Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

2275 Speedway, Mail Code C9000
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www.esi.utexas.edu

Insulation

Lesson Plan for Grades: 6th – 8th
Length of Lesson: 2 hours

Authored by: UT Environmental Science Institute
Date created: 08/01/2016

Subject area/course: Science

Materials:

- Elaboration/Exploration
  - 3 identical soda cans painted with flat black paint (per team)
  - 3 Thermometers (per team)
  - Stopwatch/ Ruler (1 per team)
  - Oven mitts (1 per team)
  - Insulating materials (wool, Styrofoam, newspaper, aluminum foil)
  - Rubber bands
  - Hot water
  - 200 watt incandescent/flood lamp (1 station for every 2 teams)
- Markers, pens, posters

TEKS/SEs:

§112.18, §112.19, §112.20, Science

(2) Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:
  (A) plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology;
  (B) design and implement experimental investigations by making observations, asking well-defined questions, formulating testable hypotheses, and using appropriate equipment and technology;
  (C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;
  (D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
  (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

(4) Science investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:
  (A) use appropriate tools to collect, record, and analyze information, including life science models, hand lens, stereoscopes, microscopes, beakers, Petri dishes, microscope slides, graduated cylinders, test tubes, meter sticks, metric rulers, metric tape measures, timing devices, hot plates, balances, thermometers, calculators, water test kits, computers, temperature and pH probes, collecting nets, insect traps, globes, digital cameras, journals/notebooks, and other equipment as needed to teach the curriculum

Lesson objective(s):
Students will:

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- Understand how insulating materials work.
- Create a graph showing how heat accumulates or disperses depending on the insulating materials used.

Differentiation strategies to meet diverse learner needs:

- ELL students and students with learning disabilities should have multiple forms of instruction including visual and written instruction sheets as well as verbal instruction and demonstration.

ENGAGEMENT (15 minutes)

- Teacher divides class into teams. Teams have five minutes to answer the following questions as a group:
  - What are insulators?
  - What are some examples of objects or things around they have seen that use insulation?
- Discuss with the whole class individual definitions and what are some everyday examples teams came up with. Share a formal definition of insulation (material that provides resistance to heat flow).
- Introduce the goal of the lesson: Working in teams, you will explore different insulating materials to figure out which one is the best insulator.

EXPLORATION (45 minutes)

- Teams test 2 different materials to see which one is best at maintaining or dispersing heat in a container. Each team is given 3 cans. Teams will pick two insulating materials (wool, Styrofoam, newspaper, aluminum foil) and measure the temperature changes of hot water over a period of 15 minutes. Teams will then pour out the water, insulate their cans again and measure the changes in temperature when the cans are placed under a hot lamp for a period of 15 minutes.
- Teams create posters with information on the two materials selected, their data tables, a graph showing the results and the overall conclusion as to which insulator worked best in each instance. Each team will present their poster in a 5-minute presentation.
  - Teacher walks around the room asking questions about what the students are doing.
  - Teacher listens to student ideas as they talk to each other.
  - Teacher provides support to students as needed (without providing the answer).

EXPLANATION (40 minutes)

- Each team leads a 5-minute presentation highlighting the results of their experiments. Presentations should include:
  - Description of the two materials used for comparison.
  - Overview of their results what happened to the uninsulated can and which material insulated the best in keeping heat in or out.
  - Poster should include table with their results along with a graph for comparison.
    - Teachers encourage students to explain concepts in their own words.
    - Teachers provide important ideas that students provide.
    - Teachers introduce vocabulary, formal labels or definitions as needed.

ELABORATION (20 minutes)

- Teams do additional research on the following questions “What are ‘green’ building materials? What are some new types of ‘green’ insulation being used?”
  - Teachers ask student to use the new vocabulary appropriately.
  - Teachers encourage students to incorporate real world connections.

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EVALUATION (throughout)

- Students will be evaluated on their presentations using the rubrics provided.
    - Teachers ask questions that provide insight into student progress.
    - Teachers observe students as they create posters and look for evidence of understanding.

