Chapter 18 General Science

Heat, Light, and Sound

18-1 Heat and Matter

Words to Know

**conduction**- the way heat is passed along by molecules of matter that bump into one another

**insulator**- matter that does not conduct heat well

**convection**- the transfer of heat within a gas or a liquid by the movement of warmer particles

**vacuum**- any place where there is no matter

**radiation**- energy that travels in waves

\* Identify sources of heat, light, or sound (other than a campfire). \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* How is heat, light, or sound different from one another? Similar? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* You can feel the heat from a campfire. You can see the light of its orange-yellow flames. You can hear the sound of the crackling wood. What do you think heat, light, and sound all have in common? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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REFLECT=BOUNCE….bounce a ball and see how it reacts. Does it bounce back?

BEND=REFRACT…bend down…this is how light rays bend.

The suffix *–tion* means “the act of.” Words such as *conduction, convection, reflection, radiation,* and *refraction* refer to the acts of *conducting, convecting, reflecting, radiating,* and *refracting*. These words are made from the root words *conduct, convect, reflect, radiate*, and *refract*.

\* Heat is measured in calories. A calorie is the amount of heat needed to raise the temperature of 1 gram of water 1 degree Celsius.

\* Calories are also used to measure the amount of energy obtained from the food and used by the body.

\* Heat and temperature are related but they are not the same. You feel heat energy while standing in the sunlight. You feel it next to the fire. You feel your own heat energy when you sleep under the blankets. There is heat energy in everything, even the oceans.

\* Heat is a form of kinetic energy. Remember that matter is made up of moving atoms and molecules. The moving particles all have kinetic energy.

\* However, no two particles in a substance have exactly the same amount of kinetic energy. Heat is the *total* kinetic energy of the particles in a substance. Temperature is the measure of the *average* kinetic energy of the particles in a substance.

\* Adding heat makes particles move faster. Removing heat makes the particles move slower. This lowers the temperature.

\* A large pot of soup and a small bowl of soup have the same temperature. The *average* kinetic energy of the particles is the same. Remember, heat is the *total* kinetic energy of the particles. Therefore, the large pot of soup has a higher total kinetic energy, or more heat, than the smaller cup.

\* This explains why the Pacific or Atlantic Ocean have more heat than the hot cup of soup. The soup may be hotter, but the size of the oceans give it way more heat (kinetic energy) than the soup.

\* Heat always moves from a warmer place to a cooler place. That is why you become cold when you step outdoors on a cold day. The heat moves from your body into the cold air. That is also why you warm a piece of pizza in an oven.. The oven’s heat moves into the cold pizza.

\* Remember that particles in a solid are closer together than those in a liquid or gas.

\* Suppose you put a spoon into a cup of hot soup. The top of the spoon does not touch the soup at all. Will it get hot? Explain. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* A process called **conduction** actually moves the heat along. Also, remember the tendency of heat particles to move towards cooler ones.

\* The warm molecules bump the smaller molecules to warm them up. The heat moves up the handle of the spoon.

\* Some types of matter are good conductors. Heat moves quickly through these substances. Metals are good conductors. Metals are good conductors. Copper, for example, is a very good conductor.

\* Other forms of matter are very poor conductors. Heat moves through poor conductors very slowly. Paper, wood, rubber, glass, and plastic do not conduct heat very well. These are **insulators**.

\* Can you name conductors around your house or at this school?

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\* Can you name insulators around your home or at this school?

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\* Because of conduction, placing a metal spoon in a hot liquid will make the liquid cool faster.

\* The material inside of a potholder has long fibers that trap air. Air is a poor conductor. Also, the fibers hold the air in place, so heat cannot move by **convection** through the air.

\* Think of a space heater in a room. The heater warms the air around it. This causes the kinetic energy of the molecules in the air to increase. As the molecules move faster, they spread out. The air becomes less dense. This less dense, warm air rises to the ceiling. The warm air pushes the cooler air towards the heater. This circular movement of air is called *convection current*.

\* Most weather is caused by convection currents in the air around the Earth. There are convection currents in the oceans called *density currents*. These are caused by warm water rising and pushing down cool water

\* This partly explains why water in a pool is warmer at the top. Why else might this be the case? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* Both conduction and convection move heat energy through matter. In some places, however, there is no matter. These are **vacuums.**

\* Neither conduction nor convection can move heat through a vacuum. However, the energy from the sun can travel through a vacuum.

\* The sun’s energy travels in waves. This is in the form of **radiation**.

\* When light from the sun strikes the Earth, a lot of it changes to heat energy.

18-2 Light

**wavelength**- the distance from the crest, or top, of one wave to the crest of the next wave

**amplitude**- the height of a wave

**frequency**- the number of wave cycles that pass through a point in one second

**reflection**- the bouncing of light off an object

**refraction**- the bending of light rays as they pass from one substance into another

**spectrum**- the band of colors that make up white light

**prism**- a triangular-shaped, three-dimensional object made of clear glass that breks up white light into its different colors

\* I need two volunteers for the following jump rope activity.

\* Waves carry energy from one place to another. These waves move in repeated patterns. If you have ever been to an ocean or a wave pool, describe what happens when a wave crashes against something. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* If you could actually see waves of energy, they would look something like ocean waves. TV and radio signals move through space in waves. Light and sound move in waves, too.

