Energy Enigma

Students put on their detective hats and research clues to uncover energy facts. This cooperative learning activity accesses language arts and critical thinking skills as students try to conceal their own energy source while guessing the opposing teams’ sources.

Grade Levels:

Intermediate  Secondary

Subject Areas:

Science  Social Studies  Language Arts
NEED Mission Statement

The mission of The NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

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Teacher Advisory Board

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

Energy Data Used in NEED Materials

NEED believes in providing teachers and students with the most recently reported, available, and accurate energy data. Most statistics and data contained within this guide are derived from the U.S. Energy Information Administration. Data is compiled and updated annually where available. Where annual updates are not available, the most current, complete data year available at the time of updates is accessed and printed in NEED materials. To further research energy data, visit the EIA website at www.eia.gov.
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Standards Correlation Information

www.NEED.org/curriculumcorrelations

Next Generation Science Standards

- This guide effectively supports many Next Generation Science Standards. This material can satisfy performance expectations, science and engineering practices, disciplinary core ideas, and cross cutting concepts within your required curriculum. For more details on these correlations, please visit NEED’s curriculum correlations website.

Common Core State Standards

- This guide has been correlated to the Common Core State Standards in both language arts and mathematics. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED curriculum correlations website.

Individual State Science Standards

- This guide has been correlated to each state’s individual science standards. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED website.
Background

In *Energy Enigma*, student teams are each assigned a different energy source. Working cooperatively, students use their reading, brainstorming, and organizational skills to conceal the identity of their team's energy source while trying to guess which energy sources the other teams represent.

Note: If you teach younger students, download *Energy in the Balance* from www.NEED.org. This activity has students learning about each source and discussing the advantages and disadvantages of each energy source. A similar activity for grades 6-12 is the *Great Energy Debate*.

Objectives

- Students will be able to differentiate between renewable and nonrenewable sources of energy.
- Students will be able to classify a source of energy as a major or minor contributor to U.S. energy consumption and electricity generation.

Concepts

- We use ten major sources of energy in the United States.
- Some energy sources are nonrenewable while others are renewable.
- Some energy sources may affect the environment more than others.
- Energy is used for transportation, heating, manufacturing, and for generating electricity.
- Some energy sources provide a lot of the energy used in the U.S., while others provide only a small amount.

Materials

- *Nonrenewable* and *Renewable Enigma Infosheets* (two copies of each per group), pages 9 and 10
- *Energy Enigma Graphs* (two per group), page 11
- *Energy Enigma Data Sheet* (each group needs 10 Data Sheets, separated into stacks), page 12
- *Energy Enigma Clue Card* (each group needs 10 Clue Cards), page 13
- *Energy Enigma Score Card* (one per group), page 14
- *Energy Enigma Clue Order Envelope* (one per group), page 15
- *Energy Enigma Source Clues* (one paper copy or transparency of each), pages 16-25

Grade Levels

- Intermediate, grades 6-8
- Secondary, grades 9-12

Time

Three 45 minute class periods

Additional Resources

NEED has many resources on each of the energy sources available to download online at www.NEED.org.

- *Intermediate Energy Infobook*
- *Secondary Energy Infobook*

NEED also has specific curriculum units on several of the energy sources. Check out these units and more!

- Solar
- Wind
- Hydropower
- Nuclear
- Fossil Fuels

The *Energy Enigma* computer file is an HTML, browser-based method for revealing clues during the activity. It can be a substitute for an overhead projector or extra printing and can be downloaded for easy use at www.NEED.org with instructions.
Procedure

Step One—Preparation

• Divide the students into seven groups with three to five students per group.*

• Make copies of the Energy Enigma materials listed on the previous page.

• Cut the Energy Enigma Clue Cards and clip together seven stacks of ten.

• Cut the Energy Enigma Data Sheets and staple nine together in a stack. Staple together seven stacks of nine.

• Set aside the remaining data sheets as they will be passed out individually.

• Fold the Energy Enigma Clue Order Envelopes in half and tape the sides closed.

