

# Conduction, Convection, and Radiation

## (The 3 ways HEAT ENERGY is transferred)

There are three ways to heat is transferred from one object to another object: by conduction, by convection, or by radiation. *You can remember the difference between these three ways by remembering the three ways you can make popcorn:*

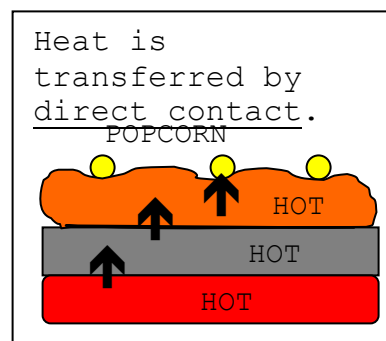
### 1. Making popcorn by CONDUCTION heating:



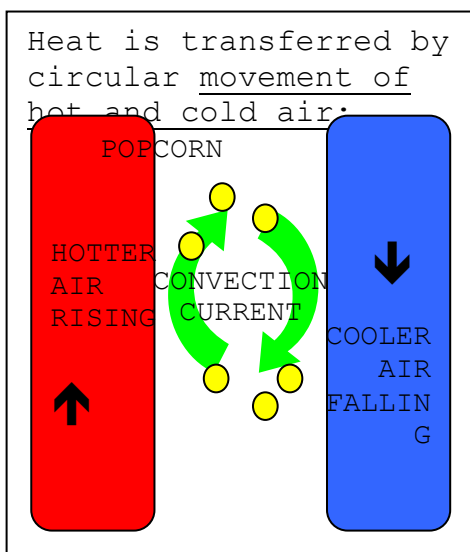
Put vegetable oil in the bottom of a pan. Add popcorn kernels. Place the pan on the stove and turn on the burner. Cover the pan with a lid. Shake the pan to coat all the kernels with oil. Listen for to the corn go “pop!”

**How it works:** Heat from the pan transfers *directly* to the oil. Heat from the oil

transfers *directly* to the popcorn kernels. When the kernels reach  $100^{\circ}\text{C}$ , the liquid water inside each kernel turns into gas (steam) and expands, making the kernel “pop.”



### 2. Making popcorn by CONVECTION heating.



Obtain an “air popcorn popper.”

Put popcorn kernels in the popper. Plug in and turn on the popper. **How it works:** Hot air begins to rise in the popper while cooler air falls. As hot air circulates past the popcorn kernels, the kernels absorb the heat. When the kernels absorb enough heat to reach  $100^{\circ}\text{C}$ , the water inside turns to steam. The expanding steam makes the kernel “pop” open.

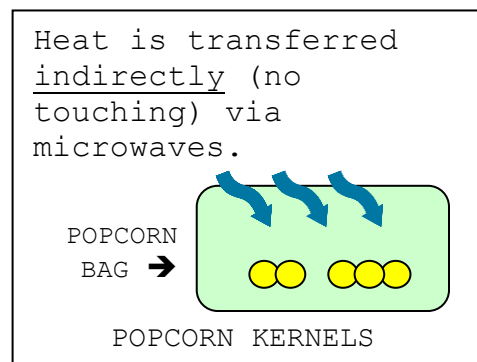


### 3. Making popcorn by RADIATION heating.



Put a bag of popcorn in a microwave oven. Microwave it for 2-3 minutes.

**How it works:** Invisible microwaves excite water molecules inside the kernels. When the molecules move fast enough to reach  $100^{\circ}\text{C}$ , they change to steam and go “pop.”



# Why do you need to learn about Conduction, Convection & Radiation?

You need to learn about them because these three “heat transfer” processes greatly affect your planet. They cause tornados and hurricanes.

**Conduction** makes cities hotter than the surrounding country.

Have you ever noticed the blurry waves of heat rising off a hot road on a sunny day? This is called a *mirage*. A mirage happens when hot pavement heats the layer of air floating just above it.

Because the hot pavement is *in direct contact* with the air layer above it, this is considered a form of *conduction*.

Because cities have lots of pavement (roads, sidewalks,



parking lots, even roofs), lots of ground air gets heated up this way. That’s why city temperatures are always 1-3 degrees higher than the surrounding rural areas.

**Convection** creates our winds, ocean currents and weather.

If you have ever been to the ocean, you probably noticed that there is always a breeze blowing. This is due to circular *convection currents* in the air.

