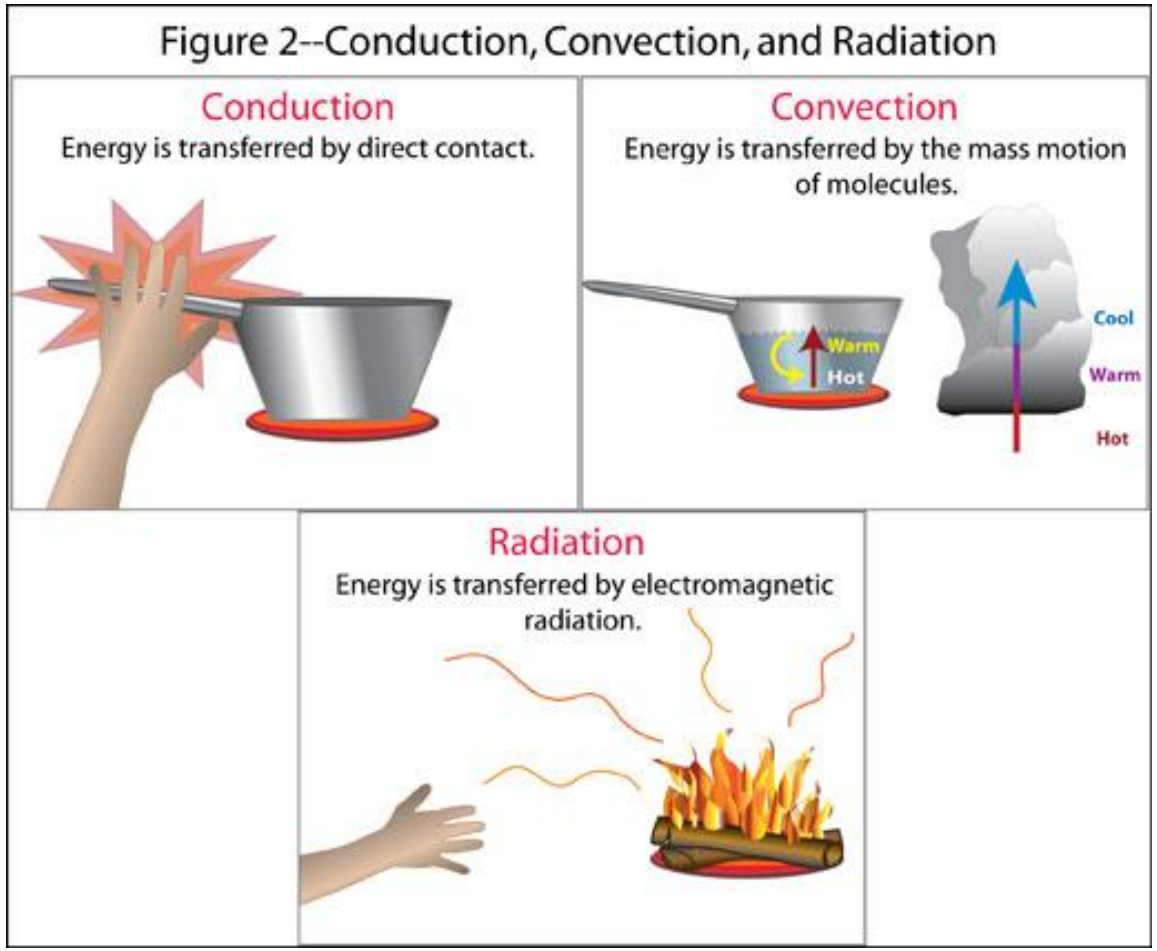
Week 1 Day 1-2 (combine)

