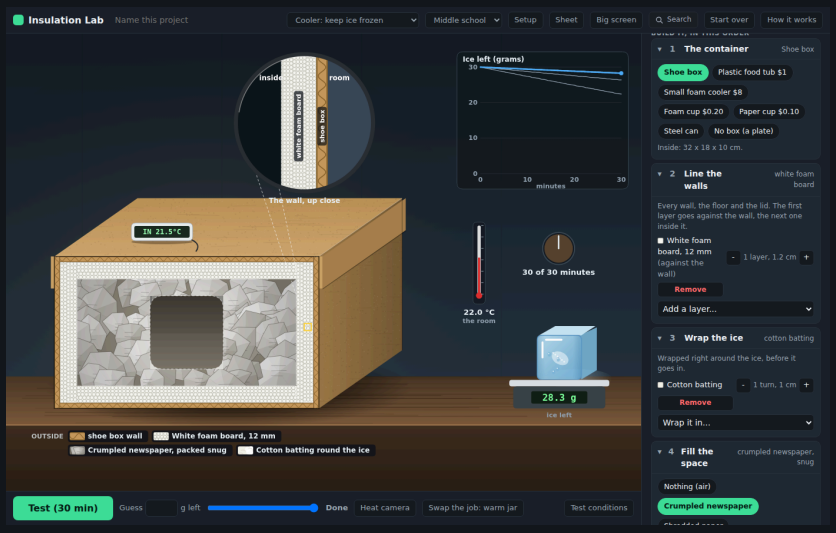
mytekDev

Insulation Lab: The $12 Cooler

Grades 6-8 · 45 minutes

Physical science · Engineering



Slides, rubric and answer key **Print and go** **No student accounts**

Chromebook friendly

What's included

- A one-page overview: objectives, essential question, vocabulary, standards and assessment
- A 45-minute lesson sequence: warm-up, direct instruction, guided practice, independent practice, closure
- Slides for the board: a PowerPoint file that also opens in Google Slides
- A student worksheet with a QR code and a tests table
- A 3-question exit ticket, two to a page, with an answer key
- A rubric: 3 criteria, 4 levels, scored out of 12
- Differentiation for English learners, students with IEPs or 504 plans, and students who need more support or more challenge
- Cross-curricular extensions, and notes for teaching it in grades 4 and 5 and in high school physical science
- Standards: NGSS

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Grades 6-8 · 45 minutes · Physical science, Engineering

Students guess how much of a 30 gram ice cube an empty shoe box will keep for 30 minutes, test it, and find the box hardly helps. They write criteria and constraints, then improve the box one change at a time on a $12 play-money budget: a wrap on the ice, fill packed round it, a lining, tape on the lid. The tests table names each change, and the question becomes which change did the most for the money.

At a glance

ESSENTIAL QUESTION

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

OBJECTIVES

Students will be able to:

- write criteria and constraints for a design: a measurable goal, a time and a cost
- explain that energy moves from the warmer room into the colder ice
- test a design, change one thing, and test again
- use data from several tests to say which change helped most for the money

VOCABULARY

Thermal energy, Insulator, Criteria, Constraint, Fair test

STANDARDS

MS-PS3-3, MS-ETS1-1, MS-ETS1-4

TIME AND MATERIALS

45 minutes, grades 6-8.

- One computer or Chromebook per student
- A projector
- The worksheet and exit ticket, one copy each per student
- The rubric, one copy per student if you grade the work

PREP

Make copies of the worksheet and exit ticket. Before class, open mytekdev.com/try/insulationlab?lesson=the-12-dollar-cooler&ref=tpt-insulationlab-1 once on a student computer: it opens on an empty shoe box with a 30 g ice cube, and checks that your school's filter allows the app. Test it once, then wrap the ice in cotton batting and test again, about five minutes.

ASSESSMENT

- Formative: the questions under What to look for, asked while students work, and the exit ticket (answer key included).
- Summative: the worksheet, scored with the rubric.

TECHNOLOGY AND PRIVACY

Runs in any browser, Chromebooks included, with nothing to install. Students need no account and no email: the link works signed out, and nothing they do is stored on our server unless they choose to save.

