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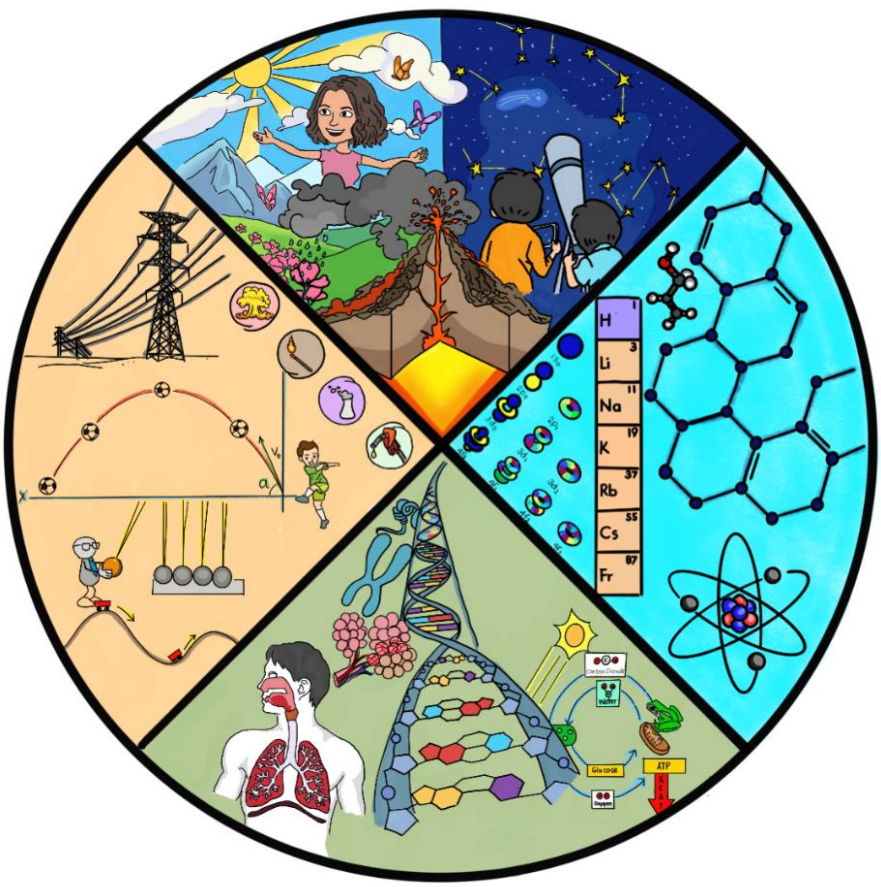
Department of Education
National Capital Region
SCHOOLS DIVISION OFFICE
MARIKINA CITY

Science

Quarter 3 -Module 3
Geothermal Energy



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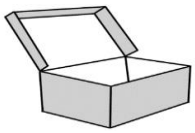


What I Need to Know

The purpose of this module is to provide clear understanding on how energy from volcanic activities produce energy in the form of geothermal energy and how humans can benefit from this energy. After all, volcanoes are not all bad but they also help us promote tourism.

This module contains one lesson: Geothermal Energy

After going through this module, you are expected to **illustrate how energy from volcanoes may be tapped for human use. S9ES-III C-D-29**

Specifically, you should be able to:

- identify the type of energy from volcanoes;
- create a graphic representation of geothermal energy flow in a geothermal power plant;
- explain how a geothermal energy is transformed into electrical energy; and
- identify the advantages and disadvantages of using geothermal energy.

What I Know

Read each question and encircle the letter of the correct answer.

1. Which energy is harnessed from the Earth's underground?
   A. Electrical
   B. Mechanical
   C. Geothermal
   D. Solar

2. Which of the following shows the proper sequence of energy conversion in a Geothermal powerplant?
   A. Electrical energy → mechanical energy → heat energy
   B. Heat energy → mechanical energy → electrical energy
   C. Heat energy → electrical energy → mechanical energy
   D. Mechanical energy → heat energy → electrical energy

3. Which of the following shows the correct order of the parts of a Geothermal powerplant?
   A. Magma → reservoir → turbine → generator → transmission lines
   B. Magma → turbine → generator → reservoir → transmission lines
   C. Magma → generator → turbine → reservoir → transmission lines
   D. Magma → turbine → reservoir → generator → transmission lines