\* The top of a wave is called the *crest*. The bottom of the wave is called the *trough*.

\* Every wave has three features that can be used to describe the wave. These are:

1.) **Wavelength**

2.) **Amplitude**

3.) **Frequency**

\* The greater a wave’s amplitude, or height, the more energy it has. A sound wave with big amplitude will make a loud sound. A light wave with big amplitude will make a bright light.

\* The speed of a wave is the product of its frequency and wavelength.

\* A laser produces a narrow, strong beam of light. Lasers have many uses. Doctors sometimes use lasers instead of scalpels to cut body tissues. Laser light is also used to send signals from telephones and televisions. The laser light travels through hairlike strands of glass called optical fibers.

\* A beam of light consists of a very narrow range of wavelengths. Thus, laser light is usually a single color.

\* Light energy travels in waves. These waves ALWAYS travel in straight lines. These lines are called *rays*. When a group of rays all travel in the same direction, they are called a *beam*.

\* Light travels through a vacuum at 186,000 miles per second. However, air slows down light waves. Liquids slow them down even more, and solids even more.

\* Light travels in many different wavelengths. Some wavelengths we can see. This is called *visible light*.

\* Some wavelengths are too short for us to see. These wavelengths are called *ultraviolet light*.

\* Some wavelengths are too long for us to see. These wavelengths are called *infrared light.*

\* Light can do one of four things when it strikes an object.

1.) It can pass through the object.

2.) It can get absorbed into the object.

3.) It can bounce off the object.

4.) It can be bent by the object.

\* A substance or and object is *transparent* if light passes through it. Some things that are transparent are air, clear glass, clear plastic, and colorless liquids such as water.

\* A *translucent* object allows some light to pass through it. Frosted glass, stained glass, and most paper are translucent.

\* An object that blocks light completely is *opaque*. An opaque object makes a shadow where the light is being blocked.

\* Objects that are opaque absorb most of the light that hits them. The light does not pass through the objects. Light energy that is absorbed is changed into heat energy. Dark colors and rough surfaces absorb a lot of light.

\* All substances **reflect** some light. Mirrors and objects with shiny surfaces reflect almost all the light that strikes them. The light reflecting off objects sends images to your eyes.. That is how you see objects.

If you dip a pole into clear water, it appears to bend. The pole looks like it bends just at the point where it enters the water. Of course, the pole does not really bend. The water bends the light rays. This is an example of **refraction**.

\* Refraction is caused by a change in the speed of light as light passes from one substance into another. When light strikes water, the light slows down. Then, it bends away from the surface of the water.

\* Let’s see what happens when we shine a flashlight off of a mirror. What do you think will happen? Why? What science rules apply? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* White light, such as sunlight, is made up of several different wavelengths. These different wavelengths are the different colors we see…ROY G. BIV

1.) Red

2.) Orange

3.) Yellow

4.) Green

5.) Blue

6.) Indigo (violet-blue)

7.) Violet

These are the same colors in the rainbow. Rainbows are caused by sunlight passing through drops of water. The drops of water refract the white light. This is why we typically only see rainbows during or just after a rainstorm.

\* The different wavelengths of the white light bend different amounts, so they separate into a band of seven different colors called the **spectrum**.

\* All of the colors combined make up white light.

\* You can create a spectrum yourself by letting sunlight shine through a **prism**.

\* Using a glass prism, Sir Isaac Newton discovered that sunlight consists of a mixture of colored light.

\* You know that objects absorb light, reflect light, refract light, or let light pass straight through them. The color of an object is determined by the color of light that the object reflects.

\* For example, if you look at a red sweater, the sweater absorbs all of the other colors except red. The orange, yellow, green, blue, indigo, and violet all get absorbed. Only the red bounces off of the sweater and enters your eyes. Red is all you see.

\* A pure black object absorbs all the light striking it.

\* A pure white object reflects all the light striking it.

18-3 Sound

\* Sound travels well underwater. Whales can hear one another from hundreds of miles away.

\* Sound actually travels faster through water than through air because the molecules in water are closer together than the molecules in the air are.

\* Use the rubber band and try to make interesting sounds with it. Describe.

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\* Why do you think you were able to hear any sounds at all? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* Until the middle 1800’s, Native Americans of the Great Plains hunted buffalo. To find herds, a hunter would press his ear to the ground. Why? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* Sound travels better through solids than through the air. Hunters could not hear the stampede of hooves in the air. However, they could sometimes hear it in the ground. This helped the Native Americans find buffalo for food and clothing.

\* Sound is another form of energy that moves in waves. Sound travels about a MILLION times slower than light waves.

\* Sound is made by matter that vibrates. Feel your throat as you talk, sing, or hum. Describe the sounds and how you think they occur. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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\* When your vocal cords vibrate, they cause surrounding air molecules to vibrate. The vibrating air causes sound waves. Eventually, the sound waves reach everyone else’s ears. There are tiny bones in your ear that actually vibrate as well.

\* Unlike light, sound cannot travel in a vacuum. Sound travels fastest through solids. It moves slowest through gases.

\* The loudness of sound is determined by the amplitude of the sound waves. If you hit a drum hard, you will cause it to vibrate in big waves. You will make a loud sound. If you just tap the drum, you will cause only tiny waves. You will make a quiet sound.

We will take some time to try games at the following website…

http://www.kids.esdb.bg/fungames.html