

THE UNIT QUESTION · MATHEMATICS + SCIENCE

“Can we trust a graph?”

Today: How fast does a hot drink cool down?

LESSON 1 ✓ What a graph tells us	LESSON 2 ✓ Temperature and heat	LESSON 3 · TODAY How fast does a hot drink cool down?	LESSON 4 The graph that tricks you	LESSON 5 Presentation and Unit Report
-------------------------------------	------------------------------------	--	---------------------------------------	--

THE BIG IDEA Heat always moves from the hotter body to the colder one. An insulating material does not “make heat”: it slows the transfer down. On a temperature–time graph, the rate of cooling shows in the slope of the line.	THE MISCONCEPTION WE TARGET “Wool makes you warm.” The lesson opens with an ice cube wrapped in wool: it melts more slowly than an uncovered one. If wool “gave off heat”, it would melt faster.
--	--

1 First pass · Knowledge

WHAT THEY WILL LEARN

#	LEARNING OBJECTIVE	SUCCESS CRITERION	EVIDENCE	MAX
O1	Explains that insulation slows the transfer of heat and does not “make heat”.	Uses the phrases “heat transfer” and “from hotter to colder”; explains the ice-cube experiment.	Explanation in the core · exit ticket, Q1	3
O2	Designs a controlled experiment with one independent variable: the insulating material.	Names what changes, what is measured and at least two control variables (volume, starting temperature, cup, time).	Group plan · exit ticket, Q2	3
O3	Draws a line graph with a suitable scale and compares cooling rates from the slope.	Equal intervals, axes with units, points placed correctly; comparison in °C per 10 minutes.	Group graph · exit ticket, Q3	4
R	Recall: 5 questions from lessons 1–2 (temperature or heat, thermometer scale, reading a graph).			5

Target vocabulary: temperature · heat · heat transfer · insulator · conductor · independent / dependent variable · slope · rate. **Mastered:** at least 80% correct today; confirmed by recall in lesson 4.

2 Second pass · Growth

WHAT THEY WILL DEVELOP AND THROUGH WHICH ROUTE

GROWTH TARGET	WHY IN THIS LESSON	HOW IT SHOWS TODAY		
EXECUTIVE FUNCTIONS Planning ROUTE · WITHIN THE TASK	The experiment has eight readings in 14 minutes; if it is not planned beforehand, it falls apart.	S · WITH SUPPORT Completes the plan with a guiding question (“What will you do if...?”).	I · INDEPENDENTLY Their group foresees a problem on its own and plans for it.	N · IN A NEW CONTEXT Plans the same way in the Challenge or in a new project.
HOLISTIC COMPETENCIES Critical thinking and decision-making ROUTE · WITHIN THE TASK	The prediction “wool makes you warm” clashes with the ice-cube data.	S · WITH SUPPORT Changes prediction when shown the data.	I · INDEPENDENTLY Says unprompted what in the data changed their mind.	N · IN A NEW CONTEXT Asks for data before accepting a claim on another topic.
HOLISTIC COMPETENCIES Global citizenship ROUTE · BRIDGE	The same physics explains why some people spend the winter in the cold.	S · WITH SUPPORT Names a consequence for others when asked “who does it affect?”.	I · INDEPENDENTLY Connects an everyday choice with a specific consequence for someone else, unprompted.	N · IN A NEW CONTEXT Makes the same connection on another topic, without prompting.

Also cultivated, without being recorded today: Communication and collaboration (timekeeper, reader and recorder roles) · Empathy (in the Bridge).
Three routes of cultivation: **within the task** (the academic problem itself) · **Bridge** (a neighbouring social, emotional, ethical or cultural theme) · **way of working** (roles, climate, natural difficulty). Each lesson records the day’s mark (S · I · N); a level is given only in the Developmental Profile.