During the day, hot air rises over the warmer land, while cool air falls over the cooler water. This makes a nice cool *shore breeze*.

At night, the land cools more quickly than the water. This means hot air rises over the warm water, while cool air falls over the cooler land. This makes a nice cool *sea breeze*.

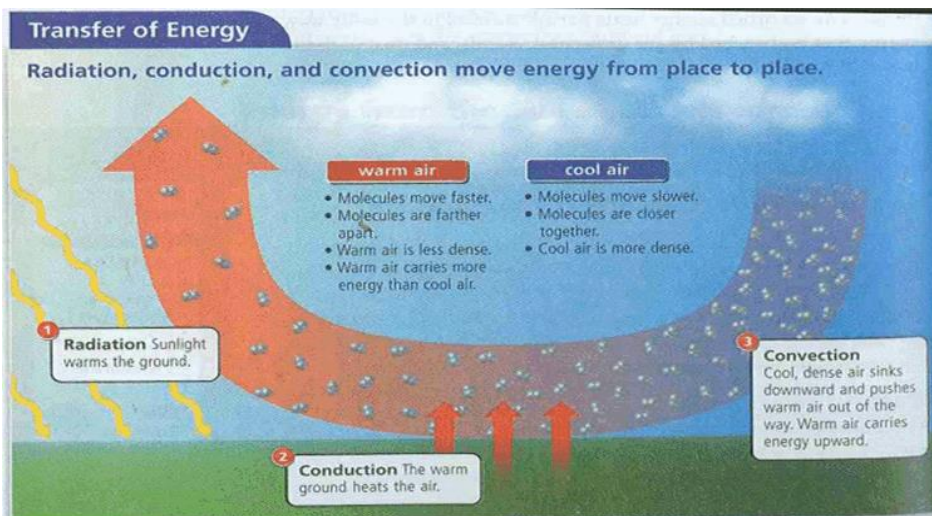
Similar temperature differences in ocean water help create convection-driven ocean currents. Strong convection currents in our atmosphere also create violent thunderstorms, tornados and hurricanes.

**If Earth were not heated by the sun’s radiation, it would be a frozen, lifeless planet.**

The majority of our heat energy arrives in the form of *radiation* (electromagnetic waves) from our Sun. And lucky for us, the Earth atmosphere and oceans are extremely good at absorbing that radiation. Perhaps even more important, the Earth’s atmosphere and oceans are extremely good at holding onto that radiant energy and “re-radiating” it at night. This keeps dark half of the planet from freezing at night!

We’re also lucky our atmosphere is just the right thickness. If it were too thin, Earth would loose too much heat at night and, like Mars, become icy cold. Conversely, if our atmosphere were too thick, Earth would hold onto too much heat and eventually bake dry.

Indeed, that’s why scientists are worried about global warming. All the evidence suggests that man-made carbon emissions are “thickening” Earth’s atmosphere causing the planet to slowly grow warmer!

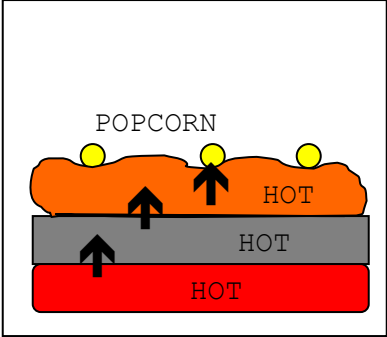


Name \_\_\_\_\_ Date \_\_\_\_\_ Period \_\_\_\_\_

**In the left column,**  
draw a picture of a way  
to cook popcorn that  
illustrates the type of  
energy transfer. ↓

**In the center  
column,** explain how  
the energy is  
transferred. ↓

**In the right column,** list  
or draw an example of how  
the heat transfer method  
affects the Earth's  
atmosphere, weather and  
ocean systems. ↓

	Which way of making popcorn illustrates this kind of energy transfer?	How is the heat energy is transferred?	How does this kind of energy transfer affect our atmosphere, weather or ocean systems?
<b>Conduction</b>			
<b>Convection</b>			<p>Rising hot air and falling cool air create circular convection currents that make shore or sea breezes.</p> <p>Similar actions in warm and cold sea water create ocean currents.</p>
<b>Radiation</b>		<p>Heat is transferred indirectly (without touching anything) via electromagnetic waves, such as microwaves.</p>	

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***Don't forget to title this page "3 Transfers of Heat: CCR"***