a change in their surroundings, such as heat or light, and the change is reversible.

2. A baby spoon changes colour when food is too hot. What material is used?

a) Shape memory alloy, b) Piezoelectric material, c) Photochromic pigment, d) Thermochromic pigment

Answer: d) Thermochromic pigment. Thermochromic pigments respond to temperature.

3. Sunglasses that darken in sunlight use…

a) Photochromic pigment, b) Piezoelectric crystal, c) Shape memory alloy, d) Thermochromic pigment

Answer: a) Photochromic pigment. Photochromic materials darken in response to UV light.

4. What is a use of a shape memory alloy?

a) Sunglass lenses that darken in bright light, b) A buzzer that sounds when it is squeezed, c) A strip thermometer that shows the room temperature, d) Glasses frames that return to shape after bending

Answer: d) Glasses frames that return to shape after bending. Nitinol frames return to their set shape after bending. The other uses are thermochromic, photochromic and piezoelectric.

5. A gas lighter clicks to make a spark. Which smart material does this?

a) Thermochromic, b) Piezoelectric, c) Photochromic, d) Shape memory alloy

Answer: b) Piezoelectric. Squeezing a piezoelectric crystal produces a voltage, creating a spark.

READY-TO-RUN COVER LESSON

Project the existing lesson slides as normal; read the key facts and talking points above before the lesson starts.

Low-prep silent task (needs no workshop tools or machinery): write or display the numbered questions above without the "Answer:" line, and have pupils answer them in silence on paper. Mark from the answers above at the end, or next lesson.

If the lesson plan calls for tools, machinery, heat or anything hands-on, do not run that part as a non-specialist cover teacher - set the silent task above instead and leave the practical for the subject teacher. See the general workshop safety guide in the Teachers hub.