Thermal Energy

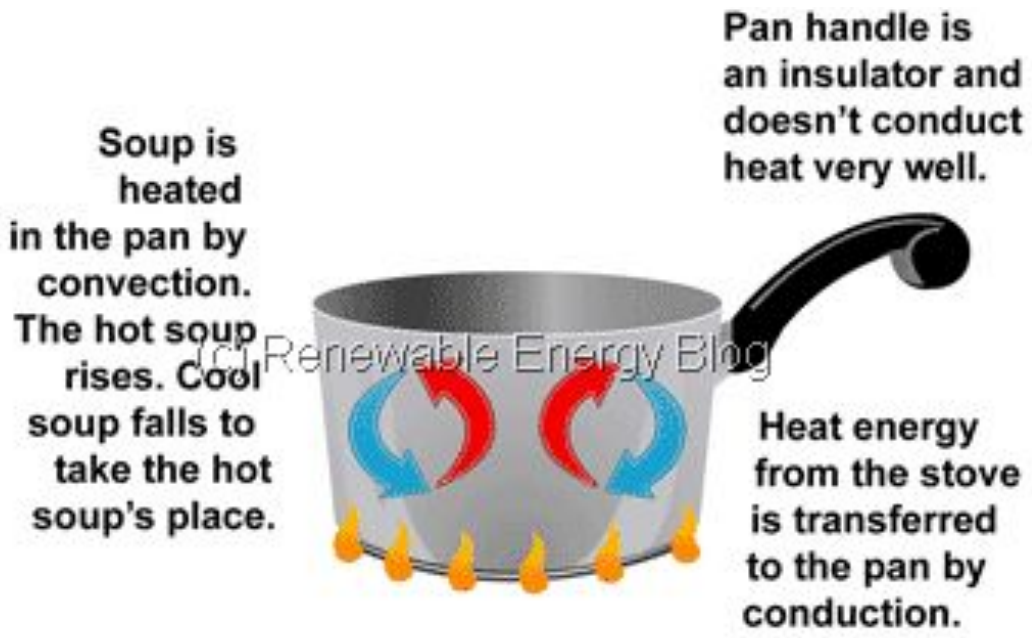
Heat Transfer

Conduction, Convection and Radiation



Thermal Energy Transfer

- Thermal energy transfer is heat moving from a warmer object to a cooler object. This is known as thermal energy transfer.



How do you use thermal energy?

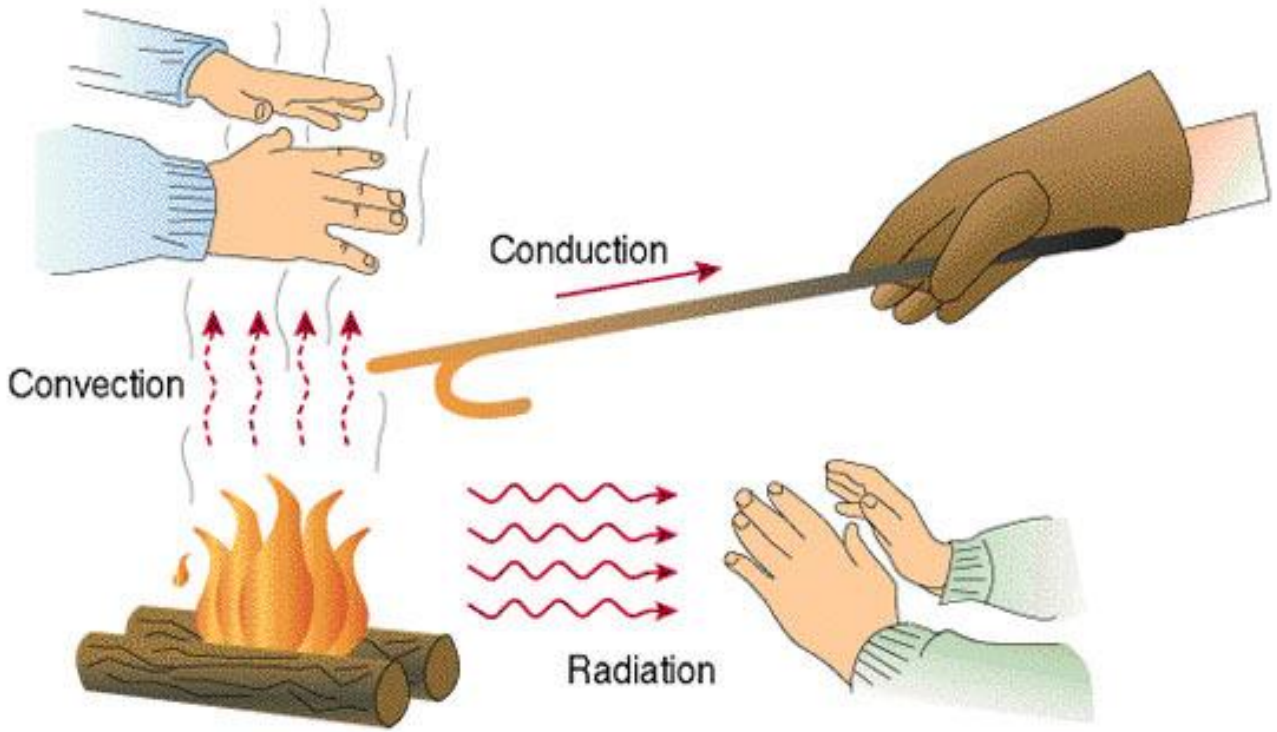
A pastry chef is making a cake for her customers. She mixes several ingredients and then pours the batter into a pan. She reads the recipe for the next step: "Add **heat**: stir over a low burner for 10 minutes." What does it really mean to "add heat" while cooking? Did the pastry chef find heat in the contents of any of her jars or boxes?

