Unit 2: Water! From Waves to Weather

Lesson 2

Heat Energy

[Image: Illustration of a person taking a picture of a volcano eruption.]
Heat energy makes molecules move faster. Students learn to explain heat energy observed everyday on a molecular basis. They also learn ways in which heat energy moves from warmer objects to cooler ones.
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Ready?

Nothing to prepare.

Set?

- Unit 1-Lesson 1-Activity 1: Matter Matters (Matter)
- Unit 2-Lesson 2-Activity 1: Warm, Warmer, Warmest (Add Heat)
- Unit 2-Lesson 2-Activity 2: Pass It On (Heat Transfer)

Go!

Develop Know-Wonder-Learn chart with students.
Think about it...
What is one type of energy?

Launch!

Produce heat energy individually!

• Consider temperature of your hands. Warm? Cool?
• Rub hands together quickly for thirty seconds.
• Consider temperature of your hands again. Warmer? Cooler? Why did your hand temperature change?

How it works
Heat! When you rub your hands together you create friction. Friction produces heat. Aunty says you also use friction when you rub together two sticks to create fire.

Scientists Say...
...thermal energy instead of heat energy.

Did You Know?
Nearly all of Earth’s heat energy comes from the sun!
HOW DOES HEAT ENERGY EFFECT MOLECULES?

Heat energy makes molecules move faster.

Ready?

Explore
Heat some water.

Elaborate
Boil and peel an egg.
Make sure bottle’s opening is a little smaller than an egg’s width.

Set?

• Unit 1-Lesson 1-Activity 1: Matter Matters (Matter)
• Unit 1-Lesson 2-Activity 5: Making Changes (Changing States)
• Unit 2-Lesson 2-Activity 2: Pass It On (Transfer Heat)
• Unit 4-Lesson 1-Activity 3: Hot! Hot! Hot! (Heat from Sun)
• Unit 4-Lesson 1-Activity 4: Blown Away (Wind)

Go!

Develop Know-Wonder-Learn chart with students.

Materials
Cold water
Hot water
Clear glass bowls (2 per group)
Food coloring (liquid)
Hard-boiled egg
Plastic juice bottle
Matches (3 sticks)
Plastic water bottle (with cap) (1 per student)
Rice (uncooked)

Standards
SC.K.1.1
SC.1.2.2
SC. 2.1.1
SC. 2.6.1

Warm, Warmer, Warmest
(Add Heat)
Think about it...
What happens to molecules after they receive heat energy?

**Engage**

Play *Heat, No Heat* as a class.
Played similar to *Red Light, Green Light*.

- **Followers:** Pretend to be molecules.
  Stand still and close together in a group.

- **Leader:** Call out, “Heat!”
  Followers: Slowly wiggle and move apart. Then, wiggle faster, jump and continue to move apart even more.

- **Leader:** Call, “No Heat!”
  Followers: Reverse “heat” movement. Over time, slow down to a wiggle and stand close together.

- **Repeat various times.**

- **Discuss.**
  Did you notice how slow and squished molecules became when you remove heat and how far apart and fast when you add it?

**Scientists say...**

...absolute zero for the temperature where an object’s molecules do not move at all. Although many have tried, no one has removed all the heat energy from an object.

**Reading Resource**

*All About Heat* by Lisa Trumbauer (J 536 Tr)

**Video Resource**

*Bill Nye the Science Guy: Heat* (J DVD-Nonfiction)
**Explore**

Do the *Heated Water* activity in small groups.

- Fill a clear, glass bowl with cold water.

- Fill an identical bowl with same amount of hot water.

- Put a drop of food coloring into center of each bowl.
  Wait until water has stilled before dropping in the coloring.

- Observe and record what happens.

**Activity Extension**

*Make activity into an experiment!*

- Ask a question,
  Do molecules move faster in hot or cold water?

- Do background research.

- Construct a hypothesis.
  “If (I do this), then (this) will happen.”