• Download the pre-prepared Energy Enigma computer file from www.NEED.org. Or, prepare the Energy Enigma Source Clues sheets to project for the class. If using an overhead projector, make a transparency of each of the ten Energy Enigma Source Clues sheets. Cut each sheet into its eight clues and clip together.

• Choose seven out of the ten energy sources to assign to the groups. Next, place the Energy Enigma Source Clues for the seven sources you chose in separate clue order envelopes. Write the team number and name of the energy source in the space provided. You will need to determine the clue order for the three energy sources not represented by student groups.*

• Place on each table two Energy Enigma Graphs sheets, one Energy Enigma Data Sheet, two Nonrenewable and two Renewable Energy Enigma Infosheets, and an Energy Enigma Clue Order Envelope face down.

*NOTE: Energy Enigma can be easily played with up to ten groups or fewer than seven groups. If playing with a different number of groups than specified in the instructions, you must adjust the number of copies and stacks of each sheet to reflect the number of groups playing.

Step Two—Introduce Unit to the Class (Day One)

Explain to the students that they will be working in small groups and how they must work together. Give students the following introduction:

• The name of this activity is Energy Enigma. Everyone knows what the word energy means, but the word enigma may be a mystery to you. Actually, a mystery is a good way to define enigma. So, if we put together the words ENERGY and ENIGMA, we get an activity in which teams look for clues about energy sources. You will need to communicate with others, solve problems, and use your academic and critical thinking skills.

Step Three—Developing the Data Sheet

Read the following instructions to the students:

• Each team has been assigned an energy source. To find out which energy source your team is, pick up your Energy Enigma Clue Order Envelope. Your team’s goal is to be the best at eliminating energy enigmas. You will do this by identifying which energy source the other teams represent, using as few clues as possible. Naturally, it’s best if the other team(s) can’t guess which energy source you represent, or take a lot of clues guessing who you are, because this will give them a lower score.

• The first thing you must do to become the best team of Energy Enigma eliminators is to learn something about your source of energy. To accomplish this objective, each team has been given four energy source infosheets—two on renewable sources and two on nonrenewable sources. Each team also has an Energy Enigma Data Sheet. Someone from the team should write the name of your energy source in the space at the top of the data sheet. When the data sheet is completed, it will be for your eyes only; no other team should see it.

• To successfully complete the data sheet, you’ll need to run an efficient team. This means each team will need a facilitator and a recorder. A facilitator keeps the session orderly and your team moving smoothly. The facilitator calls on people with their hands raised to prevent everyone from yelling out their facts all at once. He or she will point to members of the group, keeping pace with the writing speed of the recorder. The recorder writes down the information on the data sheet for the team. You have one minute to select your team’s facilitator and recorder.

• The first question on the data sheet will be easy to answer. Just look at the Nonrenewable and Renewable Enigma Infosheets to determine on which one your source appears. Mark on the data sheet whether your source is renewable or nonrenewable.

• You’ll get your data for Questions Two and Three by looking at the Energy Enigma Graphs on your table. Question Two asks how much energy your source contributed to total energy consumption. Read the Energy Consumption By Source graph and place an X on one of the five lines on your data sheet.

• Do the same thing for Question Three, using the Electricity Generation By Source graph, to determine how much your source contributed to the generation of electricity. You have one and a half minutes to answer Questions Two and Three.

• For Questions Four through Seven, you must consult your Enigma Infosheet. You have five minutes to answer Questions Four through Seven. When reading through the infosheet, try to answer the following questions:

• Is your energy source’s major use for heating, transportation, or generating electricity?

• Is your source of energy found everywhere in the country, or more so in certain regions of the nation?

• Is your energy source imported from another country?

• For Question Seven, the Enigma Infosheet will let you know about any facts that are particular to your source of energy.
**Step Four—Determining the Sequence of Clues**

Read the following instructions to the students:

- Now, each team should take out the eight clues from their Energy Enigma Clue Order Envelope and arrange them in one column, A through H. Place your completed Energy Enigma Data Sheet next to this column. Your opponents will be constructing data sheets on your source of energy using the same resources you did—keep this in mind as you complete the next task.

