MEASURING HEAT ENERGY IN VARIOUS SOLIDS AND LIQUIDS

BIG IDEA 6: EARTH STRUCTURES
BIG IDEA 8: PROPERTIES OF MATTER

BENCHMARKS AND TASK ANALYSES

SC.3.E.6.1 Demonstrate that radiant energy from the Sun can heat objects and when the Sun is not present may be lost.
The student:

- investigates and understands that objects absorb and release heat.
- understands that the Sun emits heat.
- investigates that objects heated by the Sun can lose heat when the Sun is not present.

SC.3.P.8.1 Measure and compare temperatures of various samples of solids and liquids.
The student:

- uses a thermometer to measure and graph the temperatures of various solids (e.g., soil, sand, rice, beans, clay, etc.).
- compares and contrasts the temperatures of various solids.
- uses a thermometer to measure and graph the temperatures of various liquids (e.g. water, soda, milk, orange juice, hand soap, vinegar).
- compares and contrasts the temperatures of various liquids.

SC.3.N.1.1 Raise questions about the natural world, investigate them individually and in teams through free exploration and systematic investigations, and generate appropriate explanations based on those explorations.
The student:

- poses and investigates questions individually and collaboratively through free exploration and systematic investigations.
- draws conclusions based on the results of the explorations.

SC.3.N.1.3 Keep records as appropriate, such as pictorial, written, or simple charts and graphs, of investigations conducted.
The student:

- records in a science notebook, pictorial or written information or simple charts and graphs of investigations conducted.

SC.3.N.1.4 Recognize the importance of communication among scientists.
The student:

- understands the importance of communicating results.

SC.3.N.1.7 Explain that empirical evidence is information, such as observations or measurements, that is used to help validate explanations of natural phenomena.

KEY QUESTIONS

What happens to the temperature of solids and liquids when the Sun heats them?
What happens to the temperature of solids and liquids when the Sun is not present?

TEACHER BACKGROUND INFORMATION

The Sun is the closest star to the Earth and provides us with heat and light. Objects absorb and release heat energy so when the Sun is heating and lighting an area, the objects in that area will become warmer. As the objects become warmer, their temperature will rise. Temperature is the

measure of heat energy in an object. Thermometers are used to measure heat energy and the unit of measurement used is a degree. Thermometers can be read in either Celsius or Fahrenheit.

MATERIALS

Per group
cup of sand
cup of water
cup of packing peanuts
cup of uncooked rice
cup of soda
cup of juice
6 thermometers

Teacher
solid Flavor Ice pop (frozen)

Per Student
frozen Flavor Ice pop

SAFETY

Caution students to avoid touching the liquids once the Sun has warmed them.
Tell students to report any broken thermometers immediately to the teacher.

TEACHING TIPS

- Teach students how to accurately read a thermometer prior to this lesson.
- Do not leave the materials in the Sun for too long or the temperatures on the thermometers will max out and the readings will be inaccurate.
- Flavor Ice pops are the rectangular popsicles in clear plastic that can be eaten once one end is cut off. These are not regular popsicles in white plastic. The students need to be able to see the solid and liquid in the plastic.
- Keep your own data tables for use in the Explain section on Day 2. Sometimes student data can be inaccurate and it is helpful to have adult data for students to analyze.

ENGAGE (Day 1)

1. Create a circle map about the Sun.
2. Ask:
   - *What is the Sun?* (a star)
   - *Why does it appear so large and bright to us on Earth?* (It's the closest star to Earth)
   - *What are two things that the Sun provides the Earth?* (heat and light energy)
   - *How do we measure heat energy?* (thermometer)

EXPLORE (Day 1)

1. Show students a solid Flavor Ice pop (frozen).
2. Ask*: How could I turn this solid into a liquid?* (heat it)
3. Ask*: What could I use in the classroom to heat the solid?* (microwave, Sun, hands, etc)
4. Pass out solid (frozen) Flavor Ice to each group and tell them to turn the solid into a liquid without leaving their seats.
5. Stop students every minute or two to discuss what is happening in each group.
6. Ask*: What do you observe?* (Flavor Ice is melting, my hands are cold)
7. Ask*: How do you know the solid is turning into a liquid?* (I can see colored water where there was ice before)
8. Ask*: What made the solid turn into a liquid?* (heat from my hands)

9. Ask*: How do your hands feel?* (cold, less warm)
10. Ask*: Did the Flavor Ice make your hands cold or did your hands make the Flavor Ice warm?* (hands made Flavor Ice warm, that's why it's melting from a solid to a liquid)

EXPLAIN (Day 1)

Discuss concepts through asking:

- *Why did the Flavor Ice melt?* (heat from my hands)
- *Why did my hands feel cold?* (released heat energy to the Flavor Ice)
- *Why did the Flavor Ice feel warmer* (evidence was solid turning into liquid)? (Flavor Ice absorbed heat energy from hands)
- *Can objects absorb heat energy?* (yes)
- *Can objects release heat energy?* (yes)
- *Does the Sun come down and grab us to make us warm?* (no)
- *How come we feel warmer from sunlight?* (Sun releases heat energy and light energy to Earth through the air)
- *Does heat energy have to actually touch an object to warm it?* (No, a pot on the stove releases heat energy to the water inside the pot)

ENGAGE (Day 2)

Ask:

1. *Do you think all solids have the same temperatures? Why or why not?*
2. *What could we do to find out if all solids have the same temperature?*
3. *Do you think all liquids have the same temperatures? Why or why not?*
4. *What could we do to find out if all liquids have the same temperature?*
5. *Do you think the Sun could release heat energy into solids?*
6. *Do you think the Sun could release heat energy into liquids?*

EXPLORE (Day 2)

1. Classify the cups of water, packing peanuts, rice, sand, soda, and juice as solids or liquids.
2. Record on board which objects are solids and which are liquids.
3. Tell students to create a data table listing all the solids and a label for temperatures.
4. Record the inside temperature of each solid and liquid.
5. Go outside and place the cups in a sunny area.
6. Discuss that each cup has the same amount of material in it to make it a fair test.
7. Place thermometers in each cup. Make sure that the thermometers are in the same place inside each cup to make this a fair test.
8. Ask*: What is the one thing we are changing in our fair test?* (Type of material)
9. Record temperatures every 2 minutes for 10 minutes.
10. Take cups inside classroom.
11. Continue recording temperatures every 2 minutes for 10 minutes.

EXPLAIN (Day 2)

Display teacher data tables for temperatures of solids. Ask the following questions to stimulate discussion:

- *What do you notice about the temperatures of solids? Of the liquids?*

- *What happened to the temperatures of the solids and liquids when we left them in the sunlight?* (The temperatures rose) *Why?* (Heat energy was released from the Sun to them)
- *Which solid heated up the fastest? Which liquid heated up the fastest? Why do you think that is? How do we know which solid/liquid heated the fastest?* (Measurements written on data table)
- *Which solid heated up the slowest? Which liquid heated up the slowest? Why do you think that is?*
- *What happened to the temperatures of the solids/liquids once we brought them back into the classroom away from the sunlight?* (The temperatures lowered) *Why?* (Heat energy from the Sun was no longer available)
- *Why do we need to gather data?* (So others can learn from our fair tests, to prove what we saw, to support the conclusions we make)

EXTEND AND APPLY

Allow students to record temperatures of other solids and liquids (with and without heat energy from the Sun)

ASSESSMENT

Check science notebooks for evidence of understanding the key questions, complete and accurate data tables, and accurate diagrams (labeled pictures).