Sixth Grade Strand 6.2 Scope & Sequence
Energy Affects Matter
Salt Lake City School District 2023-2024

Standard 6.2.1: Develop models to show that molecules are made of different kinds, proportions, and quantities of atoms. Emphasize understanding that there are differences between atoms and molecules, and that certain combinations of atoms form specific molecules. Examples of simple molecules could include water (H2O), atmospheric oxygen (O2), or carbon dioxide (CO2). (PS1.A)

Standard 6.2.2: Develop a model to predict the effect of heat energy on states of matter and density. Emphasize the arrangement of particles in states of matter (solid, liquid, or gas) and during phase changes (melting, freezing, condensing, and evaporating). (PS1.A, PS3.A)

Standard 6.2.3: Plan and carry out an investigation to determine the relationship between temperature, the amount of heat transferred, and the change of average particle motion in various types or amounts of matter. Emphasize recording and evaluating data and communicating the results of the investigation. (PS3.A)

Standard 6.2.4: Design *an object, tool, or process* that minimizes or maximizes heat energy transfer. *Identify criteria and constraints, develop a prototype for iterative testing, analyze data from testing, and propose modifications for optimizing the* ***design solution***. Emphasize demonstrating how the structure of differing materials allows them to function as either conductors or insulators. (PS3.A, PS3.B, ETS1.A, ETS1.B, ETS1.C)

Instructional Pacing for Strand 6.2 Energy Affects Matter (Oct. 30- Dec. 20) OpenSciEd 6.2 Thermal Energy Unit			
Week of Oct. 30 Lesson 1	**Week of Nov. 6** Lesson 2	**Week of Nov. 13** Lesson 4	**Week of Nov. 20** Lesson 9
Week of Nov. 27 Lesson 10	**Week of Dec. 4** Lesson 11	**Week of Dec. 11** Lesson 12 **Recommended RISE Benchmark 6.2.2**	**Week of Dec. 18** Lesson 16

Unit information

OpenSciEd is an open-education resource that supports high-quality instruction and implementation of 3D standards. In its 6.2 Thermal Energy unit, *How can containers keep stuff from warming up or cooling down?* students investigate different cup features to learn how energy affects matter.

This scope & sequence includes eight suggested lessons out of OpenSciEd's eighteen-lesson unit. Each lesson is intended to last multiple days as specified in the lesson outline. Teachers should feel free to condense, supplement, and otherwise adjust these lessons as necessary to fit their classroom needs.

Teacher edition (see p. 23 for vocabulary guidance)
Student edition
All unit materials (including Spanish student edition)
Student videos, teacher videos, and simulations

Lesson 1
Week of October 30, 2023

Lesson information	Lesson materials
Investigative Question: Why does the temperature of the liquid in some cup systems change more than in others? **SEEd Standards:** 6.2.1, 6.2.2, 6.2.3 **What students will figure out:** • The cup system includes the different parts of the cup and the water and air inside the cup. All of these parts work together (interact) to form the system. • Some systems have structural features that help maintain the temperature of a substance inside the system, keeping the substance hot or cold longer compared with other systems.	Prepare according to directions on p. 30 of teacher edition • Slide deck • (1) 16 oz “regular” cup • (1) 16 oz “fancy” cup • Student science notebooks • Ice • Water • (2) thermometers • (1) 500 mL beaker • Timer • Chart paper/whiteboard/markers • Sticky notes

