

Grade: 3-5

What is Energy? Lesson #1C: Effective Insulators

Time: 1-3 class periods

Overview: Students design and conduct an investigation to test insulators.

Essential Questions:

Which materials conduct heat and which materials keep heat in?

Contents:

- Standards addressed
- Vocabulary
- Assessment
- Teacher Information and Procedure
 - Prior knowledge for students
 - Materials
 - What to do in advance
 - Teaching the lesson
 - Gear up
 - Explore
 - Generalize
 - Assess
 - Related Resources in the AMEREF Kit
 - Extensions, Adaptations, and more resources
- Student Handouts:
 - Insulation Box Data Sheet: ICE
 - Insulation Box Data Sheet: Potatoes
- Background

Source:

Adapted from previous AMEREF Curriculum materials

"Copyright secured by the Oregon Museum of Science and Industry."

Effective Insulators

Grades 3-5

1-3 class periods

Overview: Students design and conduct an investigation to test insulators.

Essential Questions:

- Which materials conduct heat and which materials keep heat in?

Assessment:

Can students

- Choose insulators for practical applications?
- Use observations and data to answer questions?

Vocabulary

- Insulator
- Infiltration
- Caulking
- Weather-stripping

Alaska Standards Addressed:

Science GLEs

The student demonstrates an understanding of:

. how energy can be transformed, transferred, and conserved by [4]SB2.1 investigating the effectiveness of different insulating and conducting materials with respect to heat flow and recording the results

- the processes of science by [3,4,5]SA1.1 asking questions, predicting, observing, describing, measuring, classifying, inferring, and communicating [3]SA1.2 observing and describing the student's own world to answer simple questions, [4]SA1.2 observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate [5]SA1.2 using qualitative and quantitative observations to create inferences and predictions

Technology

C1) use technology to observe, analyze, interpret, and draw conclusions;

C2) solve problems both individually and with others

E1) evaluate the potentials and limitations of existing technologies;

Teacher Information and Procedure

Prior knowledge for students: Students should know how to read thermometers.

Materials needed:

Per group (2-4 students)

- Small containers - 4 per group
- Ice cubes
- Thermometers - 4 per group
- Small identical boxes - 4 per group
- Data sheets
- "Insulation materials" such as:
 - Packing material
 - Cloth
 - Styrofoam
 - Cardboard
 - Newspaper
 - Cotton
 - Foam
 - Dried grass
 - Fur
 - Animal skin
 - Mud or dirt
 - Packing bubbles
- Oven mitts
- Warm potatoes - 4 per group
- Insulated cups - 4 per group

SAFETY WARNING:

The insulation materials should be safe, household items, not commercial insulation.

Use oven mitts to pick up potatoes. Students should not touch potatoes if they are too hot.

What to do in advance:

Gather insulation materials and other supplies.
Make copies of data sheets. Students may bring insulating materials and shoe boxes from home.

What to do during the lesson:

Gear up:

Show some pictures of wall tents, log cabins, sod houses, modern houses, and other Alaskan dwellings. Ask students which would "keep the heat in" the best?

What do students do when they are cold? (put on a sweater, hat, or coat) Does clothing give off heat? Why does it keep you warm?

Challenge the class to think of a way to keep cold water cold and hot water hot. Brainstorm and record ideas.

Explore:

Complete data sheet for Alaska Home or design a new data sheet.

And

1. Students work in cooperative groups to devise an insulation plan that will use their materials to keep ice cubes in a container from melting, using just one insulation material at a time. They write their plan on the data sheet.
2. Give each group 4 equal containers of ice cubes and 4 small shoeboxes. Students put containers in the shoebox and surround them with the insulation of their choice. Predict which one will melt fastest and slowest. Record findings, and write analysis on data sheets.

And/Or

1. Show students a potato. Tell students the potato is warm and their challenge is to keep it warm. Brainstorm ideas. Students work in cooperative groups to devise an insulation plan that will use their materials to keep the potato warm, using just one insulation material at a time. They write their plan and predictions of heat loss on the data sheet.
2. Students prepare their insulation boxes. Teacher puts warm potatoes in cups and places them inside each insulation box. Students add a thermometer to cup without disturbing the potato. Record temperatures. Students predict the loss of heat per box, and record findings in 5-minute intervals following the data sheet.

