Oklahoma Alliance for Geographic Education

Teacher Training | Curriculum Development | Outreach Programs

Sustainable Energy Systems

Adapted from: "From Resources to Energy: the Origins of Energy"

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Lesson Title: Sustainable Energy Systems

Grade Level: 6th-7th grade

Purpose/Overview:
The lesson will introduce different types of sustainable energy and students will learn how these energy systems work.

National Geography Standards from *Geography for Life*
Geographic Elements & Standards:
12 The processes, patterns, and functions of human settlement
14 How human actions modify the physical environment
16 The changes that occur in the meaning, use, distribution, and importance of resources
18 How to apply geography to interpret the present and plan for the future
https://www.nationalgeographic.org/standards/national-geography-standards/

Oklahoma Academic Standards for the Social Studies:
6.C.2.4 Describe the distribution of natural resources found in each region, delineating between renewable and nonrenewable resources, and explaining how the relative location to such resources can influence the economic development of a region.
6.C.4.6 Describe the role of citizens as responsible stewards of natural resources and the environment (e.g., recycling campaigns, water conservation, national parks, protection of wildlife preserves).
7.C.3.3 Evaluate the effects of human modification of the natural environment through processes related to industrialization**.**
7.C.3.4 Describe the role of citizens as responsible stewards of natural resources and the environment, through sound resource use and conservation.
https://oklahoma.gov/content/dam/ok/en/osde/documents/services/standards-learning/social-studies/SS%20OAS%20July%202025.pdf

Geographic Themes:
- Human-Environment Interaction | Movement

Objectives:
1. What **key topic/issue**(s) is/are associated with this lesson/unit?
    a. Energy sources, energy conversion, ethical/social issues surrounding Earth's natural energy resources and the advantages and disadvantages of long-term use
2. **What should students know** after this lesson/unit?
    a. Students will understand the origins and uses of different energy

sources.

3. **How will students apply** this lesson/unit content?
    a. Students will be able to describe the many different forms of energy and how they can transform from one to another.

Materials:

- Energy strips (Attached)
- Vocabulary sheets (Attached)
- Energy source worksheets for teams: Coal, Gas, Oil, Water, Wind (Attached)
- Pen or pencil

Time Frame: Two 45-minute class periods

Procedures:

Day 1

1. The teacher will explain the following:
    a. Fossil fuels are natural fuel sources formed by historical geological processes from the remains of living organisms. The most famous fossil fuels include coal, oil, and natural gas. These are nonrenewable, meaning these sources of energy are depleted by use and can be permanently eliminated. Alternate fuel sources include solar, wind, biomass, hydroelectric, and geothermal energy, which are renewable. These sources occur naturally by the sun, wind, or plant life.
    b. The teacher will hand out the vocabulary sheet so that students can reference it during the activity.
2. Pre-activity discussion
    a. The teacher will ask students the following questions:
        - How do we get our energy?
        - Why do we need energy sources?
        - Which energy sources could we use here in Oklahoma?
3. Activity
    a. Before class, the teacher will cut the sentence strips into sets to give to each team.
    b. At the start of the activity, the teacher will define an energy source as the resource used to create electricity, heat, or fuel.
    c. The teacher will pass out sentence strips to each team and ask teams to begin sorting them into different energy source categories (coal, gas, oil, water, wind, etc.) and tell the students that the sentence strips describe the following categories: solar, wind, oil, water, natural gas, wood, and coal, and they should team the sentence strips accordingly. For added critical thinking, tell the students there are seven kinds of energy and they need to divide the strips into

categories and determine the teams.
    d. Throughout this activity, the teacher should ask each team why they teamed certain strips together. Have students write down the energy sources for each of their teams (oil, wind, sun, etc.)
4. Discussion: The teacher will ask either each team or the entire class the following questions:
    a. Describe the perfect energy source. Do you see one in your teams?
    b. Which energy sources did you use today (riding the bus, turning on lights, heater)?
5. Extension question
    a. Explain why Oklahoma is an ideal place for one or more of these sources.

