

# Heat Moves

Grade 6

**Created by:** Sandra Cornell (Terrace Middle School); Sue Cascio (Coyote Valley Elementary School); and Stacy Holland (Terrace Middle School)

**Science Content Standards:** Grade 6, 3c — *Students know* heat flows in solids by conduction (which involves no flow of matter) and in fluids by conduction and by convection (which involves flow of matter); 3d *Students know* heat energy is also transferred between objects by radiation (radiation can travel through space).

**Lesson Concept:** Thermal energy can be transferred through the processes of radiation, convection, and conduction.

## Conceptual Flow:

The sun's energy is transferred to the Earth with a wide range of wave lengths consisting of visible light, infrared, and ultraviolet.

- ▶ Heat is the transfer of energy when one object has a relatively higher temperature than another object.
  - Heat moves in predictable ways, from warmer to cooler objects, until both are the same temperature.
- ▶ Thermal energy can be transferred through the processes of radiation, convection, and conduction.
  - Conduction is heat transferring through direct contact of a warmer object to a cooler one.
  - Convection is heat transfer through a fluid (liquid or gas) creating a current as cold, denser matter displaces warm less dense matter.
  - Radiation is the transfer of heat through space between objects that are not touching.

## Teacher Background:

In both solids and fluids (liquids and gases), heat transfer is measured by changes in temperature. Conduction occurs when a group of atoms or molecules whose average kinetic energy is greater than that of another group transfers some of that excess energy by means of collisions. Because hot objects have atoms with greater average kinetic energy than do cold ones, there is a transfer of this kinetic energy from hot to cold.

In a solid the atoms vibrate in place, but energy may still be transferred from atom to atom as happens when a pan is placed on a stove and its handle becomes hot.

The same mechanism describes the conduction of heat in liquids and gases, where the atoms are free to slip past one another provided there is no cumulative flow in the material.

Convection occurs because most fluids become less dense when heated; the hot fluid will rise through cold fluid because of the hot fluid's greater buoyancy. As hot fluid arises away from a heat source, it may cool, become denser, and sink back to the source to be warmed again. The resulting circulation is called a convection current. Convection currents account for the water in a kettle reaching a uniform temperature although the kettle is warmed only at the bottom.

Another form of energy transfer between objects is radiation: the emission and absorption of electromagnetic waves. Radiation is fundamentally different from conduction and convection in that the objects do not have to be in contact with each other or be joined by a solid or fluid material. Heating by sunlight is an obvious example of radiant energy transfer. Both the heat and the light that can be seen are forms of electromagnetic radiation.

(Excerpted from the *Science Framework for California Public Schools: Kindergarten Through Grade Twelve*.)

For definitions of conduction, convection, and radiation, see [www.wisc-online.com/objects/ViewObject.aspx?ID=SCE304](http://www.wisc-online.com/objects/ViewObject.aspx?ID=SCE304)

For additional information on heat flow, see "Heat Flow and Air Flow" by Cathy Koehler in "Other Science Resources" on this website.

## Materials Needed for the Lesson:

### Teacher Materials

For the three stations:

- ▶ Station 1
  - Lamp (goose neck)
  - card stock (approximately 5" x 7")
- ▶ Station 2
  - Jar of hot water
- ▶ Station 3
  - Larger beaker (or a 4-6 cup heat resistant glass pot or measuring cup)
  - Hot plate
  - Miso soup

### Student Hands-on Materials

- Whiteboards (optional)

### Student Handouts

- "Student Handout 1: Heat Activities"
- "Student Handout 2: Heat Transfer" (assessment)

