FORMS OF ENERGY – LESSON PLAN 2.7

Heat Energy

This lesson is designed for 3rd – 5th grade students in a variety of school settings (public, private, STEM schools, and home schools) in the seven states served by local power companies and the Tennessee Valley Authority. Community groups (Scouts, 4-H, after school programs, and others) are encouraged to use it as well. This is one lesson from a three-part series designed to give students an age-appropriate, informed view of energy. As their understanding of energy grows, it will enable them to make informed decisions as good citizens or civic leaders.

This lesson plan is suitable for all types of educational settings. Each lesson can be adapted to meet a variety of class sizes, student skill levels, and time requirements.

Setting	Lesson Plan Selections Recommended for Use
Smaller class size, higher student ability, and /or longer class length	• The "Modeling" Section contains teaching content. • While in class, students can do "Guided Practice," complete the "Recommended Item(s)" and any additional guided practice items the teacher might select from "Other Resources." • NOTE: Some lesson plans do and some do not contain "Other Resources." • At home or on their own in class, students can do "Independent Practice," complete the "Recommended Item(s)" and any additional independent practice items the teacher selects from "Other Resources" (if provided in the plan).
Average class size, student ability, and class length	• The "Modeling" Section contains teaching content. • While in class, students complete "Recommended Item(s)" from "Guided Practice" section. • At home or on their own in class, students complete "Recommended Item(s)" from "Independent Practice" section.
Larger class size, lower student ability, and/or shorter class length	• The "Modeling" Section contains teaching content. • At home or on their own in class, students complete "Recommended Item(s)" from "Independent Practice" section.

Electrical Safety Reminder: Teachers should remind students that electricity is dangerous and that an adult should be present when any recommended activities or worksheets are being completed at home. Always obey instructions on warning labels and ensure one has dry hands when touching electronics or appliances.

Public School System Teaching Standards Covered

State Science Standards

- KY 4-ET-U-5 4th
- MS 9.c 4th
- NC 3.P.3.2 3rd
- NC 5.P.3.1 5th
- TN GLE 0307.10.1 3rd
- TN GLE 0507.10.2 5th

Common Core Language Arts/Reading

- ELA.CCSS.W.3.1 NC, TN 3rd
- ELA.CCSS.W.4.1 MS, KY 4th
- ELA.CCSS.W.5.1 NC, TN 5th

Performance Objectives

By the end of this lesson, students will be able to:

- **Describe heat energy and its functions.**
- **Define conduction, convection, and radiation.**
- **Explain the relationship between temperature and heat.**

I. Anticipatory Set (Attention Grabber)

Essential Question

How do objects become hotter?

Videos

Heat Video and Quiz: http://studyjams.scholastic.com/studyjams/jams/science/energy-light-sound/heat.htm (AWESOME explanation)

II. Modeling (Concepts to Teach)

All matter is composed of vibrating atoms or molecules. These molecules can vibrate even faster by adding kinetic energy. For example, a penny can be made warmer by hitting it with a hammer. A liquid can be made warmer by putting a flame to it. It is this movement (kinetic energy) that creates the effect that is sensed, warmth. Whenever something becomes warmer, the kinetic energy of its atoms or molecules increases. The energy that transfers from one object to another because of temperature difference between them is called **heat**. Heat is energy in transit from a body of higher temperature to one of lower temperature.

3 Ways Heat is Transferred: http://www.energyquest.ca.gov/story/chapter01.html

1. **Conduction** – Conduction occurs when energy is passed directly from one item to another by touching the two objects. The faster-moving molecules contact slower-moving molecules and transfer energy to them.

   The slower-moving molecules speed up and the faster-moving molecules slow down. If someone stirred a pan of soup on the stove with a metal spoon, the spoon would heat up. The heat is being conducted from the hot area of the soup to the colder area of spoon.

   Metals are excellent **conductors** of heat energy. Wood or plastics are not. These “bad” conductors are called **insulators**. That’s why a pan is usually made of metal while the handle is made of a strong plastic.

2. **Convection** – Convection is the movement of **gases or liquids** from a cooler spot to a warmer spot.

The pan’s handle is an insulator and does not conduct heat very well.