Day 2

1. Activity
    a. Before class, the teacher will print out the Energy source worksheets for each class.
    b. At the start of class, the teacher will hand out worksheets of a given energy source to teams. Ideally, there should be five teams - one energy source per team.
        i. Each team is responsible for a unique energy source and will be teaching their peers about how we use it.
    c. Each team will complete the first table in the worksheet (Renewable vs. Non-renewable vs. indefinite) individually.
    d. Afterwards, each team will be instructed to collectively work on answering the questions following the energy paragraph. The teacher should check in with the teams frequently during this step.
        i. Guiding questions such as “Where do you find this resource? Is it easily accessible?” and “How does the electricity from the power plant get to your house?” can help teams think in a logical sequence.
    e. Each team will present their energy source. Each student listening should answer the following questions on a piece of paper which will be turned in after class:
        i. What is the energy source?
        ii. Where is it found?
        iii. How is it harnessed?
        iv. How is it transported?

Assessment Options:

The teacher should assess each student's understanding by grading their energy source worksheet and presentation and then their answers to the provided questions about other teams' energy sources.

After this lesson, students should be able to: list important energy sources, understand the process of attaining energy from a resource and how this affects the environment, and compare and contrast the impacts of certain energy sources.

Resources:

- Fossil fuels
  - http://energy.gov/science-innovation/energy-sources/fossil
- Renewable resources
  - https://www.energy.gov/topics/renewable-energy
- Wind farms in desert
  - https://www.gem.wiki/Desert_Sky_wind_farm
- Hoover dam energy production
  - https://www.eia.gov/kids/for-teachers/field-trips/hoover-dam-hydroelectric-plant.php
- Fracking
  - https://www.usgs.gov/mission-areas/water-resources/science/hydraulic-fracturing
- Coal from swamps
  - http://www.ucmp.berkeley.edu/carboniferous/carboniferous.php
- Oil from limestone
  - https://www.sciencelearn.org.nz/resources/477-limestone-as-an-oil-reservoir

Extension and Enrichment/Simplification:

Instead of having each team teach the others about their energy source, have the teams rotate so that they each fill out all five worksheets and learn about the different energy sources themselves. Allow an extra 1-2 class periods for this.

Vocabulary

- Cap rock – a layer of hard, impervious rock overlying and often sealing in a deposit of oil, gas, or coal
- Carbon dioxide – a heat trapping gas present in the atmosphere formed when energy sources containing carbon are burned
- Coal – a fossil fuel burned as an energy source consisting of plant matter found in underground deposits
- Emission – the production and discharge of something
- Fracking – hydraulic fracturing of non-permeable rocks in order to obtain oil or gas deposits
- Generator - a machine for converting mechanical energy into electricity
- Kinetic energy - energy that a body possesses by virtue of being in motion
- Oil – a fossil fuel burned as an energy source derived from petroleum that stays as a liquid and is drilled for underground
- Shale - soft, finely stratified sedimentary rock that formed from consolidated mud or clay and can be split easily into fragile slabs
- Turbine - a machine for producing continuous power in which a wheel or rotor, typically fitted with vanes, is made to revolve by a fast-moving flow of water, steam, gas, air, or other fluid

Sentence Strips

Uses wind to spin fan blades.

Uses flowing water to spin a turbine.

Uses a turbine to create electrical energy.

Created by the remains of organic matter.

Uses a drill to cut through shale.

Cleanest burning fossil fuel.

Produces high carbon dioxide emissions.

Can be transported by pipeline or ocean tanker.

Uses a special sheet to absorb sunlight.

Can be put on your roof.

Only produces energy during the day.

Helpful fuel source in poor regions.

Contributes to deforestation.

Uses a renewable energy source.

Can destroy aquatic ecosystems.

Needs a dam to create different water heights.

Consists of a giant windmill.

Uses a gas (methane) as an energy source.

Can pollute underground water sources.

Uses a turbine to create electrical energy.

Can be built on open plains and by the ocean.