## 5E Lesson: Heat Moves

Teacher Does	Student Does	Concept
<p><b>ENGAGE:</b></p> <p><b>Skit:</b> Narrator; Main Character (Ms. Tannalot). Select 1 student to be in the skit and act out the role of Ms. Tannalot as the teacher reads the Narrator's part.</p> <ul style="list-style-type: none"> <li>▶ <i>We are going to be doing a skit. We want you to be watching for situations where heat is being transferred.</i></li> <li>▶ <b>NARRATOR:</b> <i>It is summer, and look, there's Ms. Tannalot all kicked back in her lounge chair, enjoying her vacation, complete with her sunglasses and summer wear. Oh, how she is enjoying those sun rays.</i>  <i>Hours go by, and she is feeling so hot, so thirsty for a cool drink. As she goes to find something to quench her thirst – ouch, it seems that the sand has burned her tender little feet! Oh, poor Ms. Tannalot.</i>  <i>Once her feet are feeling better, she gets a cold drink. She sets her drink in the hot sand. As she sips her drink, the drink is cold on top and warm on the bottom – but then it starts feeling warm on top.</i>  <b>***End of Skit***</b></li> <li>▶ <b>NARRATOR:</b> <i>We've just demonstrated, through our skit, the three types of heat transfer. We'd like for you and a partner to discuss where you saw examples of heat transfer, describing at least one heat transfer on your whiteboard.</i></li> </ul> <p>Have students show their boards. Have one set of students share one description of heat transfer, then ask:</p> <ul style="list-style-type: none"> <li>▶ <i>Who else saw that one? Someone share a different example of heat transfer; raise your hand if you have that one, etc.</i></li> </ul> <p>Note: Students will learn the proper terms of the three types of heat transfers in this lesson. Avoid telling them the answer at this time. Consider using the skit again at the end of the lesson to assess students' understanding and their use of proper terminology.</p>	<p><b>Expected Student Response (ESR):</b> Watch skit.</p> <p>Discuss with partner. Describe examples of heat transfers.</p> <p>Students show boards and describe an example of heat transfers.</p> <p><b>ESR:</b> sun rays on body; hot sand on feet; ice in drink.</p>	<p>Heat is the transfer of energy when one object has a relatively higher temperature than another object.</p>

<p><b>EXPLORE:</b></p> <ul style="list-style-type: none"> <li>▶ You will be exploring three stations showing different ways heat is transferred from one object to another.</li> </ul> <p>Explain the stations:</p> <ul style="list-style-type: none"> <li>▶ <b>Station #1</b> – Heat lamp: hold your hands about 6 inches from the lamp. Have a partner hold a card stock over one of your hands for the count of 10 and then remove the card stock. Think about how the heat was getting to your hand.</li> <li>▶ <b>Station #2</b> – Jar of hot water: Put your hand on the jar. Think about how the heat from the jar is getting to your hand.</li> <li>▶ <b>Station #3</b> – Beaker of Miso soup on hot plate: Observe what happens to the bits in the soup. You will draw and label what you see. Think about what is causing the bits of soup to go up and down.</li> </ul> <p>Distribute “Heat Activities” to students. Assign students to stations.</p> <ul style="list-style-type: none"> <li>▶ Rotate through stations (you will have about 8 minutes per station) and on the “Heat Activities” sheet, answer for each station up to “Definition” and “Examples.” We will answer these together.</li> </ul> <p>Once students have complete all three stations discuss with them:</p> <ul style="list-style-type: none"> <li>▶ <b>Station #1- How does the heat get to your hand?</b></li> <li>▶ <b>Station #1 is an example of radiation. On your definition line write the following</b> (and write on the board for students to copy): <i>Radiation is the transfer of heat through space between objects that are not touching. What are some examples of radiation?</i></li> <li>▶ <b>Station #2 – How is the heat from the jar getting to your hand?</b></li> <li>▶ <b>Station #2 is an example of conduction. Conduction is heat transferring through direct contact of a warmer object to a cooler one.</b></li> <li>▶ <b>What are some examples of conduction?</b></li> </ul>	<p>Record observations.</p> <p><b>ESR:</b> The heat moved through the air.</p> <p><b>ESR:</b> The sun; the fire, heater</p> <p><b>ESR:</b> The heat moved straight from the jar to my hand.</p> <p><b>ESR:</b> A pan on the stove; holding a cup of hot chocolate; burning tongue on hot food; hot car seat in summer; hot sand on feet.</p>	<p>Radiation is the transfer of heat through space between objects that are not touching.</p> <p>Conduction is heat transferring through direct contact of a warmer object to a cooler one.</p>
--	--	---