SOURCES AND RESOURCES

- Dr. Werner Lang's *Hot Science – Cool Talks* #59, "Design with Climate: Building for a Cooler Planet", www.hotsciencecooltalks.org
- CalRecycle, "Green Bulding Materials", http://www.calrecycle.ca.gov/greenbuilding/materials/
- Popular Mechanics, "Stay Warm and Safe with 4 Types of Green Insulation", http://www.popularmechanics.com/home/how-to/a12769/stay-warm-and-safe-with-4-types-of-green-insulation-16441624/
- Solar Energy Activities, Watts On Schools

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TEACHER HANDOUT (EXPLORATION): Keep the Heat In/Out (45 minutes)

Purpose: Explore different insulating materials and create a poster to record the results.

Materials:

- Identical soda cans painted with flat black paint (3 per team)
- Thermometers (3 per team)
- Stopwatch/Ruler (1 per team)
- Oven mitts (1 per team)
- Insulating materials (wool, Styrofoam, newspaper, aluminum foil)
- Rubber bands
- Hot water
- 200 watt incandescent/flood lamp (1 station for every 2 teams)

Safety Information:

- Students need to be careful when handling hot water.
- Students need to use oven mitts/gloves when handling the cans with hot water or those that are under the lamp for long periods of time to avoid burns.
- Students should not look directly at lamps. Remind students to stand behind the lamps or consider putting the lamps at below eye level.

Procedure:

Prior to class:

- Gather and wash enough aluminum soda cans. You will need 3 for each team in your class.
- Paint the outside of the cans with flat black paint so they will not reflect too much heat.
- Gather different insulating materials (wool, Styrofoam, newspaper, aluminum foil) and consider cutting rectangles or squares that will fit the cans. Ensure all pieces are the same size.

During class:

- Each team will have 3-4 members. Make sure all members have an assigned part in the exploration activity.
- Keeping Heat In:
    - Teams will fill the cans to within 1 centimeter of the top with hot water. *Note: If needed, have the teacher or facilitator pour the water in the cans to avoid injuries.*
    - Teams select two insulating materials to test. Ensure that the tops of the can are also covered but make sure teams leave a small hole near the opening to insert the thermometer. Teams should use rubber bands to hold the insulation in place.
    - Two cans are covered with insulation. Third can should not have insulation.
    - Teams should use additional rubber bands to hold the thermometers at the same level for each can (about halfway in). Thermometers should not touch any part of the cans. Initial temperature should be recorded.

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- Teams use timers to record the temperatures at one-minute intervals for 15 minutes. Students should record their results in Table 1.

- Keeping Heat Out:
  - *Note: Teams should use oven mitts or gloves when handling the cans.* Teams remove insulation and thermometers from cans and pour out the liquid.
  - Teams replace the insulation (the one they used in previous experiment) and reposition the thermometers again (making sure it does not touch the edges of the can).
  - Place each can about 30 centimeters away from a lamp. *Note: Lamp should be turned off. Two teams can position their cans around the same lamp.*
  - Record initial temperature in each of the cans.
  - Teams turn on the lamps and record the temperature at one-minute intervals for 15 minutes. Data should be recorded in Table 2.
  - Teams turn off the lamp and remove insulation and thermometers from cans. *Note: Students should use oven mitts or gloves when handling the hot cans.*

- Teams create posters with information on the two materials selected, their data tables, a graph showing the results and the overall conclusion as to which insulator worked best in each instance. Each team will present their poster in a 5-minute presentation. All teams will evaluate at least 3 other teams' posters.

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STUDENT HANDOUT (EXPLORATION): Keep the Heat Out/In (45 minutes)

Explore different insulating materials to figure out which one is the best insulator.

What Your Team Will Need:

- 3 Soda Cans
- 3 Thermometers
- 1 Stopwatch
- 1 Ruler
- 2 Insulating Materials (wool, Styrofoam, newspaper, aluminum foil)
- Rubber Bands
- Oven Mitts
- Hot water
- 200 watt incandescent/flood lamp

Safety Precautions:

- Be careful when handling hot water.
- Wear oven mitts or gloves when handling the cans.
- Do not look directly at the lamps as they may damage your eyes.

