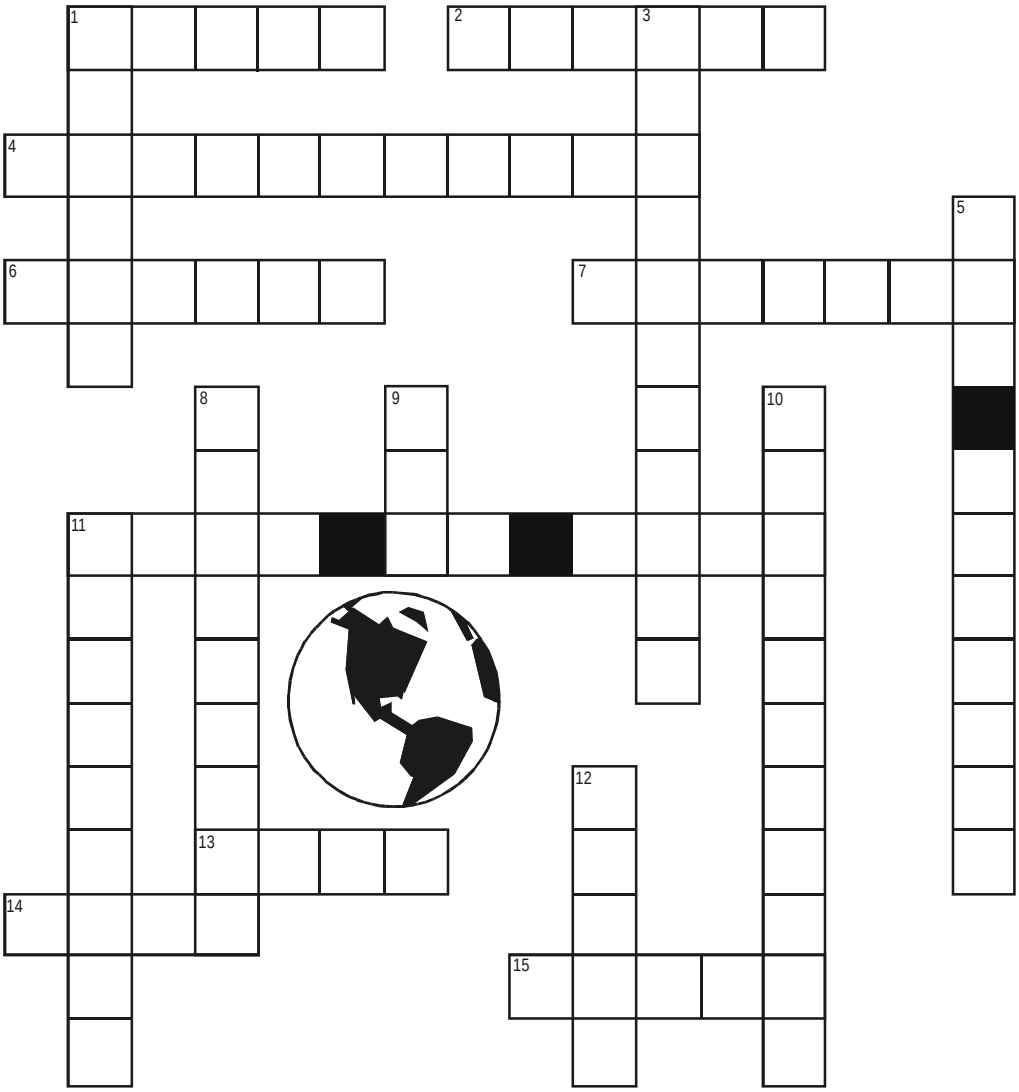
# ELEMENTARY **CROSSWORD PUZZLE: Geothermal Energy**



**ACROSS**

1. Melted iron
2. Greek word for heat
4. Where geothermal energy is located
6. The Earth's crust is in giant pieces called ____
7. Mountain with geothermal energy
11. Area of Pacific with geothermal resources
13. Produced by volcanoes
14. Center of the earth
15. Outer layer of the earth

**DOWN**

1. Earth layer with magma and rock
3. Geothermal energy is caused by _____ decay
5. Geothermal resource good for bathing
8. Replenished in a short time
9. Greek word for earth
10. Produced by geothermal plant
11. Underground geothermal pool
12. Greek word for water

# INTERMEDIATE ACTIVITY: Natural Refrigeration

**GOAL:** To build a refrigerator that doesn't need electricity. *(This system is used by many desert dwellers in Africa who have no access to electricity.)*

**MATERIALS:**

- ☐ 5 large earthenware flower pots
- ☐ 5 small bags of sand
- ☐ 5 thermometers
- ☐ cardboard
- ☐ 5 smaller earthenware flower pots that will fit inside large ones
- ☐ 5 lids to cover large flower pots (dinner plates will work)
- ☐ water

**PREPARATION:**

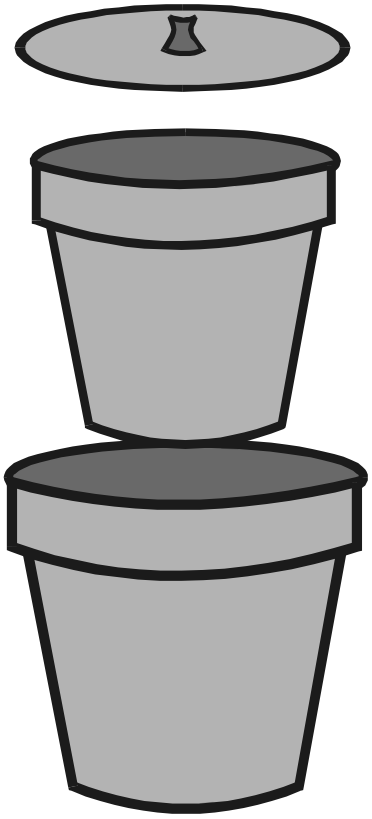
1. Prepare five sets of materials listed above for five groups of students.
2. Make a copy of this page for each group.
3. Place the students into five groups.

