

## INTERMEDIATE AND SECONDARY ACTIVITY

# GEOHERMAL EXCHANGE SIMULATION

### BACKGROUND

In most areas of the country, geothermal energy can be used to heat and cool homes. Since the temperature four to six feet underground remains fairly constant all year long (although it varies by your latitude), the underground temperature is warmer than your unheated home during the winter and cooler than your uncooled home during the summer. A geothermal heat pump (also known as a geothermal exchange system) takes advantage of this and exchanges heat with the earth, warming or cooling a home using a renewable source of energy. A heat pump moves heat energy from one place to another, instead of generating heat, like a conventional furnace or air conditioning system. Therefore, a geothermal exchange system is much more efficient and saves a lot of energy.

### QUESTION

How does geothermal exchange occur?

### MATERIALS

- 4 Bendable straws
- Nail
- Scissors
- Tape
- 2 Small cups
- 13x9 Baking dish
- Tongs
- Paper towels
- Heating pad
- Kitchen hand towel
- Cold water
- Digital or instant read thermometer
- Ice
- Hot water
- Safety goggles
- Oven mitt

*Note: This model WILL leak water. Use a protected surface and place towels underneath cups.*

### PROCEDURE

1. Set up the model similar to Fig. 1.

Poke a hole in the bottom of one cup, and the side of another.

Use scissors to snip into the long end of three straws. Pinch each cut end and insert it into a short uncut end of another straw, and tape the joint. The last straw should be joined at the short end, then trim the straw as needed once inserted into the collection cup.

Insert the free straw end into the drain cup. (If needed, use tongs to pull the straw through the hole.)

Tape the straws to the bottom of the 13x9 dish to keep the model stable.

2. **Heating Season:** moving heat from the earth to your home

Turn the heating pad to high, and place under the 13x9 dish. Place paper towels under the cups (Fig. 2).

Place a towel over the straws in the dish. Wait about ten minutes for the heating pad to warm the model.

Pour ice water into the drain cup. Use an instant read thermometer to take the temperature of the water entering the system (Fig. 3) and record it in the data table.

Take the temperature of the water filling the collection cup and record in the data table.

Pour the water out of the cups.

FIG. 1 MODEL SET-UP



FIG. 2 MODEL SET-UP



FIG. 3 HEATING SEASON MODEL



3. **Cooling Season:** moving heat from your home into the earth to cool your home

*SAFETY: Use extreme caution when handling, pouring, or holding the cup with hot water. Splashes and drips could burn. Wear safety goggles and an oven mitt when handling hot water.*

Heat water in a hot pot to no more than 100°F or 37°C. Water that is too hot may melt the cup.

Fill the 13x9 pan with ice. Cover the model as much as possible.

Pour hot water into the drain cup (Fig. 4). Use an instant read thermometer to take the temperature of the water entering the system and record it in the data table.

Take the temperature of the water filling the collection cup and record in the data table.

Pour the water out of the cups.

FIG. 4 COOLING SEASON MODEL



**DATA**

	Starting Temperature	Ending Temperature	Temperature Change
Heating Season			
Cooling Season			

**CONCLUSION**

1. Explain how heat moves by conduction.
2. How would adding more straws to the system affect the temperature change?
3. Draw a picture to show how you would redesign the model to create a more efficient exchange of energy. Write a paragraph describing how your system works.

**EXTENSION**

Research geothermal heat pumps (check out [www.energysavers.gov](http://www.energysavers.gov)), and write a few paragraphs describing the advantages and disadvantages to installing and operating this kind of heating and cooling system. Do you think it would be a good investment for your family home? Explain why or why not.

THANKS! Activity developed by NEED Teacher and Facilitator, John McLaren, Centreville High School, Centreville, Virginia.