Energy Source Worksheets

Define renewable resource:

_____

Define non-renewable resource:

_____

Define indefinite resource:

Write the following list of fuels in the correct category in the table:

Oil	Natural Gas
Coal	Nuclear Fission
Sun rays	Wood
Ocean Tides	Compost

Renewable	Non-renewable	Indefinite

Team 1:
What is the energy resource? _____

Where is it found?_____

How is it harnessed?_____

How is it transported?_____

Team 2:
What is the energy resource? _____

Where is it found?_____

How is it harnessed?_____

How is it transported?_____

Team 3:
What is the energy resource? _____

Where is it found?_____

How is it harnessed?_____

How is it transported?_____

Team 4:
What is the energy resource? _____

Where is it found?_____

How is it harnessed?_____

How is it transported?_____

Gaining energy from coal

You are an electrical engineer and are in charge of gaining energy from coal. **Coal** is formed when fallen plant matter in a swamp is subjected to heat and pressure over time. When coal is burned, it provides energy in the form of heat. In a coal power plant, we use **turbines,** machines that produce continuous power when a wheel or fan is turned by a fast-moving flow of water, steam, gas, or air. **Generators** can turn this power into electricity.

1. How will you make the turbine spin? Hint: think about the uses of the heat produced by the burning coal.

2. What natural resources are needed in a coal powered plant?

3. To keep the plant efficient, it is important to reuse resources. How can resources be reused?

4. How will the electricity produced by the generator be transported for use?

5. Draw a diagram of your water powered plant and label all your components.

Gaining energy from natural gas

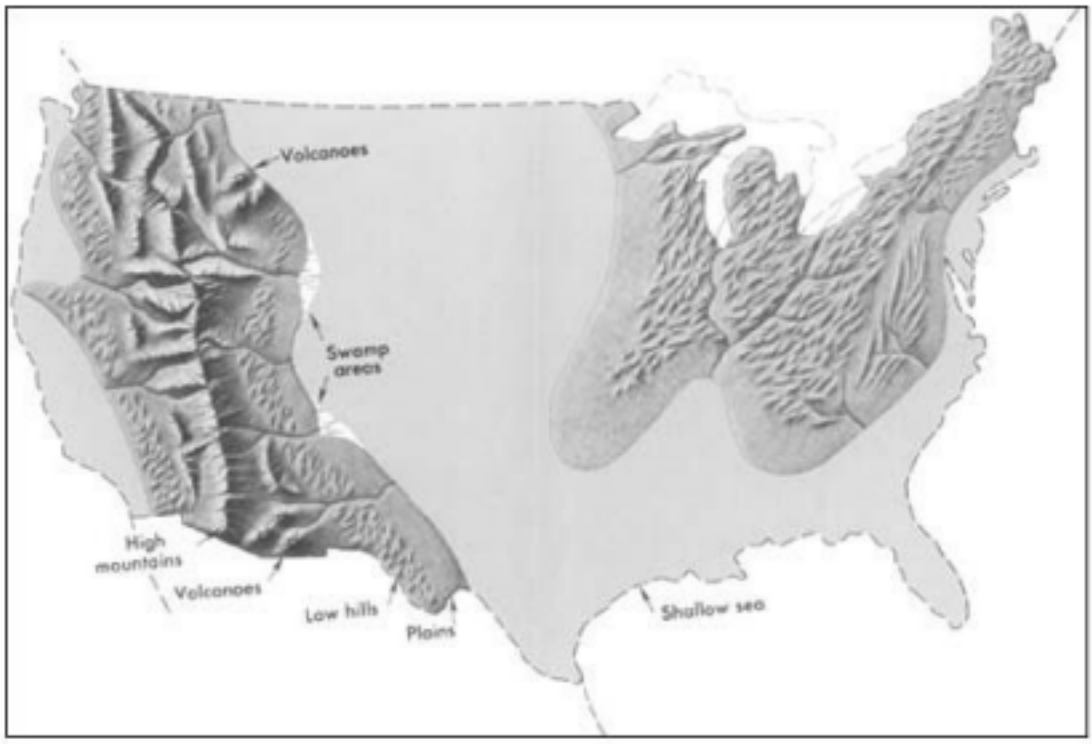
You are a geological engineer assigned to the task of retrieving natural gas to use as an energy source. Natural gas forms when organic matter is heated to high temperatures and compressed by high pressure. **Shale**, a sedimentary rock, is found underground and is composed of deposits found in water sources, such as the ocean, lakes, and rivers and often overlays natural gas. Shale is not very porous or permeable.

1. Where would you find shale deposits in the United States? What is required for shale to be deposited? Use the historical maps to help.