Generalize:

Discuss how the potato, the cup, the box, and the insulators might represent a home in the wintertime. Brainstorm how heat might escape from a home. Make a list of ideas on the board. Ask what openings are necessary for

a home or building. What openings are not necessary?
Discuss ways to insulate a home

Compare natural insulators with man-made insulators.
Discuss traditional forms of insulation and why some of them have been replaced in modern times.

Research traditional insulators used by Alaska Natives.
Report the different resources used in each region and their significance.

Research the cost and effectiveness of different types of home insulators (including freight costs). Report to class.

Assess:

Students design ways to insulate:

- A dog house
- A cold drink in their lunch box
- A stone home on top of a mountain subject to extreme wind and cold temperatures.

Related Resources in the Kit:

- Lesson 2E, "Building the Pipeline"
- NEED CD "Energy Fair" - has a guide to designing experiments
- NEED CD "Energy House" has a transparency showing insulators and conductors
- NEED CD "Energy Works" p 16 - has another insulation experiment
- NATURAL GAS Poster - National Energy Foundation (back)
-has investigation of insulation provided by curtains

Extensions, adaptations, and more resources:

Have students graph their data.

Have students design a test to determine which type of fur hat is the warmest.

Have students investigate how arctic and alpine plants and animals insulate themselves from the elements. Report your findings to the class.

Make models of traditional Alaskan dwellings using natural insulation.

Develop an experiment that measures the insulation in clothing in conjunction with body temperatures.

Conduct an additional warm potato experiment making adjustments to the box and the environment. Cut holes in the box and elevate it on secure blocks. Place full ice cube trays under and around the box. Blow cold air at it.

You can find photos of all types of Alaskan dwellings in Alaska's Digital Archives at <http://vilda.alaska.edu>

Home Energy Brief #1 at
<http://www.rmi.org/sitepages/pid171.php> (scroll to bottom of the page) has more background information on home insulation.

Insulation In Alaska Homes Data Sheet

Student Sheet

Name: _____

Our Insulation Plan:

Home	Insulation Material	Cost	Effectiveness*	Location of material used for insulation
1				
2				
3				
4				

*Scale of 1 to 5 (1=poor, 3=fair, 4=good, 5=excellent)

What kind of insulation works the best?

What improvements could be made for each home?

Insulation Box Data Sheet: ICE

Student Sheet

Name: _____

Our Insulation Plan:

Box	Insulation Material to Be Used	Prediction
1		
2		
3		
4		

Time how long it takes for your ice cube to completely melt in each of the boxes, and record your data

Box 1	Box 2	Box 3	Box 4
Time:	Time:	Time:	Time:

What kind of insulation worked the best?

What would you do differently next time?

Insulation Box Data Sheet: POTATOES

Student Sheet

Name: _____

SAFETY NOTE:

Only safe, non-commercial insulation is to be used.

Potatoes may be hot. Do not touch if too hot.

Design four different insulation boxes to keep your potato from cooling.

Our Insulation Plan:

Box	Insulation Material to Be Used	Prediction
1		
2		
3		
4		

Insulation Box Data Sheet: POTATOES (Continued)

Put a thermometer next to the potato in each box. Record the temperature every 5 minutes for each box.

Time	Temperature: Box 1	Temperature: Box 2	Temperature: Box 3	Temperature: Box 4

What kind of insulation worked the best?

What would you do differently next time?

Background

Alaska is known throughout the country for its winters. Although not all of Alaska is subjected to severe winter temperatures, most of the state has climate conditions that make insulation a must in most homes. The extreme cold, high wind, damp weather, permafrost, and long dark days all affect the ability of a home to stay warm.

The most effective insulators are those which create an air barrier between what is to stay warm and the elements. Windows in Alaska are triple paned, doors are insulated and very thick, arctic entry ways are added to homes, and insulation is packed in the ceiling, floors, and walls and in most instances, thicker than one would find elsewhere. Many try to build their homes with a southern exposure to take advantage of the sun's warmth, and with a wind block barrier to maintain heat.

Any home insulating supplies in Alaska are expensive, especially when adding weight to the item, increasing the cost of freight. Teachers or students may want to talk to a local builder to review the most common insulators and insulation techniques used in your area.