Discovery Ed Thermal Energy Video

How is Heat Transferred?

There are THREE ways heat can move.

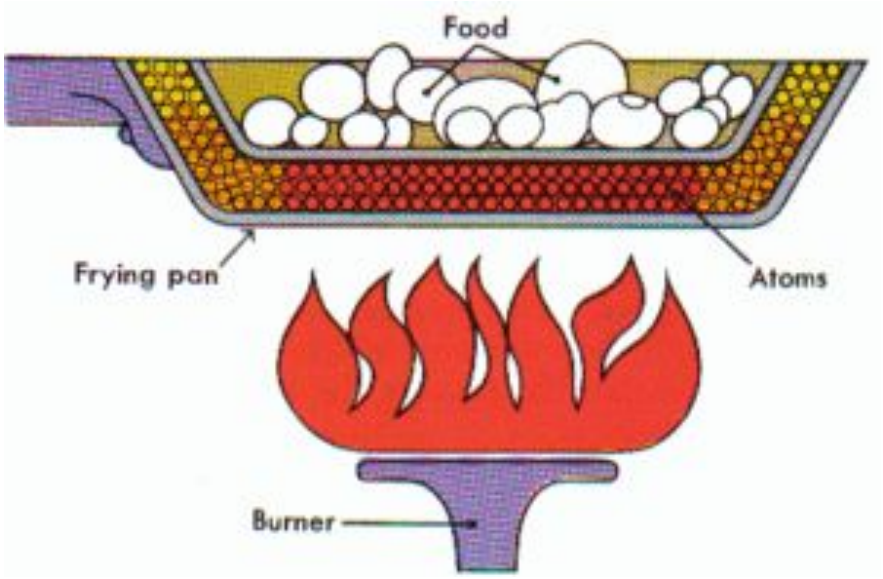
- **Conduction**
- **Convection**
- **Radiation**



CONDUCTION

- Heat is transferred from one particle of matter to another in an object without the movement of the object.

- Conduction = CONTACT



Have you ever…

- Touched a metal spoon sitting in a pan of boiling water only to be surprised by HOW hot it is??

Think back to what you know about metals and nonmetals. What conducts heat better, metal or nonmetal? Why?

Example of Conduction

- Think of a metal spoon in a pot of water being heated.
- The fast-moving particles of the fire collide with the slow-moving particles of the cool pot.
- Because of these collisions, the slower particles move faster and heat is transferred.
- Then the particles of the pot collide with the particles in the water, which collide with the particles at one end of the spoon.
- As the particles move faster, the metal spoon gets hotter. This process of conduction is repeated all along the metal until the entire spoon is hot.

EXAMPLE OF CONDUCTION

- A piece of cheese melts as heat is transferred from the meat to the cheese (Contact)

EXAMPLE OF CONDUCTION

EXAMPLE OF CONDUCTION

Feet on hot sand. The heat from the sand is transferred to you feet through direct contact.