<ul style="list-style-type: none"> <li>▶ <i>Station #3 – What did you notice that the bits of soup were doing?</i></li> <li>▶ <i>Station #3 is an example of convection. Convection is heat transfer through a liquid creating a current as cold, denser matter displaces warm less dense matter.</i></li> <li>▶ <i>What are some examples of convection?</i></li> </ul>	<p><b>ESR:</b> They went up and down.</p> <p><b>ESR:</b> Something boiling on the stove; magma in the mantle; air/weather.</p>	<p>Convection is heat transfer through a liquid creating a current as cold, denser matter displaces warm less dense matter.</p>
<p><b><u>EXPLAIN:</u></b></p> <p>Distribute the assessment: “Heat Transfer.”</p> <ul style="list-style-type: none"> <li>▶ <i>Write which type of heat transfer is being shown in the picture.</i></li> </ul> <p>Once everyone has completed identifying the pictures, ask students to talk with a partner and take turns to explain each type of heat transfer.</p> <p>Discuss or do the skit again and ask students to name the type of heat transfer.</p>	<p><b>ESR:</b> Write the type of heat transfer on the student sheet. Give the definition or explain how the heat is being transferred to a partner.</p> <p><b>ESR:</b> sun rays on body (radiation); hot sand on feet (conduction); ice in drink (convection).</p>	<p>Conduction, convection, and radiation are the three processes of heat transfer.</p>
<p><b><u>EXTEND:</u></b></p> <p>Have students answer the question on the bottom of the student sheet, “Heat Transfer.” Allow them to use their textbook or other resources.</p> <p>Do the “Popcorn Lesson (Three Methods of Heating)”: <a href="http://aspire.cosmic-ray.org/labs/atmosphere/popcorn.html">http://aspire.cosmic-ray.org/labs/atmosphere/popcorn.html</a></p> <p>Download and sing a song about conduction, convection, and radiation from: <a href="http://www.educationalrap.com/song/radiation-conduction-convection.html">www.educationalrap.com/song/radiation-conduction-convection.html</a></p> <p>Study convection in the mantle. For technical information for the teacher go to <a href="http://en.wikipedia.org/wiki/Mantle_(geology)#Movement">http://en.wikipedia.org/wiki/Mantle_(geology)#Movement</a></p>		

**Input Question:** What are some examples of convection? (in Explore section)

**Process Question:** Explain which type of heat transfer is being shown in the picture and explain. (in Explain section)

**Output Question:** How is the heat from the jar getting to your hand? (In Explore section)

**STUDENT HANDOUT 1**  
**Heat Activities**

**Station 1: Heat Lamp**

Describe what happened when you placed your hand under the card stock:

---

---

How is heat getting to your hand?

---

---

Definition: \_\_\_\_\_

---

---

Examples:

---

**Station 2: Conduction**

Describe what happened when you placed your hand on the jar.

---

---

How is the heat from the jar getting to your hand?

---

---

Definition: \_\_\_\_\_

---

---

Examples:

---

**Station 3: Convection**

Describe what you observe in the glass container.

---

---

Draw and label what you see.

Definition: \_\_\_\_\_

---

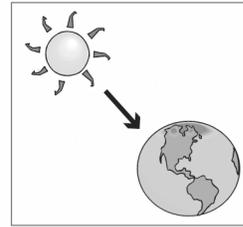
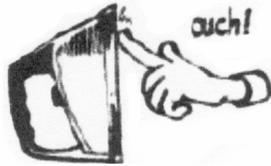
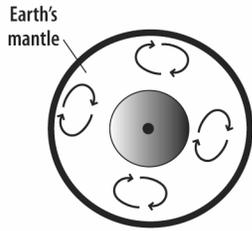
---

Examples: \_\_\_\_\_

---

## STUDENT HANDOUT 2 **Heat Transfer**

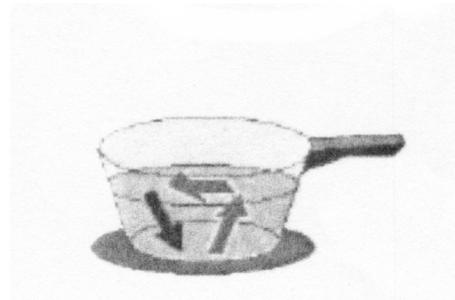
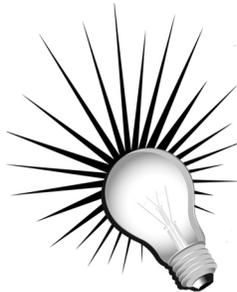
The following pictures show the different types of heat transfer. Review each picture and determine which type of heat transfer is correct. Is it **RADIATION**, **CONDUCTION**, or **CONVECTION**? Write the correct response under each picture.



1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_



4. \_\_\_\_\_

5. \_\_\_\_\_

6. \_\_\_\_\_

Radiation, conduction, and convection — what processes of heat transfer apply to:

- the weather?
- Earth's mantle?
- ocean or lake currents?