• Heat can enter the cup system and/or cold can leave the cup system, and maybe gases can escape the system too.	
Lesson 2 Week of November 6, 2023	
Lesson information	**Lesson materials**
Investigative Question: What cup features seem most important for keeping a drink cold? **SEEd Standards:** 6.2.1, 6.2.2, 6.2.3, 6.2.4 **What students will figure out:** • Some systems have structural features that are designed to help maintain the temperature of a substance inside the system. • The cup features that seem to play a significant role in keeping a drink cold are a lid, double walls, and maybe the type of cup material.	Prepare according to directions on p. 51 of teacher edition • Slide deck • Science notebooks • Colored pencils • 1 timer or stopwatch per group • (1-2) thermometers per group • (1) 500 mL graduated cylinder or beaker per group • (20) 16 oz single-wall plastic cups with lids • (4) 16 oz single-wall metal cups with lids • (2) 16 oz double-wall plastic cups with lids (note: students can stack 2 single-wall cups together to make a double-wall cup) • (10) 16 oz paper cups with lids • (20) plastic straws clear plastic wrap • (3-4) pitchers of ice-cold water (chilled to ~6℃ and enough for each group to have 400 mL for their cup) • Ice • Aluminum foil • 1 roll of tape • Lamp with 100-watt bulb (optional) • Whiteboard/chart paper/markers

<table>
<tr><th colspan="2">Lesson 4
Week of November 13, 2023</th></tr>
<tr><th>Lesson information</th><th>Lesson materials</th></tr>
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Investigative Question:
How does a lid affect what happens to the liquid in a cup?

SEEd Standards:
6.2.1, 6.2.2, 6.2.3, 6.2.4

What students will figure out

- A cup with a lid helps to maintain the temperature of a hot liquid inside it longer than a cup without a lid.
- The lid also slows down matter loss from the system.
- Matter has mass and takes up space. Liquids and gases are made of particles of matter. Particles in a gas have a lot of space between them but those in liquids do not.
- The smallest particle of water is a molecule, and it is much smaller than we can see. Molecules of water in liquid form go into gas form over time (evaporation).
- An open system has enough space between the solid parts of the system for particles of matter to get in or out. A closed system is one in which no matter can enter or exit.
- The hot liquid still cools down even when we prevent most matter from leaving the cup system by using a lid.

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Prepare according to directions on p. 80 of teacher edition

- Slide deck
- Handouts listed on p. 80 of teacher edition
- Safety goggles
- Science notebooks
- Note cards
- tape
- markers
- 800 mL hot water per group
- (1) 500 mL graduated cylinder or beaker per group
- (4) 16 oz single-wall plastic cups per group
- (2) clear plastic lids per group
- (2) thermometers per group
- (1) timer per group
- (1) digital scale per group
- (1) calculator per group
- (1) bag of 19 blue chips per group
- (19) blue magnets
- (1) bag of 4 yellow chips per group
- (4) yellow magnets
- (2) 16 oz single-wall plastic cups and (1) lid for whole class demo
- Whiteboard/chart paper/markers

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<tr><th colspan="2">Lesson 9
Week of November 20, 2023</th></tr>
<tr><th>Lesson information</th><th>Lesson materials</th></tr>
<tr><td>Investigative question:
How does the temperature of a liquid on one side of a cup wall affect the temperature of a liquid on the other side of the wall?

SEEd Standards:
6.2.1, 6.2.2, 6.2.3, 6.2.4

What students will figure out:

• When the temperature of a sample of matter in one system decreases, the temperature of the matter in the neighboring system increases.
• When the temperature difference between two neighboring systems is great, more energy transfers between them.
• Heat or cold can move through the wall of the cup system.</td><td>Prepare according to directions on p. 157 of teacher edition
• Slide deck
• Handouts listed on p. 157 of teacher edition
• Science notebooks
• Note cards
• (1) calculator per student
• 400 mL room-temperature water
• 400 mL water heated to 50°C
• 400 mL water chilled to 6°C
• (4) 9-oz single-wall plastic cups
• (4) Rubbermaid Take Along Twist and Seal containers (size: 2 cup) or 16 oz deli container
• (8) thermometers
• (1) beaker
• (1) timer
• marker</td></tr>
<tr><th colspan="2">Lesson 10
Week of November 27, 2023</th></tr>
<tr><th>Lesson information</th><th>Lesson materials</th></tr>
<tr><td>Investigative question:
What is the difference between a hot and a cold liquid?