EXAMPLE OF CONDUCTION

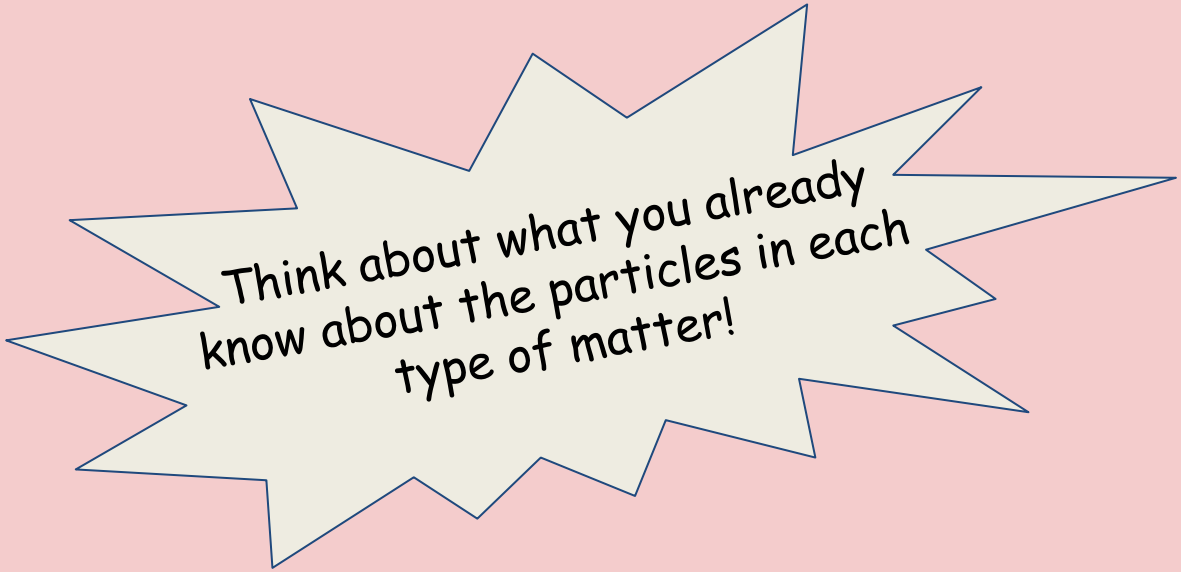
Hot Iron

Hot Cocoa

Camp Stove

Snow

Why are gases and liquids generally poor conductors of heat?



Which object is a poor conductor? What do we call this?

Week 1 Day 3

Conduction Left Side activity

Conduction Left Side

Design a science experiment that shows conduction. Include conductors and how you would show an example of conduction.

Your Experiment must include:

-materials needed

-step by step instructions on how to complete the experiment

-how the experiment shows conduction

-an illustration/diagram to show the outcome

Convection

Day 1 - Notes and left side activity

Day 2 - Exploration/Demonstrations

Day 3 - Discovery Ed Lesson (reviews all types of heat transfer)

Day 4 - Review for quiz

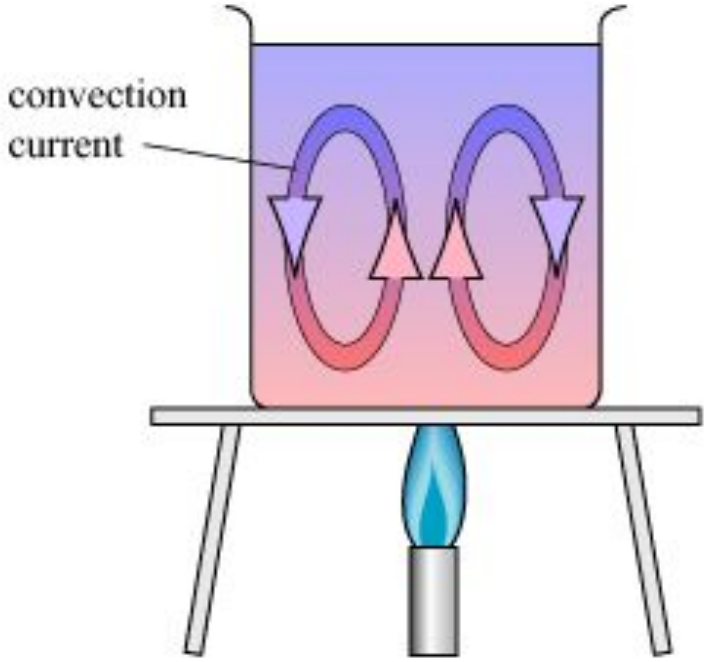
Day 5 - Thermal energy quiz

CONVECTION

- Convection is the movement that transfers heat within fluids and air (gas)
- Heat is transferred by currents within the fluid or gas