2. Once you find shale, how would you see if natural gas is underneath?

3. Natural gas flows naturally towards the Earth's surface. Knowing this, how would you retrieve natural gas from the underground deposits?

4. Once the natural gas has been found, how can it be transported for use?



Generalized geographic map of the United States in Late Cretaceous time.

Gaining energy from oil

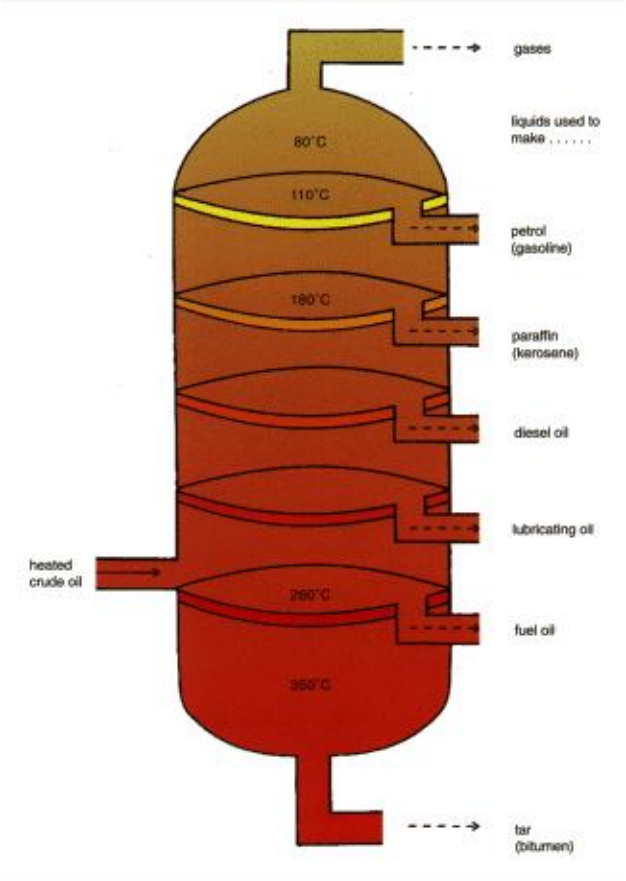
You are a geological engineer assigned to the task of retrieving oil to use as an energy source. Oil is formed when organic matter accumulates at the bottom of oceans, rivers, and swamps, and is then layered with sediment. With more sediment, the organic matter is subject to high pressures and heat from deep within the earth. These factors break the organic matter into carbons and hydrogens, which we can use as fuel. Many oil deposits are found beneath **cap rocks**, which are non permeable rocks prevent things below them from migrating to the surface.

1. How will you know you found oil underneath a cap rock? Hint: cap rock can produce high amounts of pressure.

2. Once you find oil, what does it look like and composed of? Is it ready for use?

3. How is oil transported for use? Think about the different places where oil is found.

4. What is happening in the diagram below?



Gaining energy from water

You are an aquatic engineer and are in charge of gaining energy in the form of electricity from a river. Energy is produced when **kinetic energy**, or energy something possesses by being in motion, is turned into electrical energy. Moving water possesses a lot of kinetic energy. **Turbines** are machines that produce continuous power when a wheel or fan is revolved by a fast-moving flow of water, steam, gas, or air. **Generators** can turn power into electricity.

1. How will you make sure that water is constantly moving over the turbine? Hint: have some water at a higher height than the rest of the water.

2. How will the energy produced by the generator be transported for use?

3. Draw a diagram of your water powered plant and label all your components.

Gaining energy from wind

You are an electrical engineer and are in charge of gaining energy in the form of electricity from the wind. Energy is produced when **kinetic energy**, or energy something possesses by being in motion, is turned into electrical energy. Wind possesses a lot of kinetic energy. **Turbines** are machines that produce continuous power when a wheel or fan is revolved by a fast-moving flow of water, steam, gas, or air. **Generators** can turn power into electricity.

1. How would you design a machine that can turn wind energy into electricity? What components does it need?

2. What locations are good for harnessing wind power?

3. What direction will your machine face to get the most energy? Why?

4. What forms of energy are seen in this process? How are they being transformed?

5. How will the electricity produced by the generator be transported for use?