3 The flow of the lesson

90 MINUTES · SIX STAGES

5' Welcome	10' Warm-up	28' Academic core	24' Application & creation	14' Bridge	9' Reflection
5' 0:00–0:05 Welcome	Each group shows the three materials they found at home (Challenge: “materials that keep the warmth in”) and writes their goal for today in one sentence. LINK TO LESSON 2 GROUP GOAL			A Leads; writes the materials on the board in two columns: “we think it warms” · “we think it keeps warmth in”. B Notes which groups set a measurable goal.	
10' 0:05–0:15 Warm-up	Recall (5'): 5 questions from lessons 1–2, mixed up. One graph, two stories (5'): a line with no title. Each pair writes two different stories that fit it. RECALL · R/5 COGNITIVE FLEXIBILITY			A Reads the questions; picks two stories for the board. B Records the recall score.	
28' 0:15–0:43 Academic core	Phenomenon (6'): two ice cubes, one in wool, put out 20' earlier. Prediction: which has melted more? They check. Worked example (8'): teacher A sets up a variables table (what I change, what I measure, what I keep the same) and plots the first two points. Hinge question (3'): a metal or a wooden spoon in the same room: which is warmer? Planning (11'): each group designs an experiment for wool, foil and nothing, with roles and a “what could go wrong” box. O1 · O2 CRITICAL THINKING PLANNING			A Models the table; asks “What made you change your mind?”. B Counts the answers to the hinge question; records the groups' plans.	
24' 0:43–1:07 Application & creation	Experiment (14'): hot water at about 60 °C, poured only by the teacher. A reading every 2 minutes, eight times. Graph (10'): three lines on the same axes; how many degrees did each cup lose in the first 10 minutes? Comparison on the board. O2 · O3 PLANNING COLLABORATION			A Checks safety and time; asks “What does the slope show?”. B Records how the group handles what it had not foreseen.	
14' 1:07–1:21 Bridge	“A winter without heating”. Mrs Evans's story; reading two cooling lines; questions in pairs; a paper-strip test at the window; each child writes one action (p. 3). APPLYING O3 CITIZENSHIP EMPATHY			A Tells the story, shows the lines, asks the questions. B Records who connects a choice with a consequence for someone else, unprompted.	
9' 1:21–1:30 Reflection	Exit ticket (5'): three questions with confidence 1–4 on each (p. 4). Circle (2'): “What made me change my mind today?” Challenge (2'): the paper-strip check at home. O1–O3 SELF-REGULATED LEARNING			A Hands out and collects the exit ticket. B Records one phrase “in the child's words”.	

4 Bridge · from knowledge to life

14 MINUTES · A ROUTE OF CULTIVATION

BRIDGE · FUEL POVERTY · CARING FOR THOSE AROUND US

“A winter without heating”

A house loses heat just like their cup. Using the same cooling graph, the children read the night in two homes: a well-insulated one and an old one, where the heating goes on for only a few hours because it costs money.

HOW IT UNFOLDS

- Mrs Evans, 79 (4').** A short example story and two cooling lines: her living room and an insulated home, from 10 at night to 6 in the morning.
- They read the slopes (3').** “How many degrees does each home lose by morning?” They use what they have just learned.
- Questions (4')** in pairs, then as a group.
- The paper strip (3').** A test at the classroom window: where the strip moves, heat is escaping. Each child writes one action they can take.

Cultivates: Global citizenship · Empathy.

QUESTIONS FOR DISCUSSION

- What does the graph show about Mrs Evans’s night? How might she feel?
- Who else might be in the same position?
- Which small choice of ours affects someone else?

CARE

We do not ask about the heating or the bills in the children’s own homes. We talk about “people who are struggling”, not “poor people”. The story is presented as an example.

The Bridge is not a moral lesson. We ask, we listen, and the children take a position; the day’s learning gives them the tools to think it through.

5 How · Methods, strategies, practices

MODEL 2 IN PRACTICE

METHODS	STRATEGIES	CLASSROOM PRACTICES
Phenomenon-based learning. The ice cube in wool opens the question. Inquiry-based learning. A controlled experiment with their own design.	Retrieval practice with interleaving · Worked example for the variables table and the first points · Hinge question · Explicit teaching of metacognition.	Think-Pair-Share for predictions · Experiment with roles · Graph reading in the Bridge · Exit ticket.

6 Differentiation

SAME OBJECTIVES, DIFFERENT SUPPORT

MORE SUPPORT	MORE CHALLENGE	FADING THE SUPPORT
- Experiment table with ready-made columns. - Axes already drawn, with a scale. - A sound signal every 2 minutes.	- Predicting the temperature at 20' from the slope, then checking. - Average rate in °C per minute for each material.	In lesson 4 the axes are not given: the group chooses a scale and explains why. This opens the discussion about “the graph that tricks you”.

