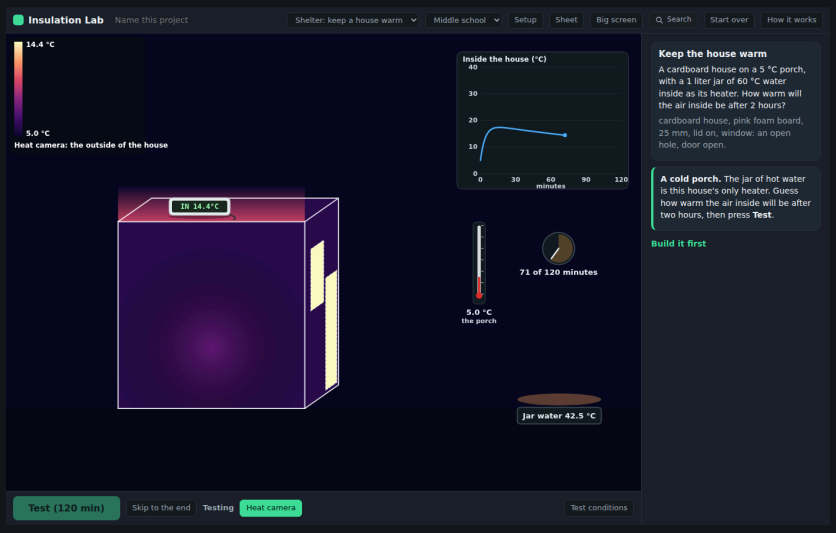
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Insulation Lab: Where Does the Shelter Lose Energy?

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 shelter test 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

Insulation Lab: Where Does the Shelter Lose Energy?

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A small cardboard house sits on a 5 °C porch with a jar of hot water as its only heater. Students test it, look at it with the heat camera, and line the walls: the inside stays twice as warm above the porch. Once the walls are good, the open door costs five degrees. Then they wrap the jar, guessing it will help, and the house gets colder.

At a glance

ESSENTIAL QUESTION

Where does a house lose its energy, and what keeps it in?

OBJECTIVES

Students will be able to:

- use a heat camera picture to find where a house loses energy
- compare how much walls, a door and a window let out
- explain why sealing a door matters more once the walls are insulated
- explain why insulating the heater makes the room colder

VOCABULARY

Thermal energy, Heat camera, Air leak, Heat source, Insulation

STANDARDS

MS-PS3-3, MS-PS3-4

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=where-does-the-shelter-lose-energy&ref=tpt-insulationlab-4 once on a student computer: it opens on the Shelter, a cardboard house with a jar of 60 °C water on a 5 °C porch. Test it, press Heat camera, line it with pink foam board 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: where does warmth escape from a house? List the answers.	Answer the warm-up on the worksheet.
5 to 12	**Direct instruction (I do)** Model it	Project the app on the Shelter. Test the bare house: 9.6 °C inside after two hours. Press Heat camera. Show The heat camera and What two hours on the porch do. > **It's working when:** Point out the jar is the only heater. Everything the house gains comes from it.	Watch, and fill in the vocabulary.
12 to 22	**Guided practice (We do)** The house together	Students open the link or scan the QR code. The guide walks them through: test, the heat camera, a lining, test again. > **Watch for:** Students surprised the lining costs more than $12 for a whole house. That is real: there is a lot of wall. Let them decide whether to go over budget and mark it.	Run the first tests and fill in the first rows of the shelter table.
22 to 38	**Independent practice (You do)** The warmest house	Students try the window, the door and the roof, then guess and wrap the jar. Walk the room with the What to look for questions. > **If they ask:** "The open door cost about one degree in the bare house and five in the lined one. Why the difference?" The door	Fill in the shelter table and answer the questions.
38 to 45	**Closure** Showcase and exit ticket	Show the Showcase slide. Go back to the warm-up list and check each one against the heat camera. Hand out the exit ticket.	Answer the exit ticket.

Before you teach: a ten-minute walkthrough

Open mytekdev.com/try/insulationlab?lesson=where-does-the-shelter-lose-energy&ref=tpt-insulationlab-4. A 30 cm cardboard house on a 5 °C porch, with a window and a door in its right wall and a 1 liter jar of 60 °C water inside.

1. **Test it.** Press `Test`. Two hours play in about forty seconds. Inside: about 9.6 °C.
2. **The heat camera.** Press `Heat camera`. The box is drawn closed, colored by how warm each outside surface is; the window and door are outlined.
3. **Line it.** Add Pink foam board, 25 mm in Line the walls and test: about 18.6 °C, but over the $12 budget: a whole house is a lot of wall.

4. **The door.** In Roof, window and door press Door open and test: about 13.6 °C.
5. **The jar.** Close the door, wrap the jar in cotton batting and test: the house gets colder.

> The wrapped jar result depends on time: at two hours the house is colder, but over a whole night the wrapped jar keeps giving off energy after a bare one has cooled. Worth asking the strongest students about.