- Make a prediction.

- Test with an experiment.
  Create a control: Fill bowl with room temperature water. Create a variable: bowl with hot water or bowl with ice water. Put a drop of food color into center of each bowl.

- Analyze data.

- Communicate results.

Think about it...
Do molecules move faster in hot or cold water?
Explain

Heat is a type of energy. Adding heat energy to something makes its molecules move faster and faster. It energizes the molecules!

What happens to molecules when you add heat energy?
Movement! When something becomes hotter, its molecules move faster. When it becomes cool, its molecules move slower.

Do molecules move faster in hot or cold water?
Hot! Warm water’s molecules bump into food coloring molecules. This transfers heat energy, which heats up food coloring’s molecules so they move faster. This more quickly disperses the dye.

Did You Know?
Even molecules in frozen objects move around a little.

Think about it
When you add ice to something, you do not add cold energy. It does not exist! Instead, you remove heat energy.

NOAA Link
Sometimes it feels hotter than what you read on a thermometer. A Heat Index combines temperature and humidity. Check out NOAA’s National Weather Service’s heat index calculator.
www.noaa.gov
Search “heat index calculator”
Think about it...
How can you demonstrate heat is a type of energy?

Elaborate

Watch *Tricky Egg* demonstration as a class.

- **Volunteer:** Place peeled, hard boiled egg on top of uncapped bottle. Show how the egg does not fit through the opening.

- **Teacher:** Light three matches at the same time. Blow them out and quickly drop them in the bottle.

- **Volunteer:** Immediately place egg on the bottle opening again. Observe what happens.

How it works

Egg moved! Aunty says this happened because heat energy increases activity of air molecules inside the bottle, which expanded the air inside the bottle. This caused the air in the bottle to push its way around the egg and outside. When the matches fully extinguished, the air inside the bottle cooled and contracted. The warmer air outside then pushed its way into the bottle and pushed the egg with it.
Evaluate

How does heat energy effect molecules?
Answer by creating and playing with shakers!

• Fill plastic bottle half-full of dry rice. Secure cap.

• Shake your shaker back and forth. Think of the rice as molecules.

• Change the speed you shake as your teacher calls out heat energy cues. Examples: Add heat energy! Remove heat energy!

Does a refrigerator add cold energy to cool something?
Why or why not?

Assess

SC.K.1.1 Use the senses to make observations.

SC.1.2.2 Describe a variety of changes that occur in nature.

SC.2.1.1 Develop predictions based on observations.
SC.2.6.1 Identify ways to change the physical properties of objects.

Reading Resource

Energy: Heat, Light, and Fuel by Darlene Stille (J 531.6 St)

Just for Fun

Place an empty glass soda bottle in a refrigerator for 15 minutes. Dip bottle’s mouth and a coin in water. Place coin on top of bottle. Wrap hands around bottle. Hold still. Coin will hop several times because your body produces heat energy!

NOAA Link

Learn more about heat energy in this National Weather Service activity.

www.noaa.gov
Search "Magic Balloon"
Pass It On
(Transfer Heat)

How does heat energy move?

Heat energy transfers in three ways: radiation, conduction, and convection.

Ready?
Explore
Cut butter into small pats (three per group). Heat water. Pour into mugs (one per group).

Elaborate
Draw a pretend stove burner on paper.

Set?
• Unit 1-Lesson 1-Activity 1: Matter Matters (Molecules)
• Unit 1-Lesson 1-Activity 5: We Stick Together (Molecules)
• Unit 2-Lesson 2-Activity 1: Warm, Warmer, Warmest (Add Heat)
• Unit 4-Lesson 1-Activity 4: Blown Away (Wind)

Go!
Develop Know-Wonder-Learn chart with students.

