Family edition

Insulation Lab: The $12 Cooler

Ages 11-14 · about 45 minutes, in one sitting

Your child designs a box to keep an ice cube frozen in Insulation Lab, on a pretend budget. The point is that energy moves from warmer to cooler, and materials that trap still air slow it down.

What you need

- A computer or Chromebook with a current browser.
- The lesson link: mytekdev.com/try/insulationlab?lesson=the-12-dollar-cooler&ref=fam-insulationlab-1. No account, no email and nothing to install.

Before you start: try it once yourself

Open mytekdev.com/try/insulationlab?lesson=the-12-dollar-cooler&ref=fam-insulationlab-1. A short guide opens over the app. An empty shoe box sits on a bench, cut open so its walls show, with a 30 g ice cube on a kitchen scale beside it.

1. **Test the empty box.** Press `Test`. Thirty minutes play in about thirty seconds: dots of energy drift in through the walls, the ice shrinks over a puddle, and it is weighed again: about 22.4 g.
2. **Wrap the ice.** In Wrap the ice, choose Cotton batting and test: about 26.4 g, for $0.25.
3. **Pack it.** In Fill the space, choose Crumpled newspaper and test: about 28.3 g, for nothing.
4. **Line the walls.** Add white foam board in Line the walls. It costs more and buys less than the wrap did. That surprise is the heart of the lesson.

> With one small ice cube in a big box, the cube is too small to cool the air inside, so the walls barely matter and what touches the ice does most. In a full cooler the walls matter more: the 500 g block in Test conditions shows it.

The ideas, in plain words

Thermal energy moves from warmer objects to cooler ones. The room is warmer than the ice, so energy moves into the box and into the ice, and melts it. Insulation does not make cold or keep cold in: it slows energy down. That is the language of MS-PS3-3 and PS3.B.

Good insulators trap still air in small pockets: foam, batting, felt, bubble wrap, crumpled paper. Dense solids like plastic and metal let energy straight through. Cardboard is in between. Foil works differently: it reflects the invisible glow of warm things, so it helps only when it faces air or the sun.

Common mistakes: "keep the cold in"; changing two things at once; and thinking thicker is always better, when the ice stops fitting and the budget runs out.

Do it together

1. Open mytekdev.com/try/insulationlab?lesson=the-12-dollar-cooler&ref=fam-insulationlab-1 together. Guess how many grams of the ice cube will be left, then press `Test`.

   > **You'll know it worked when:** About 22 grams are left.

2. Type a goal in My criteria: how many grams must be left, and the most to spend.

   > **You'll know it worked when:** Each test now says met or missed.

3. Wrap the ice in cotton batting and test, then pack crumpled newspaper around it and test.

   > **If you get stuck:** The guide opens the right step. Wrap it in is a menu under Wrap the ice.
   >
   > **You'll know it worked when:** About 26 grams, then about 28.

4. Try three more changes, one at a time, and say which helped most for the money.

   > **You'll know it worked when:** Your child can point to two tests that differ by one change.

Talk about it

Ask these while you work together. A child who has understood it can answer them without help:

- Which way are the dots moving? Why that way?
- Why did crumpled newspaper beat flat newspaper?
- You changed two things in that test. Which one helped?
- Why did the wrap do more than the foam lining?
- Is your best design under budget? Did it meet your criteria?

> The fourth question is the real test: a child who says the wrap is right against the ice, where the energy goes in, has the idea.

For younger and older kids

Younger: For a younger child, do the first three tests together and talk about why the newspaper worked.

Older: For a teenager, switch to high school and compare the watts per kelvin of two builds.

Keep going

- Switch to the 500 g block in Test conditions and see whether the walls matter more now. Explain why.
- Find the cheapest build that keeps at least 28 g.
- Switch to high school and use the watts per kelvin on the card to compare two builds.

Bring it into other subjects

- Math: find the cost per gram saved for three changes, and rank them.
- Social studies: how did people keep food cold before refrigerators? Read about icehouses packed with sawdust.
- English: write a one-paragraph pitch for your cooler to a buyer with $12.
- Life science: how do animal fur and bird feathers trap air?

For your records

Ready to copy into an hour log, a portfolio or a transcript.

LESSON	Insulation Lab: The $12 Cooler
SUBJECTS	Physical science, Engineering
TIME	45 minutes
WHAT WE DID	Designed and tested an insulated box in a simulation, set criteria and constraints, and compared tests to find which change slowed thermal energy most for the cost.
SKILLS PRACTICED	Engineering design; Thermal energy transfer; Fair testing

Activity sheet (optional)

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/insulationlab?lesson=the-12-dollar-cooler

Essential question: How do you slow down energy getting into something cold, on a budget?

Warm-up: You pack a lunch with an ice pack at 7 in the morning. What could keep it cold until noon?

_____

1. **Vocabulary.** Thermal energy, insulator, criteria, constraint, fair test: write each in your own words.

2. **My criteria and constraints.** At least ____ g of the 30 g cube left after 30 minutes, for no more than $____.
3. **The tests table.** For each test: what I changed _____; the cost $____; grams left ____; met my criteria? yes / no.

1. Which one change did the most for the money? Use two of your tests.

2. Why does a material that traps still air slow energy down?

Quick check

Name: _____

1. Which way does energy move? (A) from the cold ice into the room (B) from the warm room into the ice (C) both ways equally

2. Which is the best insulator? (A) a sheet of metal (B) crumpled paper (C) a plastic plate

3. A team changed the wrap and the lid at once, and kept 4 g more. What should they do to know which change helped?

Answers

QUESTION	ANSWER	WHY
1	B	Energy moves from warmer to cooler. Nothing called cold moves.
2	B	Crumpled paper holds still air in small pockets; metal and plastic are solid.
3	Test one change at a time	Undo one change and test again, so only one thing differs between two tests. A full answer says why: a fair test.

If your state or umbrella school asks, this lesson covers NGSS MS-PS3-3, NGSS MS-ETS1-1, NGSS MS-ETS1-4.

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The app this lesson uses is free and runs in the browser, with nothing to install and no account needed. It is at mytekdev.com.

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