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**Grade 7 Informative Essay on Heat Transfer**

**Prompt: In a well-developed paragraph, compare and contrast the three types of heat transfer by giving supporting evidence from the two essays.**

**Energy Likes to Move**

If there is a temperature difference in a system, heat will naturally move from high to low temperatures. The place you find the higher temperature is the **heat source**. The area where the temperature is lower is the **heat sink**. When examining systems, scientists measure a number called the **temperature gradient**. The gradient is the change in temperature divided by the distance. The units are degrees per centimeter. If the temperature drops over a specific distance, the gradient is a negative value. If the temperature goes up, the gradient has a positive value. The greater the gradient, the more energy will be exchanged.

**Ever Hear of Convection Ovens?**

**Convection** is the way heat is transferred from one area to another when there is a "bulk movement of matter." It is the movement of huge amounts of material, taking the heat from one area and placing it in another. Warm air rises and cold air replaces it. The heat has moved. It is the transfer of heat by motion of objects. Convection occurs when an area of hot water rises to the top of a pot and gives off energy. Another example is warm air in the atmosphere rising and giving off energy. They are all examples of convection. The thing to remember is that objects change position.

**Radiating Energy**

When the transfer of energy happens by **radiation**, there is no conductive medium (such as in space). That lack of medium means there is no matter there for the heat to pass through. Radiation is the energy carried by **electromagnetic** waves (light). Those waves could be radio waves, infrared, visible light, UV, or Gamma rays. Heat radiation is usually found in the infrared sections of the EM spectrum. If the temperature of an object doubles (in Kelvin), the thermal radiation increases 16 times. Therefore, if it goes up four times, it increases to 32 times the original level.

Scientists have also discovered that objects that are good at giving off thermal radiation are also good at absorbing the same energy. Usually the amount of radiation given off by an object depends on the temperature. The rate at which you absorb the energy depends on the energy of the objects and molecules surrounding you.

**Conducting Energy and Heat**

**Conduction** is a situation where the heat source and heat sink are connected by matter. As we discussed before, the heat flows from the source down the temperature gradient to the sink. It is different from convection because there is no movement of large amounts of matter, and the transfers are through collisions. The source and the sink are connected.

If you touch an ice cream cone, the ice cream heats up because you are a warmer body. If you lie on a hot sidewalk, the energy moves directly to your body by conduction. When scientists studied good thermal radiators, they discovered that good thermal conductors are also good at conducting electricity. So when you think of a good thermal conductor, think about copper, silver, gold, and platinum.

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**Heat is transferred in three different ways: conduction, convection and radiation.**

**Conduction** is the transfer of heat through matter by molecular activity. Heat moves by direct contact. If you put one half of a spoon in boiling water you will notice that the end of the spoon that is not in the water is also hot.

The second way that heat transfers is through **convection**. This is the transfer of heat by mass movement or circulation within a substance. This occurs often in gases and liquids. Consider boiling water on a stove top. At first heat moves by conduction from the stove top through the pan to the water. Warmer water rises as the molecules move apart and it becomes less dense. The hot water at the bottom of the pan moves to the top and the cooler water at the top moves to the bottom. When the cooler water is heated it moves back to the top, circulating the heat throughout the liquid. The same thing happens in air. Warmer air rises and cooler air sinks to take its place.

The third way heat is transferred is by **radiation**. Radiation energy travels through the vacuum of space. Our planet receives heat from the sun in this way.

Changes in temperature cause changes in air pressure. Warm air has less pressure than cool air. When air is heated the molecules spread apart and it rises. When air is cooled, molecules move together and it sinks. This is one way that wind is created.

As the sun comes up, heat reaches the planet through radiation. Land surfaces heat and cool more quickly than the surfaces of water. Since the land near the ocean heats more quickly than the nearby water surface, the air above the land heats faster than the air over the ocean.

Convection causes the warmer air over land to expand and rise, which in turn causes low air pressure over the land. The cooler air over the ocean rushes in to replace the warm air that just rose over land. This causes a sea breeze.

As the sun begins to set, the land cools faster than the ocean. At some point the temperature of the land air and the ocean air are the same. This causes the breeze to stop for a short period. Gradually, convection and radiation cause the air over the ocean to expand and rise because it is warmer than the air over land. The cooler air over the land rushes in to fill the gap caused by the rising, warmer ocean air. This causes a land breeze. This transfer of heat through convection and radiation happens each day.