



EduTrend Contents

EDUTECH · SCIENCE · HIGH SCHOOL

Keeping It Warm

Design a controlled experiment on insulation and analyse cooling curves

Ages 15–18

Level: Advanced

75 minutes

Teams of 3

Activity 05

Inside: activity at a glance · step-by-step session plan · facilitator notes · 3 student worksheets · assessment checklist

ACTIVITY 05 · AT A GLANCE

Keeping It Warm

Teams design an experiment to compare how well different materials insulate a beaker of hot water. They identify variables, record temperature every minute for 15 minutes, plot cooling curves, compare initial cooling rates and evaluate sources of uncertainty. Teams present conclusions with justified claims.

Learning outcomes

By the end of the session students can:

- design a controlled experiment;
- record time-series data;
- plot and interpret cooling curves;
- evaluate uncertainty and validity.

KEY WORDS

insulation · cooling curve · rate · gradient · uncertainty · validity

CURRICULUM LINKS

Maths: gradients. Engineering: building insulation. Geography: energy use.

1**OBSERVE**

Look closely

2**QUESTION**

What do we want to know?

3**PREDICT**

What do we think?

4**TEST**

Fair and repeated

5**ANALYSE**

What does the evidence show?

6**SHARE**

Explain and discuss

Materials (per team)

- Beakers
- Thermometers or probes
- Insulating materials
- Kettle (teacher)
- Stopwatch
- Worksheets 1, 2 and 3

Before the session

- Collect insulators: foil, bubble wrap, cotton wool, newspaper.
- Teacher manages hot water.
- Print worksheets.
- Check thermometers.

SAFETY

Hot water: teacher pours. Water not above 60 °C. Wear eye protection. Keep beakers on stable mats.

ACTIVITY 05 · SESSION PLAN

Step by step

Include an uninsulated beaker as a control for comparison.

Time	What happens	Say or ask
0–10 min Question	Pose the insulation question.	<i>"How will we compare fairly?"</i>
10–20 min Design	Plan variables and method.	<i>"What is the control?"</i>
20–50 min Collect	Record temperature every minute.	<i>"Is your data complete?"</i>
50–65 min Analyse	Plot curves; compare rates.	<i>"What does the gradient show?"</i>
65–75 min Evaluate	Discuss uncertainty.	<i>"How confident are you?"</i>

CHALLENGE CARD (print or copy onto the board)

Design and run a controlled experiment on insulation, plot cooling curves and justify a conclusion with evidence and uncertainty.

ACTIVITY 05 · FACILITATOR NOTES

The science know-how in brief

Hot objects cool faster when they are much hotter than their surroundings, so cooling curves are steep at first and then level off. Insulators reduce heat transfer by conduction and convection, which slows cooling.

Comparing the gradient over the first few minutes gives a fair comparison of cooling rates. Validity depends on controlling starting temperature, volume and surroundings.

Common ideas to listen for

- “Insulators make things warm.” They slow heat transfer.
- “Cooling is steady.” It slows as the difference falls.
- “A thicker layer always wins.” Material matters too.

Adapting the activity

Support

Provide pre-drawn axes.

Stretch

Use a data logger and compare with a model of cooling.

WORKSHEET 1

Experimental design

Name: _____

Class: _____ Date: _____

Plan your experiment.

Experimental design

Part	Plan
Independent variable	
Dependent variable	
Control variables	
Control beaker	
Hypothesis	

WORKSHEET 2

Temperature data

Record every minute.

Temperature data

Time (min)	Material A (°C)	Material B (°C)	Material C (°C)	Control (°C)
0				
3				
6				
9				
12				
15				

WORKSHEET 3

Evaluation

Evaluate your investigation.

Conclusion, uncertainty and improvements

FOR THE TEACHER

Assessment checklist

Use during the session. One sheet covers up to eight students; copy as needed.

Student	Designs controlled experiment	Analyses rates	Evaluates uncertainty

Suggested codes: W = working towards · E = expected · G = greater depth

ABOUT THIS ACTIVITY

Keeping It Warm is a sample activity from the EduTrend Contents Edutech Science programme (high school, level: advanced). Every activity in the programme follows the same format: a practical challenge, a clear session plan, facilitator notes and ready-to-print worksheets, so that teachers, club leaders and parents can run it without extra preparation.

Full 15-, 20- and 32-week programmes are available from EduStore at edutrend.org.

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