4. All active volcanoes can produce energy, which volcano is a good source of geothermal energy?
   A. Cinder
   B. Lava Dome
   C. Shield
   D. Stratovolcano

5. In a Geothermal powerplant, what makes the turbine rotate?
   A. Carbon B. heat C. Steam D. water

6. Where is the best place to construct a Geothermal Powerplant?
   A. near an extinct volcano
   B. far from an extinct volcano
   C. near an active volcano
   D. far from an active volcano

7. Why is the Philippines an ideal place to construct a geothermal power plant?
   A. Philippines is near the Pacific Ocean.
   B. Philippines is near a convergent boundary.
   C. Philippines has many active stratovolcanoes.
   D. Philippines is surrounded with water.

8. Why do Geothermal power plants cause global warming?
   A. Because of the burning of fuel
   B. Because of the transformation of electricity
   C. Greenhouse gases escape during the digging of ground.
   D. Steam released by the crater emits greenhouse gases.

9. Which of the following is a disadvantage of a geothermal powerplant?
   A. high cost in construction
   B. renewable energy source
   C. cause of earthquakes
   D. efficient source of energy

10. What factor/s can be considered in constructing geothermal powerplants?
   A. construction cost
   B. places with hot springs
   C. location
   D. all of the above

Lesson Geothermal Energy

What's In

Identify the following effects of volcanic eruption as POSITIVE or NEGATIVE effect.

_____1. Destruction of properties
_____2. Ash and mud mixed with rain which results to Lahar (mudflow)
_____3. Fertile soil
_____4. Human and animal casualties
_____5. Provides possible source of energy

What's New

Study the diagram below and answer the following questions.

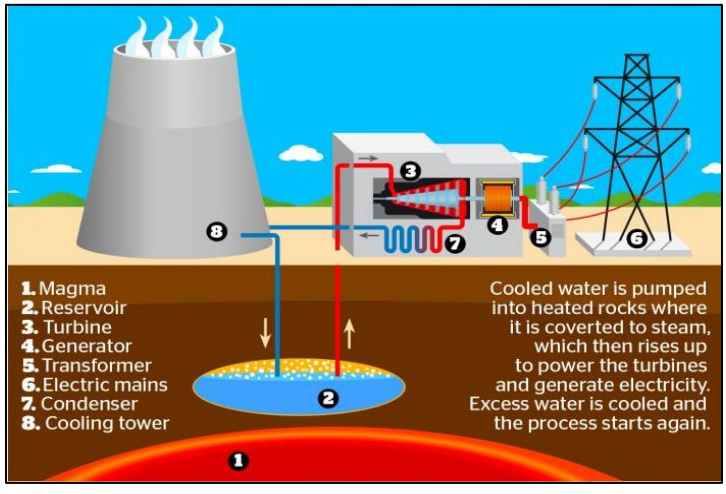


Figure 1. Geothermal Powerplant
http://bit.ly/3b0KjEB

Guide questions:

1. What is the main source of heat in the diagram? _____
2. What happens to heat energy after being processed in the powerplant?
   _____
3. Which place is ideal to build a geothermal powerplant? Why?
   _____

What Is It

Figure 1. shows how Geothermal power plant works. The term Geothermal came from the Greek word "Geo" and "Therme" meaning Earth and Heat. A **Geothermal Power Plant** is a type of power plant which produces a renewable energy that harnesses heat from the earth and converts it into electrical energy that can be wired into our homes and other establishments.

This type of powerplant is usually built near volcanoes where the heat from magma is used to create steam from a water reservoir. Figure 2 shows the process of how a Geothermal powerplant converts heat energy into electrical energy.

Process of how a Geothermal powerplant generates electricity:

1. The magma from a nearby volcano heats the water in the reservoir and converts it into steam (water vapor).
2. The steam drives the turbine. At this point, heat energy is converted into mechanical energy.
3. The rotating turbine powers the generator. The generator converts mechanical energy into electrical energy.