Background for the teacher

A house stays warm when energy from its heater leaves slowly. Energy leaves through every surface and with every bit of air that escapes. In a thin cardboard house the walls let so much through that an open door hardly matters; once the walls are insulated, the door becomes one of the biggest leaks. Real homes are the same: sealing air leaks matters most once the walls and attic are insulated.

The jar is the only heat source. Insulating it slows the energy leaving the jar, so less of it warms the air: insulation keeps energy where it is.

What to look for

Ask these while students work. A student who has understood the lesson can answer them without help:

- What does a bright color mean on the heat camera?
- Where does most of the energy leave this house? How do you know?
- Why did the open door matter more once the walls were lined?
- Where does all the energy in the house come from?
- Why did wrapping the jar make the house colder?

> The fifth question is the real test: a student who says the wrap keeps the energy in the jar instead of letting it warm the air has the idea.

Cross-curricular extensions

- Math: make a bar graph of the inside temperature for each build.
- Social studies: how do homes in very cold or very hot places keep their temperature? Look up igloos and adobe.
- Careers: what does a home energy auditor do, and what tools do they use?
- English: write a letter to a landlord explaining what to fix first, with evidence.

Vocabulary

Thermal energy	Energy that moves from warmer things to cooler things.
Heat camera	A camera that shows how warm surfaces are as colors. Warm leaks glow.

Air leak	A gap where warm air escapes and cold air comes in, like an open door.
Heat source	The thing giving off energy. In the app, a jar of hot water.
Insulation	Material that slows thermal energy, usually by trapping still air.

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 shelter table is numbers.
- Accept the explanation as a labeled heat camera sketch.

STUDENTS WITH IEPS OR 504 PLANS

- Pair students, one choosing and one recording.
- Zoom the browser to 150%.
- Allow three tests instead of five where the IEP allows a modified assignment.

STUDENTS WHO NEED MORE SUPPORT

- A sentence starter: "Most energy left through ___ because ___."
- A check-in after the lining: every table has two rows.
- Read the card's "Most of the energy left through" line together.

STUDENTS READY FOR MORE

- Find the warmest house you can build for $12, and explain your choices.
- Explain why the wrapped jar would leave the house warmer over a whole night.
- Research the R-values the US recommends for attics in your climate zone.

Adapting for other grades

Younger students: In grades 4 and 5, test the bare house, the lined house and the open door together; drop the third rubric row; total 8, and 6 meets the objectives.

Older students: In high school, compare the window, door and walls by their share of the energy leaving, and connect it to how real homes lose heat.

Student worksheet

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/insulationlab?lesson=where-does-the-shelter-lose-energy

Essential question: Where does a house lose its energy, and what keeps it in?

Warm-up: Your house feels cold in winter. Where do you think the warmth escapes? _____

1. **Vocabulary.** Thermal energy, heat camera, air leak, heat source, insulation: write each in your own words.

2. **The shelter table.** For each test: what I changed _____; inside after two hours ____ °C; over budget? yes / no.

3. **The heat camera.** The brightest part of the house was _____.

1. Why did the open door matter more once the walls were lined?

2. Why did wrapping the jar make the house colder?

Exit ticket

Name: _____

1. On a heat camera picture of a warm house on a cold night, a bright spot means (A) energy is leaving there fastest (B) the paint is lighter (C) cold is coming in

2. A house has thin walls and an open door. What should you fix first to keep it warmest? (A) the walls (B) the door (C) the jar

3. Why does wrapping the heater make the room colder?

Insulation Lab: Where Does the Shelter Lose Energy?

Exit ticket

Name: _____

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3. Why does wrapping the heater make the room colder?

Answer key: exit ticket

QUESTION	ANSWER	WHY
1	A	A warm surface outside means energy is coming through fast. Cold does not move in.
2	A	With thin walls, they let out far more than the door. Once the walls are good, the door matters.
3	The wrap keeps energy in the heater	Less energy reaches the air in the room. A full answer says insulation slows energy leaving the jar.

Rubric

Score each row from 1 to 4.

Name: _____

CRITERIA	4 EXCEEDS	3 MEETS	2 APPROACHING	1 BEGINNING
Data	Five or more tests recorded, each with one change named.	Four tests with one change each.	Tests with several changes at once.	One test.
Evidence	Uses the heat camera and the card to say where energy leaves, with numbers.	Names where energy leaves with one piece of evidence.	Names a place with no evidence.	No answer.
Explanation	Explains why the door matters more once the walls are good, and why wrapping the jar made the house colder.	Explains one of the two.	Describes a result with no reason.	No explanation.

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

Standards

The lesson is built for MS-PS3-3, with the temperatures for MS-PS3-4.

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 shelter that slows thermal energy leaving.
NGSS	**MS-PS3-4**	6-8	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.	Students relate the energy leaving the jar to the temperatures of the jar and the air.

Checked November 2026 against: NGSS MS-PS3-3, Energy, NGSS MS-PS3-4, Energy.

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/where-does-the-shelter-lose-energy/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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