TREES AS A VEHICLE FOR ENERGY TRANSFER
(MODIFIED FOR ADEED)

Science Concept:

Thermal energy transfers through conduction. (NOTE: This lesson requires data collection over a three week period.)

Objectives:

The student will:

- explain that energy can be transferred from one place to another;
- analyze data and communicate results in a lab report using appropriate vocabulary; and
- collect and graph data.

GLEs Addressed:

Science

[10] SB2.1 The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by examining energy (i.e., nuclear, electromagnetic, chemical, mechanical, thermal) transfers, transformations, and efficiencies by comparing useful energy to total energy.

[10] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.

Math

[10] S&P-1 The student demonstrates an ability to classify and organize data by organizing, displaying, or explaining the classification of data in real-world problems, using information from tables or graphs that display two or more sets of data.

Vocabulary:

absorption – the process by which one thing absorbs or is absorbed by another

conduction – the process by which heat or electricity is directly transmitted through the material of a substance when there is a difference of temperature or of electrical potential between adjoining regions, without movement of the material

data logger - an instrument that records and monitors temperature in outdoor environments

energy – the capacity of something to generate work

energy transfer – the transfer of energy from one body to another

insulate – material that prevents the transfer of heat or sound

solar energy – energy produced by or derived from the sun

thermal energy – energy derived from or produced by heat

Materials:

- Temperature data loggers (two)
- Calculators (one per student)
- OVERHEAD: "Spruce Trees"

Activity Procedure:

Please refer to the assessment task and scoring rubric located at the end of these instructions. Discuss the assessment descriptors with the class before teaching this lesson.

Gear Up

Process Skills: observing, inferring, and predicting

1. Display the OVERHEAD: "Spruce Trees." Ask students why there isn't any/as much snow within the trees' drip line. Students' possible responses include: (1) the tree is providing shelter to that specific ground

providing both a warmer temperature and a natural umbrella-like cover; (2) there is a thermal energy transfer within the ground (conduction).

Explore

Process Skills: observing, inferring, predicting, communicating, and making generalizations

2. Take the class outdoors and ask students to look at items on the ground and their relationship to the sun, such as general snow cover (aspect), rocks, various types of litter, directional aspects of ground dwellings, and trees.
3. Place one temperature data logger under a tree on top of the snow and another temperature data logger on top of the snow not within the vicinity of any tree. Ask students to predict which temperature data logger will have a greater mean temperature in 24-hours. Will there be a difference in temperatures? Why, or why not? What might happen if the temperature data logger was placed under the snow? Leave the instruments in place for 24-hours, then check the data. Discuss the results with the class.

Generalize

Process Skills: communicating, describing, and inferring

4. Ask the following questions and discuss as a class:
   a. If you found temperature variations between the temperature data loggers, what/where is the energy source that influenced the temperature?
   b. Why is there heat conduction from the area surrounding the tree?
   c. Why is there heat conduction from the ground?
   d. Why is there heat being transferred from the tree into the ground?
   e. Is energy transfer occurring? How?
   f. Where is the heat coming from?
   g. Where is the loss of heat occurring?
   h. What would happen if the data logger was placed on a dark surface?

Experiment

Process Skills: observing, hypothesizing, controlling variables, investigating, and making generalizations

5. Ask students to formulate an hypothesis to answer the following questions:
   a. Which temperature data logger will have a greater-than-mean temperature; one buried in snow beneath a tree, or one buried in snow in an open area away from trees?
   b. What would the dependent, independent, and controlled variables be in an experiment designed to to answer this question?
6. Program the data loggers to record temperature every six hours for three consecutive weeks.
7. Place one temperature data logger (variable) at the ground base of a mature spruce tree under a blanket of snow. (NOTE: The depth of snow should be the same as the level under the spruce tree.) The other temperature data logger (control) will be placed under the snow on the exposed ground in an open area (field, meadow, etc.) making sure it is not within the vicinity of any trees, however it should be within 100 feet of the other temperature data logger.
8. Download data from each data logger after three weeks.

Interpret

Process Skills: making generalizations, inferring, communicating, describing, collecting and analyzing data, and measuring

9. Ask students to graph the data from the data loggers and analyze the graph. Was their hypothesis correct? Ask them to explain. Ask students to answer the following questions.
   a. If you found temperature variations between the temperature data loggers, what/where is the energy source that influenced the temperature?
   b. Why is there heat conduction from the area surrounding the tree?
   c. Why is there heat conduction from the ground?

d. Why is there heat being transferred from the tree into the ground?
e. Is energy transfer occurring? How?
f. Where is the heat coming from?
g. Where is the loss of heat occurring?
h. What would happen if the data logger was placed on a dark surface?
i. What are the dependent, independent, and controlled variables?
j. How did the temperatures above the snow compare with those under the snow?

Apply

Process Skills: observing, inferring, predicting, communicating, and making generalizations

10. Ask students to respond to the following questions: During winter months, would moose meat be better thermally insulated when stored inside a giant cooler, or outside? Do moose bed down at night in an open or sheltered area? Why?

TREES AS A VEHICLE FOR ENERGY TRANSFER

RUBRIC

Assessment Task

Ask students to write a lab report in which they analyze the information from the data loggers. Students should explain why there was or was not a difference in temperature. If there was a difference, they should describe the energy transfer using vocabulary used in the lesson. Students should create a single line graph with both sets of collected data for comparison. Students also need to calculate the means, medians, and modes of the two temperature data loggers and include the statistics in the write up.

Rubric

Objective	GLE	Below Proficient	Proficient	Above Proficient
The student explains that energy can be transferred from one place to another.	[10] SB2.1	The student does not explain that energy can be transferred from one place to another.	The student explains that energy can be transferred from one place to another.	The student explains that energy can be transferred from one place to another and provides a real-life example.
The student analyzes data and communicates results in a lab report using appropriate vocabulary.	[10] SA1.1	The student does not analyze data or does not communicate results in a lab report using appropriate vocabulary.	The student analyzes data and communicates results in a lab report using three to four appropriate vocabulary words.	The student analyzes data and communicates results in a lab report using five or more appropriate vocabulary words. The student's report contains inferences and/or suggestions for further investigations.
The student collects and graphs data.	[10] S&P-1	The student does not collect, or graph data from two data sets, or the means, medians, and modes are missing or incorrect.	The student collects and graphs data from two sets of data. Graphs have titles, labels and scales. Means, medians, and modes from the two sets of collected data have no more than one error.	The student collects and graphs data from two sets of data. Graphs have titles, labels and scales. Means, medians, and modes from the two sets of collected data have no errors.

SPRUCE TREES

OVERHEAD