- Convection = VENTS (through air and liquid particles)

- Convection moves in a circular pattern



Convection Current

The circulation of warm and cold fluid due to convection is called a convection current. Here's how a convection current works:

1. Cold fluid is warmed by the heat source.

2. Warm fluid rises. Warm fluid rises because it is less dense.

3. The warm fluid cools.

4. Cool fluid sinks. Cool fluid sinks because it is denser.

5. Cold fluid moves to replace the warm fluid that moved in the first place.

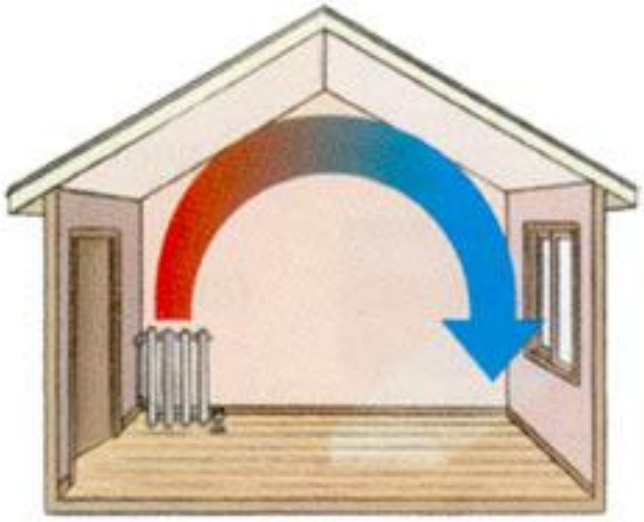
Where does convection occur?

Convection requires the movement of particles and so, convection only occurs within fluids (gases and liquids). The particles of a solid are in a fixed position and they cannot move.

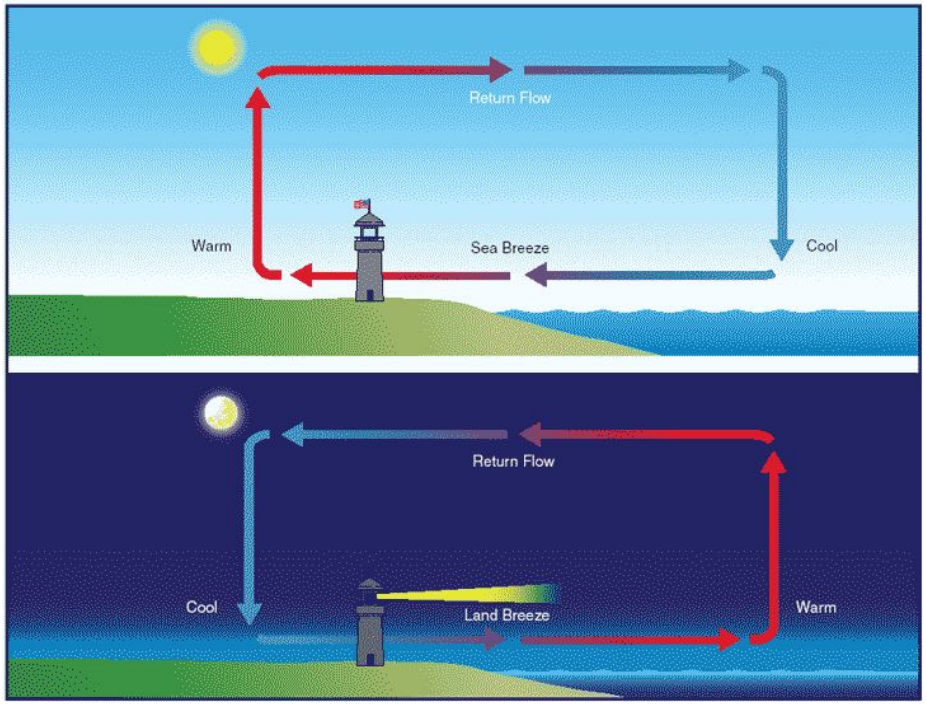
Therefore, convection cannot take place in a solid.