**SCIENTIFIC CONCEPTS:**

1. Thermal energy is required to change a liquid into a gas (heat of vaporization).
2. When water evaporates, it absorbs thermal energy from its surroundings.

**PROCEDURE:**

1. If there is a hole in the bottom of the large flower pot, cover it with a piece of cardboard.
2. Pour a one centimeter layer of sand into the bottom of the large flower pot. Dampen the sand with water.
3. Place the smaller flower pot inside the larger pot. Fill in the space between the two pots with sand.
4. Dampen the sand with water.
5. Place the thermometer inside, cover the pots, and let stand for two minutes.
6. Remove the lid and record the temperature. Use this as your control temperature.
7. Place the thermometer back in the pot, cover, and place in a dry sunny place. Record the temperature after 10, 20, and 30 minutes.
8. Record the temperature every day for several days, noting the weather conditions and the dampness of the sand.
9. Compare your results with the results of the other groups of students.



**RESULTS:**

**CONCLUSIONS:**

**QUESTIONS:** Why did the experiment call for earthenware pots? Would metal, glass or plastic containers work as well?

# SECONDARY **ARTICLE: Harnessing Waste Heat**

Almost every energy transformation involves the generation of heat, which usually dissipates into the atmosphere and is unrecoverable.

ENECO, Inc., a company focused on developments in energy sciences, has invented a semiconductor technology that converts heat from a wide variety of sources to electrical energy using solid state thermionics. ENECO expects that its new technology, which is based on solid state thermionics, will have profound implications for the recovery of waste heat, primary generation of electrical power, and efficient cooling.

The most immediate application of this technology could be the recovery of billions of dollars of wasted heat energy that literally goes up in smoke from stacks and tailpipes every year. Funneling waste heat through an ENECO device may recover a significant portion of that wasted heat energy and convert it directly to electricity.

ENECO's new devices could yield conversion efficiencies approaching thirty percent, more than twice that of the current conversion technology. ENECO technology is also considered a green technology, because its conversion process produces no pollution and reduces emissions per kilowatt-hour of electricity generated, regardless of the energy source.

ENECO's technology is expected to have a significant impact on the future of power generation and has potential applications in a wide-spectrum of industries. Devices developed from this technology will be able to generate electricity from two categories of energy sources, waste heat or primary heat.

**Waste Heat Conversion**
In the process of producing electricity, many generators expel a considerable portion of available fuel energy as waste heat. The technology promises to reduce fuel consumption, thereby reducing harmful emissions per unit of electrical power. ENECO devices can improve overall generation efficiency because no additional fuel will be consumed and are projected to have low operating and maintenance costs per unit of electricity.

In addition to power generation, mobile engines found in automobiles, trucks, ships and aircraft are producers of waste heat energy. The heat lost through engine exhausts may be captured by ENECO technology and converted into electricity to augment or replace a vehicle's electrical and air conditioning systems.

**Direct Conversion of Primary Heat**
For many applications it will be appropriate to generate electricity solely from ENECO technology, rather than harvesting waste heat from another process. Fossil fuels such as gas, oil and coal, as well as renewable fuel sources such as straw, wood products and biomass-derived methane are examples of potential primary heat sources. The heat of external combustion of these primary fuels, when channeled through ENECO devices, can not only produce electricity but also can simultaneously cogenerate useful heat and reduce pollution.

Consumer and commercial applications will focus on standby power. For example, ENECO devices could provide backup electricity during power outages to operate furnaces, fans and associated heating control electronics. On a larger scale, back-up power for an entire residence or business may become practical.

ENECO technology can also produce electricity directly from concentrated solar power. High efficiency, compactness and quiet operation make it suitable for space and terrestrial power generation. The technology may prove competitive with conventional photovoltaic cells currently in use in many satellites.

ENECO's solid state devices could also provide power at remote sites. The living conditions and economies of small villages could be improved if ENECO devices were used to provide dependable, efficient and affordable electricity to power cottage industries, medical facilities and critical communications.

**Efficient Cooling**
Solid state thermionics may also be reversed to provide an efficient cooling process if an electrical current is passed through an ENECO device. The electrical current causes the device to absorb energy from one surface and expel it on the opposite surface. The result is a cooling process, similar to a heat pump, that requires no compressor and no chlorofluorocarbons such as freon gas. This offers a variety of possibilities in everything from consumer electronics to satellites and commercial aircraft.

*More information on this emerging technology can be found on Eneco's website:* ***www.eneco-usa.com****.*