Lesson sequence

MINUTES	STAGE	WHAT YOU DO	WHAT STUDENTS DO
0 to 5	**Warm-up** Hook	Show the title, essential question and Today I can slides (about 1 minute). Then the warm-up: what keeps a lunch cold? Write every answer on the board.	Answer the warm-up on the worksheet.
5 to 12	**Direct instruction (I do)** Model it	Project the app with the starter open. Ask for guesses, then press Test on the empty shoe box. Point at the dots: energy coming in from the warm room. About 22 g is left. Show Energy moves in and What touches the ice. > **It's working when:** Do not explain why the empty box did so little yet. Let them find out with the wrap.	Guess, watch, and fill in the vocabulary.
12 to 22	**Guided practice (We do)** Criteria and the first changes	Students open the link or scan the QR code. A short guide walks them through: Test, type their criteria, wrap the ice, pack the space. Ask each team to say its criteria out loud. > **Watch for:** Teams who change two things at once. Ask which of the two did it, and how they could find out.	Set criteria, run three tests, and fill in the first rows of the tests table.
22 to 38	**Independent practice (You do)** Beat your best	Teams improve their design one change at a time, under $12. Walk the room with the What to look for questions. > **If they ask:** "You lined the walls with foam and gained less than the wrap gave you. Why might that be?" The walls	Run at least three more tests, one change each, and fill in the tests table.
38 to 45	**Closure** Showcase and exit ticket	Show the Showcase slide. Two teams name their best change and the grams it bought. Go back to the warm-up list and cross out "keep the cold in". Hand out the exit ticket.	Answer the exit ticket.

Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/insulationlab?lesson=the-12-dollar-cooler&ref=tpt-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.

Background for the teacher

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.

What to look for

Ask these while students work. A student who has understood the lesson 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 student who says the wrap is right against the ice, where the energy goes in, has the idea.

Cross-curricular extensions

- 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?

Vocabulary

Thermal energy	Energy that moves from warmer things to cooler things. In the app it is the orange dots.
Insulator	A material that slows thermal energy down, usually because it traps still air.
Criteria	What a design must do to succeed, like keep 25 g of ice for 30 minutes.

Constraint	A limit on the design, like a $12 budget or what fits in the box.
Fair test	A test where only one thing changes, so you know what made the difference.

Differentiation

ENGLISH LEARNERS

- Keep the vocabulary slide up, and point at the dots on the board as you say "energy": they always move from the warmer side to the cooler side.
- Pair each learner with a partner; the tests table is numbers and short words.
- Accept criteria as two numbers: grams and dollars.

STUDENTS WITH IEPS OR 504 PLANS

- Pair students, one choosing materials and one recording.
- Zoom the browser to 150%; the steps and the bench stay readable.
- Allow three tests instead of six where the IEP allows a modified assignment.

STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "The ___ helped most because it traps ___."
- A check-in after the wrap: every team has two tests before going on.
- Give a starting budget plan: one wrap, one fill, the lid taped.

STUDENTS READY FOR MORE

- 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.

Adapting for other grades

Younger students: In grades 4 and 5, skip the criteria step and run four tests together: empty, wrapped, packed, both; drop the third rubric row; total 8, and 6 meets the objectives.

Older students: In high school, pick high school in the level menu: the card shows watts per kelvin and the energy to melt a gram of ice. Ask students to predict the grams melted in the first minute.

Student worksheet

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?

Insulation Lab: The $12 Cooler

Exit ticket

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?

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Answer key: exit ticket

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.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
Criteria and constraints	A measurable goal in grams with a time, a cost limit, and a reason for each.	A goal in grams and a cost limit.	A goal with no number, or no cost.	No criteria.
Testing	Six or more tests, each with one change named, all under budget or marked over.	Four or more tests with one change each.	Tests with several changes at once.	One test.
Explanation	Names the best change with numbers and explains it with energy moving from warmer to cooler and trapped still air.	Names the best change with numbers and a reason.	Names a change with no numbers or no reason.	No explanation, or says cold moved.

Total: ____ / 12. A score of 9 or more meets the objectives.

Standards

The lesson is built for MS-PS3-3 and the engineering design standards.

FRAMEWORK	CODE	GRADES	STANDARD	HOW THE LESSON MEETS IT
NGSS	**MS-PS3-3**	6-8	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	Students design and test a box that slows thermal energy reaching an ice cube.
NGSS	**MS-ETS1-1**	6-8	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	Teams write a measurable goal and a cost limit before testing.
NGSS	**MS-ETS1-4**	6-8	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	The app is a model that generates data for testing and improving a design.

Checked November 2026 against: NGSS MS-PS3-3, Energy, NGSS MS-ETS1, Engineering Design.

Optional: save student work in a free class

The whole lesson runs at the link on the worksheet, with no accounts and no sign-up.

To keep students' work, and see it all in one place, make a free class. It takes about ten minutes, once, and covers every lesson in this series: mytekdev.com/tools/class-setup

Students in a class open mytekdev.com/tools/insulation-lab/lessons/the-12-dollar-cooler/start instead of the worksheet link. Each one gets their own copy of the starter, and the same link reopens it next time.

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