CLUE into CLIMATE

KQED education network

Science ready to EXPLORE

Lesson 4d: Geothermal Energy: Harnessing the Power of the Earth

SUBJECT

Earth Science

GRADE LEVELS

4–8

CA SCIENCE STANDARDS

Grade 6: Earth Sciences. 1. Plate tectonics accounts for important features of Earth's surface and major geologic events. (b, e)

Grade 6: Earth Sciences. 6. Sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. (a, b)

EARTH SCIENCE LITERACY PRINCIPLES

#4: Earth is continuously changing. (4.5)

#7: Humans depend on Earth for resources. (7.10)

OVERVIEW

Geothermal energy is a renewable energy source produced from the heat inside Earth. In this lesson, students will learn about how geothermal energy is produced, and they will discuss its limitations. Students should have a general understanding of plate tectonics before beginning this lesson.

ESSENTIAL QUESTIONS

1. What is geothermal energy and how does it work? *(Geothermal energy is energy produced from the heat inside Earth; it can be used to heat buildings and generate electricity.)*
2. How can the use of geothermal energy help address climate change? *(Increased use of geothermal energy could help reduce greenhouse gas emissions.)*

MEDIA RESOURCE

***QUEST* video: "Geothermal Energy"**
Video length: 7 minutes, 36 seconds
Link: http://www.kqed.org/education/educators/clue-into-climate/renewable-energy.jsp
Through watching this video, students will learn:

- About the Pacific Ring of Fire and where geothermal energy can be found
- What geothermal energy is, how it is produced, and how it is being used around the world as an renewable energy source
- About the cost and difficulties associated with capturing geothermal energy

VOCABULARY

fumerole
an opening in Earth's crust that emits steam

geothermal
the internal heat contained in Earth

magma
the molten rock material under Earth's crust

mantle
the molten-rock layer between Earth's crust and core

reservoir
an underground accumulation of petroleum, natural gas, or other resource

tectonic plate
the large, thin, and relatively rigid part of the upper mantle and crust, called lithosphere plates, that move relative to one another on the outer surface of Earth

ACTIVITY 1: GEOTHERMAL ENERGY

Time: 30 minutes
Materials:

- Computer with Internet access
- Projector and speakers
- Handout: Student Worksheet

Procedure:

1. Discuss the different types of alternative or renewable energy sources. What kinds of renewable energy sources do you know about?
2. Make copies of and hand out the Student Worksheet, then watch "Geothermal Energy." Ask students to pay particular attention to the benefits and drawbacks of geothermal energy. Pause the video often so students are able to answer the following questions on their Student Worksheet:
   - Where does geothermal energy come from? *(from deep inside Earth)*
   - What makes geothermal energy a good alternative source of electric power? *(Geothermal energy generates electricity around the clock and does not produce significant greenhouse gas emissions.)*
   - What is one drawback of drilling geothermal wells? *(You can't drill just anywhere for Earth heat; finding and trapping geothermal steam can be tricky and costly.)*
   - Why is geothermal energy not always a renewable energy source? *(Geothermal reservoirs are not inexhaustible; if not properly managed over time, a geothermal resource may run out of steam.)*
3. Discuss the pros and cons of geothermal energy. Students can create a chart on the board. What are some of the limitations associated with geothermal energy? How can the use of geothermal energy affect climate change? Are there other environmental issues related to the use of geothermal energy?

ACTIVITY 2: PERSUASIVE ESSAY – INVESTING IN GEOTHERMAL ENERGY

Time: 30 minutes
Materials:

- Paper and pencil or computer lab

Procedure:

1. Ask students to imagine they are part of a committee that is planning to donate a large amount of money to renewable-energy research and development in California. But first they have to decide where this money should go. Should it be spent on geothermal energy? Why or why not?
2. Have students write a persuasive essay arguing for or against the development of more geothermal energy plants. Essays should include at least three reasons to support why they believe geothermal energy is or is not a good resource to invest in. Play "Geothermal Energy" again if students need more information.
3. As a class, discuss some of the points students wrote about in their essays. Take a class poll to see how many students were for the development of geothermal energy and how many thought the money would be better spent elsewhere.
4. As an extension or variation, divide the students into teams and organize a debate between those who support geothermal energy and those who support another energy source.

WHAT CAN WE DO?

One way to reduce greenhouse gas emissions is to reduce energy consumption at home. Turn off the lights and any electrical appliances not in use when you leave a room. Also, ask your parents if you can set your home thermostat just a few degrees lower. In this way, you'll be using less energy to heat your house!

ABOUT THE AUTHOR

Tamar Burris is a curriculum developer and former elementary school teacher. She is also a contributing writer to *Kidsville News* and other child and family publications.

KQED Education Network engages with community and educational organizations to broaden and deepen the impact of KQED media to effect positive change.

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GLOBAL IMPACT

Discussion Questions/Activities

1. In "Geothermal Energy," a number of countries are mentioned that have geothermal energy projects under way. Find these countries on a world map. Then look at the National Aeronautics and Space Administration's (NASA) map of Earth's tectonic plates found here: http://denali.gsfc.nasa.gov/dtam/images/schematic_map.jpg.
2. Using both the world map and the NASA map, compare the locations of the countries mentioned with the plate boundaries of Earth. Where are these countries in relation to Earth's plate boundaries? Why do their locations make them good candidates for geothermal projects?
3. Research what the governments of these countries are doing to address climate change. Do you agree with their policies? Why or why not?

ASSESSMENT IDEAS

- Students complete geothermal energy crossword puzzles:
  - http://tonto.eia.doe.gov/kids/resources/teachers/pdfs/ElementaryActivityGeothermalPuzzle.pdf (printable)
  - http://tonto.eia.doe.gov/kids/energy.cfm?page=cwp_geothermal (online)
- Students share with a partner what they learned.

ADDITIONAL RESOURCES

Geothermal, U.S. Energy Information Administration
http://tonto.eia.doe.gov/kids/energy.cfm?page=geothermal_home-basics
This website provides a brief overview of geothermal energy, including how it is generated and where it is found.

Geothermal Energy Curriculum, Geothermal Education Office
http://www.bpa.gov/corporate/KR/ed/geothermal/homepage.htm
Designed for grades 4–8, this downloadable unit takes an in-depth look at the geology, history, and many uses of geothermal energy.

Geothermal Technologies Program, U.S. Department of Energy
http://www1.eere.energy.gov/geothermal/index.html
This resource offers information about the key activities in the Energy Efficiency & Renewable Energy Geothermal Technologies program, as well as maps and other data identifying geothermal resources around the world.

The Geysers, Calpine Corporation
http://www.geysers.com/
Learn more about the history and operations of The Geysers, the largest complex of geothermal power plants in the world.

Virtual Geothermal, CalEnergy
http://www.calenergy.com/aboutus4.aspx
Take a virtual tour of a geothermal power plant to investigate all the phases involved in obtaining, converting, and using geothermal energy resources.

STUDENT WORKSHEET

"Geothermal Energy" Viewing Questions

1. Where does geothermal energy come from?

2. What makes geothermal energy a good alternative source of electric power?

3. What is one drawback of drilling geothermal wells?

4. Why is geothermal energy not always a renewable energy source?