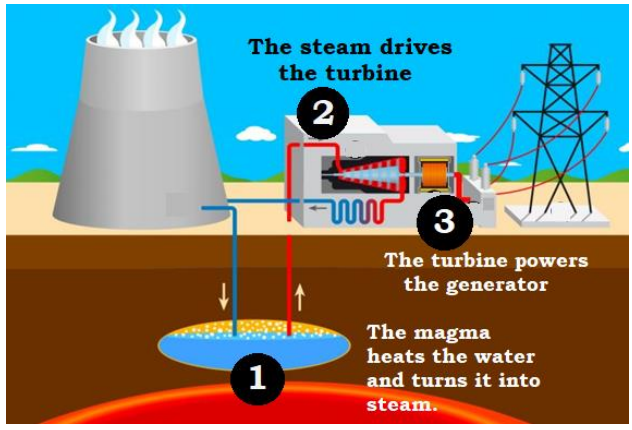


Figure 2. How Geothermal Powerplant works
http://bit.ly/3b0KjEB

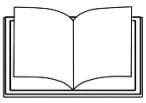
The purpose of the cooling tower is to allow the steam to turn back into water which will eventually go back in the reservoir.

In the Philippines, the first geothermal power plant is found in Tongonan, Leyte, and other specific regions like Makban (Laguna), Tiwi (Albay), Bago City (Negros Occidental), Valencia (Negros Oriental), Kidapawan (North Cotabato), Calaca (Laguna), and Bacon-Manito (Sorsogon). According to the International Geothermal Association, the Philippines ranked second in producing geothermal energy with 1094 megawatts worldwide due to the presence stratovolcanoes.

Although a Geothermal powerplant produces a renewable source of energy, it also offers some disadvantages. Table 1 shows the advantages and disadvantages of a Geothermal energy.

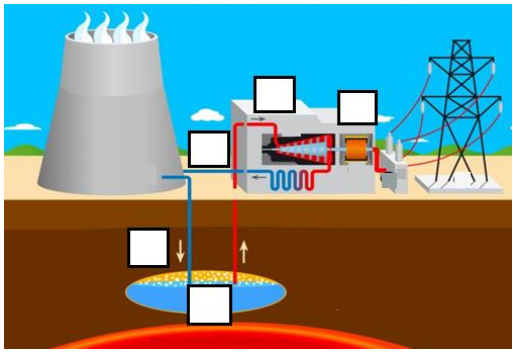
Table 1. Advantages and Disadvantages of Geothermal Energy.

ADVANTAGE	DISADVANTAGES
• **Renewable energy source** – reservoirs can be naturally replenished. • **No fuel required** – After the plant is built, no fuel is needed to distribute energy. • **Abundant supply of energy** – Compared to other energy sources, geothermal energy offers unlimited energy supply.	• **Potential emissions** – Greenhouse gases, sulfur dioxide, silica and traces of toxic heavy metals can be exposed into the earth's surface causing global warming. • **Location Specific –** Geothermal powerplant can only be built in places near tectonic boundaries. • **High cost** – Installation of geothermal systems can be costly.



What's More

Explain how a Geothermal powerplant generates electricity by labelling the image below with the appropriate description.



A. The steam goes to the condenser and becomes water.
B. The water reservoir is heated to produce steam.
C. The steam drives the turbine which powers the generator.
D. The water from the condenser will flow back to water reservoir.
E. The generator generates electricity.

What I Have Learned

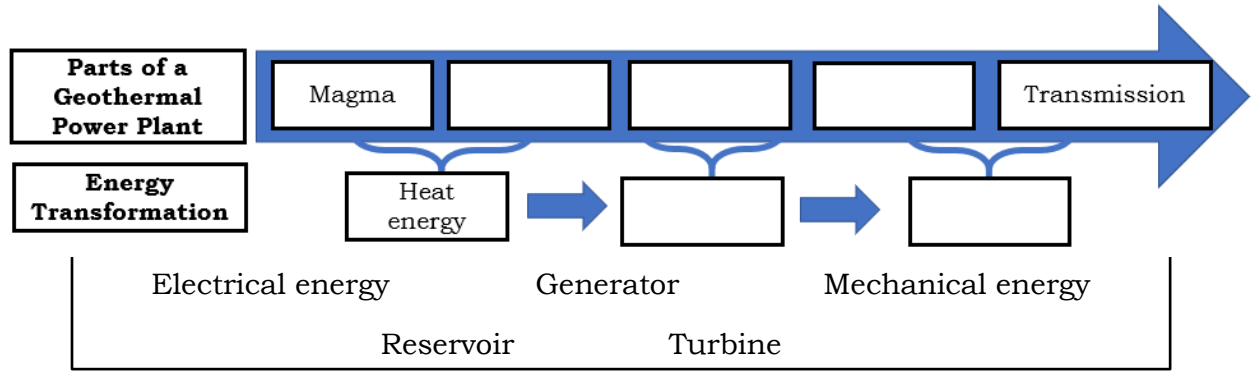
Supply the missing word/s to complete the paragraph. Choose the word/s from the box.