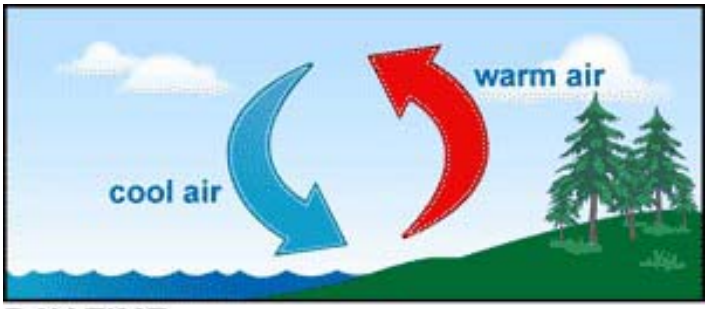
Soup is heated in the pan by convection. The hot soup rises. Cool soup falls to take the hot soup’s place.

Heat energy from the stove is transferred to the pan by conduction.

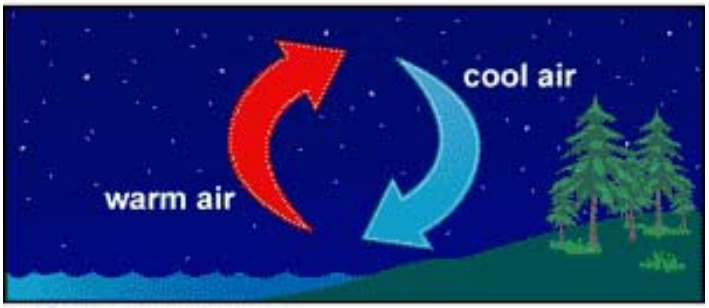
If a soup pan is made of glass, one could see the movement of convection currents in the pan. The warmer soup moves up from the heated area at the bottom of the pan to the top where it is cooler. The cooler soup then moves to take the warmer soup's place. The movement is in a circular pattern within the pan. Notice the diagram on the previous page.

During the **day**, the sun heats up both the ocean surface and the land. Water is a good absorber of the energy from the sun. The land absorbs much of the sun's energy as well. However, water heats up much more slowly than land and so the air above the land will be warmer compared to the air over the ocean. The warm air over the land will rise throughout the day, causing low pressure at the surface. Over the water, high surface pressure will form because of the colder air. To compensate, the air will sink over the ocean. The wind will blow from the higher pressure over the water to lower pressure over the land causing the sea breeze. The sea breeze strength will vary depending on the temperature difference between the land and the ocean.

At **night**, the roles reverse. The air over the ocean is now warmer than the air over the land. The land loses heat quickly after the sun goes down and the air above it cools, too. This can be compared to a blacktop road. During the day, the blacktop road heats up and becomes very hot to walk on. At night, however, the blacktop has given up the added heat and is cool to the touch. The ocean, however, is able to hold onto this heat after the sun sets. This causes the low surface pressure to shift to over the ocean during the night and the high surface pressure to move over the land. This causes a small temperature gradient between the ocean surface and the nearby land at night and the wind will blow from the land to the ocean creating the land breeze.



DAY TIME



NIGHT TIME

3. **Radiation** – The sun's light and heat cannot reach earth by conduction or convection because space is almost completely empty. There is nothing to transfer the energy from the sun to the earth.

   The sun's rays travel in straight lines called heat rays. When sunlight hits the earth, its radiation is absorbed or reflected. Darker surfaces absorb more of the radiation and lighter surfaces reflect the radiation. So a person would be cooler if he/she wore light or white clothes in the summer.

Temperature vs. Heat

Temperature is the quantity that tells how hot or cold something is compared to a standard. Temperature is

related to the average kinetic energy of the substance. The more kinetic energy an object has the higher the temperature. Temperature can be measured using the Celsius scale, Fahrenheit scale, or the Kelvin scale.

Heat is the transfer of energy from a substance with a higher temperature to a substance with a lower temperature.

III. Checking for Understanding

Teachers can ask students these questions to determine understanding of concepts.