Keeping Heat In:

- Select two insulating materials you wish to test. Which material do you think will work as the best insulator?
- Fill the of the cans to within 1 centimeter of the top with hot water. *Note: Be careful when handling the hot water!*
- Use your insulating materials in two of the cans (one material per can). Third can should not have insulation. Ensure that the tops of the can are also covered but make sure to leave a small hole near the opening to insert the thermometer. Use rubber bands to hold the insulation in place.
- Use additional rubber bands to hold the thermometers at the same level for each can (about halfway in). Thermometers should not touch any part of the cans. Initial temperature should be recorded.
- Use Table 1 to record the temperatures at one-minute intervals for 15 minutes.

Keeping Heat Out:

- *Note: Use oven mitts or gloves when handling the cans.* Carefully remove insulation and thermometers from cans and pour out the liquid.
- Replace the same insulation and put in the thermometers again.
- Place cans about 30 centimeters away from a lamp. *Note: Lamp should be turned off. Two teams can position their cans around the same lamp.*
- Record initial temperature in each of the cans. Turn on the lamp and record the temperature at one-minute intervals for 15 minutes. Data should be recorded in Table 2.
- Turn off the lamp and remove insulation and thermometers from cans. *Note: Use oven mitts or gloves when handling the hot cans.*

- Create a poster with information on the two materials selected, the data tables, a graph showing the results and the overall conclusion as to which insulator worked best in each instance. Each team will present their poster in a 5-minute presentation. All teams will evaluate at least 3 other teams' posters.

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STUDENT HANDOUT (EXPLORATION): Keep the Heat Out/In (45 minutes)

Time (Minutes)	Soda Can #1 Insulation:	Soda Can #2 Insulation:	Soda Can #3 Insulation: None
Initial (0 min.)			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
Total Change in Temperature			

Which material was the best insulator?

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Time (Minutes)	Soda Can #1 Insulation:	Soda Can #2 Insulation:	Soda Can #3 Insulation: None
Initial (0 min.)			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
Total Change in Temperature			

Which material was the best insulator?

Was there a difference in the insulators when you were trying to keep the heat in or out?

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STUDENT HANDOUT: Poster Evaluations

Team: ____________________

1	2	3	4
Only one insulating material was used. Tables were incomplete. No graph was included. No conclusion was included.	Two insulating materials were used. Table and/or graph is not clearly labeled or missing. No conclusion was included.	Two insulating materials were used. Tables and graph are clearly labeled. No conclusion was included.	Two insulating materials were used. Tables and graph are clearly labeled. A conclusion is included in the poster.

Comments:

Questions:

Team: ____________________

1	2	3	4
Only one insulating material was used. Tables were incomplete. No graph was included. No conclusion was included.	Two insulating materials were used. Table and/or graph is not clearly labeled or missing. No conclusion was included.	Two insulating materials were used. Tables and graph are clearly labeled. No conclusion was included.	Two insulating materials were used. Tables and graph are clearly labeled. A conclusion is included in the poster.

Comments:

Questions:

Team: ____________________

1	2	3	4
Only one insulating material was used. Tables were incomplete. No graph was included. No conclusion was included.	Two insulating materials were used. Table and/or graph is not clearly labeled or missing. No conclusion was included.	Two insulating materials were used. Tables and graph are clearly labeled. No conclusion was included.	Two insulating materials were used. Tables and graph are clearly labeled. A conclusion is included in the poster.

Comments:

Questions:

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STUDENT HANDOUT: ELABORATION (20 minutes)

Working in your teams, research the following questions.

What are "green" building materials?
What are some new types of "green" insulation being used?

References:

- CalRecycle, "Green Bulding Materials", http://www.calrecycle.ca.gov/greenbuilding/materials/
- Popular Mechanics, "Stay Warm and Safe with 4 Types of Green Insulation", http://www.popularmechanics.com/home/how-to/a12769/stay-warm-and-safe-with-4-types-of-green-insulation-16441624/