thermal	water	hot springs	Steam
magma	Geothermal energy		fumaroles

The internal parts of the Earth produce heat causing the production of magma on the top of the asthenosphere. 1._____ can transfer heat to the rocks nearby that can heat the 2. _____ reservoir and steam produced. This hot water and 3._____ go out to the steam vent or 4. _____ underwater hydrothermal vents, and mud pots, and 5. _____ these are the source of 6._____. Geothermal energy is also known as 7. _____ energy formed from the heat stored in the Earth's interior.

What I Can Do

Complete the flow chart below by supplying the appropriate word/s from the box.



Assessment

Write TRUE if the statement is correct and FALSE if it is not.

_____ 1. Geothermal energy is an energy derived from the heat of the Earth.
_____ 2. Generator converts heat energy to electrical energy.
_____ 3. A geothermal powerplant can be built in any open area.

Additional Activities

Choose any volcano in the Philippines and make a **POSTER** that promotes tourism in the Philippines.

Posttest

Read and understand each question and encircle the letter of the correct answer.

1. Which of the following refers to the renewable energy that uses the heat within the earth?
   A. Nuclear energy
   B. Geothermal energy
   C. Solar energy
   D. Gravitational Energy

2. Which of the following shows the proper sequence of energy conversion in a Geothermal powerplant?
   A. Mechanical energy → heat energy → electrical energy
   B. Electrical energy → mechanical energy → heat energy
   C. Heat energy → mechanical energy → electrical energy
   D. Heat energy → electrical energy → mechanical energy

3. What factor/s can be considered in constructing geothermal powerplants?
   A. the temperature of geothermal water
   B. places with geysers and hot springs
   C. location
   D. all of the above

4. Which of the following shows the correct order of the parts of a Geothermal powerplant?
   A. Magma → turbine → reservoir → generator → transmission lines
   B. Magma → reservoir → turbine → generator → transmission lines
   C. Magma → turbine → generator → reservoir → transmission lines
   D. Magma → generator → turbine → reservoir → transmission lines

5. The following are advantages of having a geothermal powerplant, **EXCEPT:**
   A. It is a reliable source of electricity.
   B. It provides free hot water production.
   C. It affects surface stability that can trigger earthquakes due to hydraulic fracturing.
   D. It is more environmental-friendly than conventional fuel source such as coal.

6. Which is the best place to construct a Geothermal Powerplant?
   A. far from the extinct volcano
   B. far from the active volcano
   C. near the extinct volcano
   D. near the active volcano

7. What makes the turbine move?
   A. carbon B. heat C. steam D. water

8. What is the purpose of a cooling tower in a Geothermal powerplant?
   A. It prevents heat from scattering throughout the power plant.
   B. It helps the turbine move faster.
   C. It helps the steam to go back into liquid form (water).
   D. It eases the production of electricity by cooling the whole powerplant.

9. The Philippines has several geothermal plant fields which supply our nation's energy, which of the following is NOT perfectly matched?
   A. Mak-ban Powerplant - Laguna
   B. Painpinon Powerplant - Negros Oriental
   C. Maibarara Powerplant - Batangas
   D. Bacon-Manito Powerplant - Albay

10. Which statement is TRUE about a geothermal powerplant?
   A. A geothermal power can be successful almost anywhere.
   B. Geothermal energy is a sustainable energy source.
   C. Initial costs in the construction of a geothermal power plant is low.
   D. There is no risk of the release of hazardous substances during drilling.

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Answer Key

What's In

1. Negative
2. Negative
3. Positive
4. Negative
5. Positive

What's New

1. Magma
2. It will be converted into electrical energy.
3. Near a volcano or a plate boundary.

What's More

What I have learned

1. Magma
2. water
3. steam
4. fumeroles
5. hot springs
6. geothermal energy
7. thermal

What I can do

Assessment

1. True 2. False 3. False

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