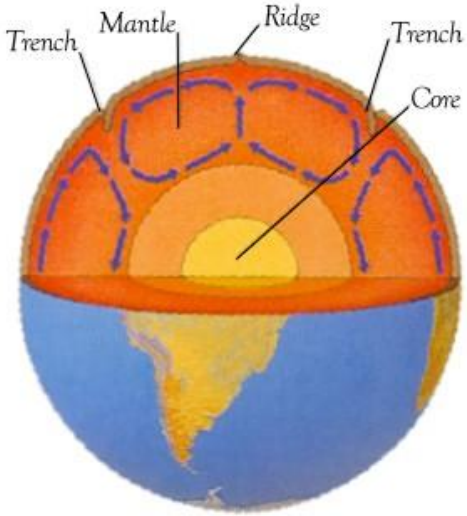
Examples of Convection:

- Have you ever noticed that the air near the ceiling is warmer than the air near the floor? Or that water in a pool is cooler at the deep end?
- Examples: air movement in a home, pot of heating water.



More Examples of Convection





- Convection currents cause the cooler breezes you experience by a large body of water.
- Ocean water is warmer at Earth's equator. The water moves north and
- south and carries thermal energy (heat) to colder water at the north and south
- poles.
- These currents also cause the movement of magma within the earth.

Convection Demonstration

Materials:
plastic cup
warm water
Ice cube colored with blue food dye

Steps:
1. Put hot water into a clear plastic cup
2. Put colored ice cube in the cup
3. Observe what happens to the blue coloring (cold water)

Discovery Ed Lesson

- Teacher will read the Engage lesson for Thermal Energy (Concept 3.1) and either watch videos as a class or have students watch independently as a review of the three types of thermal energy transfer.
- Students will read the Explore section and complete 2 Explorations: Exploration Student Worksheet Thermal Energy and Exploration Student Worksheet Melt Off.
- Students can either submit the Explain response in Discovery Ed or in their Science journals

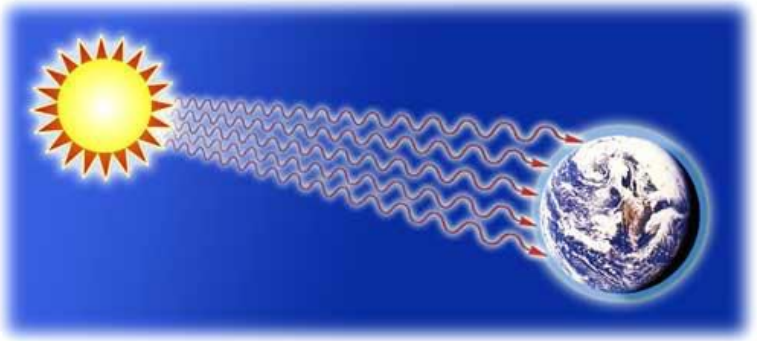
*Optional Assessment: Students can complete the Evaluate assessment in Discovery Ed.

Radiation

- Taking notes
- Day 2 exploration
- Day 3 left side activity to show understanding
- Day 4 quiz
- Day 5 experiment

Radiation

All objects radiate heat, but some radiate much more heat than others. The biggest source of radiation is the Sun – it sends a HUGE amount of heat to Earth through electromagnetic waves. (At the beach you can definitely feel the wonderful heat radiation from the Sun. I guess that's why you get a sunburn. Oops! A little too much radiation!)



Radiation

- ***Radiation*:** the transfer of (thermal) energy by electromagnetic waves.
  - Radiation does not require matter to transfer thermal energy.
    - All the sun's energy that reaches Earth travels through millions of kilometers of empty space (a vacuum).
  - All matter can radiate energy.
    - You feel the radiation of thermal energy from a bonfire, a heat lamp and a light bulb.

Radiation

Key Point: For radiation to be felt as heat it must first be absorbed by a material.

Example: Why do blue jeans feel hotter in the sun than a yellow shirt, even though they are both exposed to the same amount of sunlight?