SEEd Standards:
6.2.1, 6.2.2, 6.2.3

What students will figure out:

• The movement of particles is related to the temperature of the water, with particles in colder water moving less than particles in hotter water.</td><td>Prepare according to directions on p. 169 of teacher edition
• Slide deck
• Handouts listed on p. 169 of teacher edition
• Science notebooks
• Note cards
• (3) 9-oz plastic cups per group
• Food coloring
• (1) 500 mL beaker per group
• Pitcher of cold water (~6°C)
• Pitcher of room temperature water
• Electric kettle or other implement for heating water</td></tr>
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<tr><th colspan="2">Lesson 11
Week of December 4, 2023</th></tr>
<tr><th>Lesson information</th><th>Lesson materials</th></tr>
<tr><td>Investigative question:
Why do particles move more in hot liquids?

SEEd Standards:
6.2.1, 6.2.2, 6.2.3, 6.2.4

What students will figure out:
A particle’s speed is related to how much kinetic energy it has.
The particles in hot liquids and gases have more kinetic energy than the particles in cold liquids and gases.
Liquids and gases are made of particles that can move around freely.</td><td>Prepare according to directions on p. 183 of teacher edition
Slide deck
Handouts listed on p. 183 of teacher edition
Poster paper/markers
Science notebooks
Note cards
Tape
Perfume or scented oil</td></tr>
<tr><th colspan="2">Lesson 12
Week of December 11, 2023</th></tr>
<tr><th>Lesson information</th><th>Lesson materials</th></tr>
<tr><td>Investigative question:
How does the motion of particles compare in a sample of matter at a given temperature?

SEEd Standards
6.2.1, 6.2.2, 6.2.3

What students will figure out:
Not all particles in a sample of matter have the same kinetic energy.
Kinetic energy is transferred from one particle to another in a particle collision.
Temperature is a measure of the average kinetic energy of the particles in a sample of matter.
The total kinetic energy of a sample of matter is the sum of the kinetic energy of all the particles in that sample. If you add more particles to the sample, the total kinetic energy increases but the temperature (the</td><td>Prepare according to directions on p. 195 of teacher edition
Slide deck
Handouts listed on p. 195 of teacher edition
Science notebooks
Copies of handouts specified in lesson
Laptops or tablets
Claims posters from previous lesson
(1) timer
Poster paper/markers</td></tr>
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<tr><td>average kinetic energy) might stay the same.</td><td></td></tr>
<tr><td colspan="2">Recommended RISE Benchmark
6.2.2
Take any time before December 20</td></tr>
<tr><td colspan="2">Lesson 16
Week of December 18, 2023</td></tr>
<tr><td>Lesson information</td><td>Lesson materials</td></tr>
<tr><td>Investigative question:
How can we design a cup system to slow energy transfer into the liquid inside it?

Note: Because engineering requires testing, revising, and re-testing design solutions, consider shortening this lesson to give students more time to revise and re-test their designs. Lesson 17 provides guidance on how to conduct revisions.

SEEd Standards:
6.2.1, 6.2.2, 6.2.3, 6.2.4

What students will figure out:
The more clearly a design task is defined, the more likely the solution (cup system) will meet the criteria and constraints.
A designed cup needs to be tested and then modified on the basis of the test results that will help evaluate the solution to how well it meets the criteria and constraints of a problem.</td><td>Prepare according to directions on p. 251 of teacher edition
Slide deck
Handouts listed on p. 251 of teacher edition
Science notebooks
Copies of handouts specified in lesson
(1) 16oz single-wall plastic cup per group
(1) thermometer per group
(1) ruler per group
(1) lamp with 100-watt bulb per group
(1) 500 mL beaker per group
Plastic lids
Aluminum foil
Plastic wrap
Foam and/or felt
Plastic straws
Cotton balls
Paper towels
Cardboard wrap
Paper cups
Paint/paintbrushes
Rubber bands
Tape
Glue
Ice cold water (~6°C)</td></tr>
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