WHERE THEY WILL MEET IT AT SCHOOL	HOW IT BUILDS ON THE PREVIOUS LESSON
National Curriculum, Science Year 5 · Properties and changes of materials: thermal conductors and insulators; planning fair tests. Mathematics Years 5–6 · Statistics: reading, interpreting and constructing line graphs.	In lesson 2 they separated temperature from heat. Today they measure how heat flows over time and read it on a graph.

Measurable progress on every objective. No comparison with other children.

CogniPraxis · Lesson Plan · Explorers · 3 / 4

7 Assessment

EVERY ASSESSMENT LEADS TO A DECISION

HINGE QUESTION · MIDWAY THROUGH THE CORE

"A metal spoon and a wooden spoon have been in the same room all day. Which one is warmer?" A: the metal one · B: the wooden one · C: they are the same temperature.

CORRECT: C

DECISION RULE

If at least 6 of the 8 choose C, we move on. Otherwise teacher A measures both with an infrared thermometer (3'): "Why does the metal one feel colder?"

WHEN	TYPE	TOOL	WHAT WE DECIDE	WHERE IT IS RECORDED
Warm-up	Diagnostic	Recall: 5 questions from lessons 1–2	Which idea needs a reminder in the core	Progress: before → today
Core	Formative	Hinge question: the two spoons	Move on, or measure with the infrared thermometer	Not scored
Application	Developmental	Observation: planning, critical thinking	Which group needs a guiding question	Mark S / I / N
Application	Authentic	Group graph with three lines	What returns in lesson 4	The day's work
Bridge	Developmental	The action each child writes	What we return to in discussion	Mark S / I / N · citizenship
Close	Summative	Exit ticket · 10 marks	Mastered (≥80%) or revisited	Score per objective O1–O3
Close	Self-assessment	Confidence 1–4 on each question	A conversation when confidence does not match the result	Self-regulated learning

In the Bridge we do not assess what the child believes, but how they think, and only when that is a target for the day.

8 Exit ticket

10 MARKS · ONE QUESTION PER OBJECTIVE · CONFIDENCE 1–4 ON EACH QUESTION

QUESTION 1 · O1

CONFIDENCE ☐1 ☐2 ☐3 ☐4 3 MARKS

Ari says: "A wool scarf makes you warm." Dana wrapped an ice cube in wool and it melted more slowly. What does the experiment show? Use the phrase "heat transfer".

Wool does not make heat (1) · it slows the transfer (1) · correct direction: from hotter to colder (1).

QUESTION 2 · O2

CONFIDENCE ☐1 ☐2 ☐3 ☐4 3 MARKS

We want to compare kitchen foil and felt. Write what we change, what we measure, and two things we keep the same.

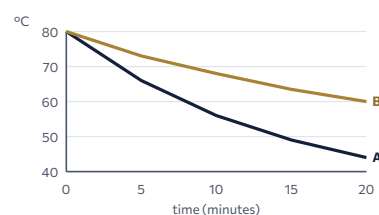
Independent variable (1) · dependent variable (1) · two correct control variables (1).

QUESTION 3 · O3

CONFIDENCE ☐1 ☐2 ☐3 ☐4 4 MARKS

Which cup cooled faster? How many degrees did each lose in the first 10 minutes? How can you see it on the graph?

Cup A (1) · A: 80 → 56, 24 °C and B: 80 → 68, 12 °C (2) · "the steeper line" (1).



CHALLENGE · ~10' WITH THE FAMILY

The paper-strip check: hold a thin strip of paper in front of closed windows and doors. Where it moves, heat is escaping. Mark the spots on a simple plan of your home. If you like, do it at a grandparent's home too.

Bring back: the plan with the spots. It opens lesson 4.

MATERIALS

8 identical cups · hot water at about 60 °C (poured only by the teacher) · 4 digital thermometers · stopwatches · wool or felt · kitchen foil · rubber bands · ice cubes · infrared thermometer · graph paper · paper strips · A/B/C cards · exit tickets.

WHAT GOES INTO THE LESSON REPORT

Score and level on each knowledge objective · progress in recall · S / I / N mark for planning, critical thinking and citizenship · the child's phrase · the day's Bridge with one question for home · the Challenge. The family receives the report after the lesson.