Materials
Butter
Butter knife
Plates (3 per group)
Marbles (3 per group)
Spoon
Mug
Hot water
Water
Pot
Straw
Writing materials
Ice (crushed)

Hawaii Standards
SC.K.1.1
SC.1.2.2
SC. 2.1.1
SC. 2.6.1

Think about it...
Can heat transfer through the air (gas) without touching?

Engage

Feel the heat individually!

Test to see if you can feel the heat from different objects without touching them.

Examples: Lay in the sun for thirty seconds. Hold hands up to incandescent light bulb.

** Activity Extension**

Do the Heat Energy Chant as a class.
Clap along as you chant!

• Chant slowly the first time through.
Repeat, gradually going faster.

Heat! Heat! Heat energy goes from something warm, to something cool you see.

Scientists Say...

...radiation for heat transferred by the emission of electromagnetic waves.

What’s in a Word?

Radiation comes from the Latin word radiatio (to beam or shine) from radius (beam of light).

Hawaii Nei

Researchers on Mauna Kea use telescopes to measure heat radiation coming from dust to observe far away planets.

Did You Know?

Heat energy from the sun travels at the speed of its light. Scientists figured this out because during an eclipse, both light and heat energy do not reach Earth.
Think about it...
Can heat transfer through a solid?

Conduct Butter up a Marble experiment in small groups.

- Ask a question,
  What will happen to the butter if it touches a warm marble?

- Do background research.

- Construct a hypothesis.
  “If (I do this), then (this) will happen.”

- Make a prediction.

- Test with an experiment.
  Place a pat of butter onto three different plates. Label plates one through three. Create a control: Plate one: Place a marble next to pat of butter. Create variables: Plate two: Hold marble two under your armpit for one minute. Plate three: Place marble in a cup of hot water for one minute. At the same time, place the marbles on their pats of butter. Use spoon to fish marble out of hot water.

- Analyze data.

- Communicate results.
Remember, energy changes forms or changes places, but does not disappear. Uncle says heat energy always moves from hot objects to cold ones. It never works the other way around.

Can heat transfer through the air (gas)?
Yes! Think about when you hold your marshmallow over a campfire, but not touching any flames. It toasts perfectly for s’mores! The heat rays leave the hot fire and radiate out toward the marshmallow just like it does from a light bulb.

Can heat transfer through a solid?
Yes! Hot things have molecules excitedly moving all over the place. When they touch something cooler, these slower molecules start moving all over the place, too! Heat energy moves directly from the warmer marbles to the colder butter. It made the butter melt!
Think about it...
Can heat transfer through liquids?

Elaborate

Observe convection heating in pairs.

• Place a pot of water on an imaginary hot plate.
  Pretend to turn on hot plate.

• Show how heat affects water by transferring heat from the stove to the water touching the pot.
  Blow bubbles into water with a straw in the water. Start slow, then get faster.

• Discuss how heat travels in liquids.

**Alternative Activity**

Observe convection heating on the stove!

If you have access to a stove and adult supervision.

• Fill a thick glass jar halfway with water.
  Place glitter and pieces of paper in water.

• Place jar in a pot over heat.
  Allow water to boil.

• Observe glitter and paper.

How it works

Yes! Warm liquid molecules on the bottom of the pot rise. Cold molecules at the top sink. Aunty says these molecules move in circles! Think of the heated pot. The stove heats the bottom of the pot (conduction). The bottom heats the water near it, forming tiny bubbles at the bottom (convection). Heated water rises to the top. Cold water from above sinks, taking the place of hot water. This water heats up in turn. When all the water becomes heated, you get a rapid (rolling) boil.
Evaluate

How does heat energy move?

• Hold a sliver of ice in your hand.
• Explain why it melts.

Is the water warmer at the surface of the ocean or the bottom? Why?

Assess

SC.K.1.1 Use the senses to make observations.
SC.1.2.2 Describe a variety of changes that occur in nature.
SC.2.1.1 Develop predictions based on observations.
SC.2.6.1 Identify ways to change the physical properties of objects.