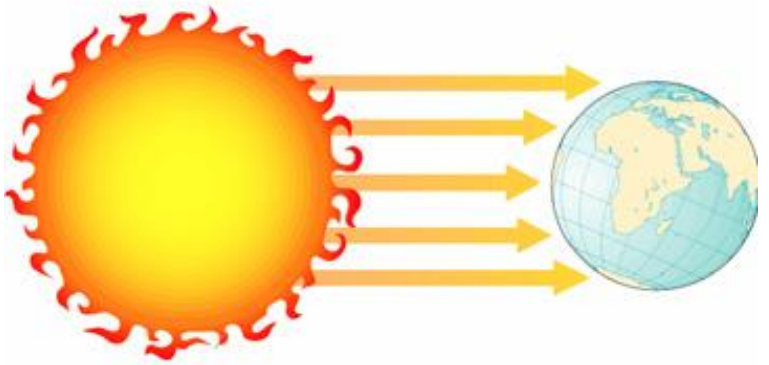
The blue jean fabric absorbs more radiant energy from the sun than the yellow shirt because of its dark color.

Radiation video

Start at 4:50

Sources of RADIATION

1. Fire
2. Heat Lamps
3. Sun
4. Ovens



Radiation may come from other sources than the sun…

Have you ever sat too close to a campfire while cooking marshmallows? You're enjoying the warmth ….. only to notice that your skin is really warm?

That's also radiation!

Light bulbs radiate heat. If you hold your hand a few inches away from a light bulb, you can feel the heat, right? In fact, a good way to remember radiation is that it is how you can feel heat without touching it. Heat passes through the empty space until it reaches your hand. That's radiation!

A fire is another example of radiation.

Even YOU are an example. Your body gives off heat! (That's why a classroom gets warm when there are a lot of people sitting in it.)

Radiation Notes Day 1:

***Radiation*:** the transfer of (thermal) _____by _____ _____. Radiation does not require _____to transfer thermal energy. All the sun's energy that reaches Earth travels through millions of kilometers of _____ _____ (a vacuum).

All matter can _____ energy. You feel the radiation of _____ _____from a bonfire, a heat lamp and a light bulb.

Key Point: For radiation to be felt as _____it must first be _____ by material.

Example: Why do blue jeans feel _____ in the sun than a yellow shirt, even though they are both exposed to the same amount of sunlight?

The blue jean fabric absorbs more _____ _____ from the sun than the yellow shirt because of its dark color.

Sources of Radiation:

1. _____
2. _____
3. _____
4. _____

_____ _____ radiate heat. If you hold your hand a few inches away from a light bulb, you can feel the _____, right? In fact, a good way to remember radiation is that it is how you can feel heat without _____ it. Heat passes through the empty space until it reaches your hand. That's radiation! A _____is another example of radiation. Even YOU are an example. Your _____ gives off heat! (That's why a classroom gets _____ when there are a lot of people sitting in it.)

Left Side Activity

Choose 2 sources of radiation and illustrate what happens when that source travels through space and reaches an object.

Radiation Day 2

Experiment #1 – Dark vs Light Color radiation

Dark surfaces absorb radiation while light-colored surfaces reflect radiated heat.

Have students put sheets of black and white construction paper side-by-side on a sunny windowsill, and after two minutes students can feel the differences in their temperatures.

Students will set out construction paper of different colors and hypothesize which of the 4 colors will warm up the fastest (cannot use black or white but they can be used as controls).

Experiment #1 - Dark vs Light Color radiation notes

Dark surfaces absorb radiation while light-colored surfaces reflect radiated heat.

Step 1: Put sheets of black and white construction paper side-by-side on a sunny windowsill, and after two minutes you can feel the differences in their temperatures.

Step 2: Choose 4 colors of construction paper (cannot use black or white) and hypothesis which will be warmest in 2 minutes. Place the papers in the same location as the black and white papers and let sit in the sun.

Hypothesized order (warmest to coldest)

Color 1(warmest): _____

Color 2: _____

Color 3: _____

Color 4(coldest): _____

Actual order (warmest to coldest)

Color 1(warmest): _____

Color 2: _____

Color 3: _____

Color 4(coldest): _____

What conclusions did you reach about how color impacts the amount of radiation absorption?

_____

_____

How could you apply this knowledge to your own life?

Experiment #2 (Lab)

Materials: 2 plastic cups, thermometer, measuring cup, timer

Students will take 2 cups of water with the same amount of water at the same temperature and place them outside, one in direct sunlight and the other in indirect sunlight. They will hypothesis whether the radiation from the direct sunlight will warm the water more quickly than the radiation from the indirect sunlight.