REMEMBER	What are the three ways heat is transferred? (Class discussion)
UNDERSTAND	In your own words, restate the definition of heat. (Class discussion)
APPLY	Illustrate how air is heated. Explain the difference between heat and temperature. (Class discussion. Teacher may show the following video; also includes a quiz: **http://studyjams.scholastic.com/studyjams/jams/science/energy-light-sound/heat.htm**).
ANALYZE	Use a Venn diagram to compare and contrast two of the following: conduction / convection / radiation. (Ex. Draw two large intersecting circles. Label one circle conduction and the other circle convection. For more information: **http://www.learninggamesforkids.com/graphic_organizers/writing/venn-diagram.html**).

IV. Guided Practice Ideas

Recommended Items

Solar Bag Experiment (see below)

Experiments

- **Solar Bag Experiment: http://www.stevespanglerscience.com/lab/experiments/solar-bag-experiment**
- **Solar Energy Balloon Blow Up Experiment: http://eisforexplore.blogspot.com/2013/05/solar-energy-balloon-blow-up.html?utm_source=feedburner&utm_medium=email&utm_campaign=Feed:+EIsForExplore+%28E+is+for+Explore!%29**

Song

Heat Energy Song: Teachers can have students listen to this song about heat energy:
http://www.youtube.com/watch?v=khZrs-UBq28&feature=share

V. Independent Practice Ideas

Recommended Item

At-Home Scavenger Hunt: Finding Heat Energy (see below)

Other Resources

Personal Practice

- What is Heat? Worksheet and Answer Key provided
- Writing Activity: Teachers write the following question on the board and ask students to copy and answer the question on a sheet of paper: How is heat used in your home?

Practice That May Involve Parents/Guardians

- At-Home Scavenger Hunt: Finding Heat Energy – Teachers instruct students to find one example of each type of heat energy in their home (conduction, convection, radiation). Write them on a sheet of paper and label them as conduction, convection or radiation. (Ex. Conduction – curling iron on hair; convection – boiling water; radiation – sun coming through window and heating up the floor).

VI. Assessment

These items provide a check for understanding so teachers can easily determine whether concepts need to be reinforced. These items can be graded, if desired.

- Online Quiz: (if completed in I. Anticipatory Set or III. Checking for Understanding) **http://studyjams.scholastic.com/studyjams/jams/science/energy-light-sound/heat.htm**
- What is Heat? Worksheet and Answer Key is provided

VII. Materials Needed

The following materials are needed for the **Solar Bag Experiment** in "Recommended Items" in Guided Practice.

- Solar Bag
- Solar Bag String

VIII. Closing the Lesson

In addition to the Essential Question shown below, teachers can reference Performance Objectives at the top of the Lesson Plan.

Essential Question

How do objects become hotter?

WORKSHEET FOR HEAT ENERGY LESSON 2.7 **NAME:** _____

What is Heat?

Objective: Students will be able to describe heat energy and its functions, identify ways heat is transferred, and understand differences between conduction and insulation.

1. **What is heat?**

_____

_____

_____

_____

2. **Identify and explain the three ways heat is transferred.**

_____

_____

_____

_____

3. **How is an object's temperature affected when its atoms slow down?**

_____

_____

_____

_____

4. **How do you use heat at home?**

_____

_____

_____

_____

5. **Why are cooking materials normally made of metal instead of wood or plastic?**

_____

_____

_____

_____

Answer Key

ANSWER KEY FOR WORKSHEET: HEAT ENERGY

1. **What is heat?**

   Ex. Heat is the energy that transfers from one object to another because of the temperature difference between them.

2. **Identify and explain the three (3) ways heat is transferred.**

   Ex. Conduction occurs when energy is passed from one item to another by touching the two objects. Convection is the movement of gases or liquids from a cooler spot to a warmer spot. Radiation is generated by the thermal motion of charged particles in matter.

3. **How is an object's temperature affected when its atoms slow down?**

   Ex. The temperature of the object will decrease as its particles slow down.

4. **How do you use heat at home?**

   Ex. Cook food, warm bath/shower water, heat the house, etc.

5. **Why are cooking materials normally made of metal instead of wood or plastic?**

   Ex. Metals are excellent conductors of heat energy. Wood or plastics are not. These "bad" conductors are called insulators. That's why a pan is usually made of metal while the handle is made of a strong plastic.