- Starting with clue A, the facilitator should call upon members of the group to comment on the clue, e.g., this clue gives away too much information and why. You have two minutes to discuss the strengths and weaknesses of each of the clues.

- You will need to decide which clues you will be giving to the opposing teams. The facilitator should lead a discussion on the pros and cons of keeping or eliminating each of the clues. You will need to select four of the least revealing clues. These clues will be given to the opposing teams. Try to come up with these four clues as a group. When you've completed this task, take the four eliminated clues and put them back in the envelope because you no longer need them.

- Now, you must arrange the remaining four clues so the first clue is the least revealing of the four, the second clue should be a little more revealing, and so on. You may decide as a team to arrange the clues so that they confuse your opposing teams. Put the least revealing clue on the top of the stack and the most revealing clue on the bottom. Once the clues are in order, write the order on the front of the envelope. Place all the cards back inside the envelope.

- At the end of this unit, your group will explain to the class why you kept or eliminated each clue. What were your reasons for choosing the four clues that you kept? Why were the others eliminated? How did you decide on the order of the clues? You have ten minutes to select your clues, to write down your reasons for choosing or eliminating them, and to organize the clues from least revealing to most revealing. I will pick up your Energy Enigma Clue Order Envelopes when you are finished and check your rationale for clue selection.

**Step Five—Developing Opposing Teams’ Data Sheets**

Pick up the Energy Enigma Clue Order Envelopes and give each team a stack of nine stapled Energy Enigma Data Sheets. Read the following instructions to the students:

- Using the Renewable and Nonrenewable Enigma Infosheets and the graphs, develop Energy Enigma Data Sheets for the other nine energy sources. Be sure to indicate which energy source you are working on in the space provided at the top of each sheet. As a team, complete Questions One, Two, and Three using the graphs provided. Divide the nine sheets equally among the team members. During the activity, I will take away your infosheets and graphs—you can only use your Energy Enigma Data Sheets.

**Step Six—Completing the Activity (Day Two)**

Option: You may use the Energy Enigma Computer File to reveal clues rather than an overhead. You can download this file for free at www.NEED.org.

Give each team an Energy Enigma Score Card and a stack of ten Energy Enigma Clue Cards. Read the following instructions to the students:

- I have placed ten Energy Enigma Clue Cards and an Energy Enigma Score Card on your table. Number the Energy Enigma Clue Cards one through ten. Write your team number and the name of your team’s energy source on the Energy Enigma Score Card.

- Now, it is time for solving mysteries! Each team has given me the clue order for their energy sources, and I have chosen the clue order for the remaining energy sources*. Shortly, I will project the first clue for each of the ten sources on the screen. The first column of five clues will be for one through five, and the second column of clues for six through ten.

  *If playing with less than ten groups.

- Members of your team should write the information for each clue in the top box (marked Round 1) of the appropriate clue card. You must work together to complete all of the clue cards.

- Your team will then have six minutes to decide if you wish to guess which energy source is represented by an opposing team. This is done by writing the number of the team on the line next to the energy source you think they represent on your Energy Enigma Score Card for Round One.

- Your team receives 30 points for guessing correctly during the first round, 25 points for the second round, 15 points for the third round, and 10 points for the fourth round. If you guess correctly, I’ll circle your choice and put the number of points you won on the line at the top of the score card. If your guess is wrong, I’ll put an X through your choice. At the end of the activity, I’ll deduct 10 points for every X or incorrect guess the team has made.

- Before I reveal the clues, I will give the teams 90 seconds to devise a plan on how they will monitor the Energy Enigma Clue Cards.

- Here are the first clues for round one; write them in the top box (marked Round 1) on your Energy Enigma Clue Cards. You will have six minutes to make a guess for any or all of the ten sources. Remember, incorrect guesses will cost your team ten points. At the end of the six minutes no score cards will be accepted.

- The first round is over. We will follow the same procedure as before, and you will have six minutes again to fill in any lines on your Energy Enigma Score Cards for Round Two. If you have already made a correct choice, there is no need to mark your choice in subsequent rounds.

Continue giving the same instructions and following the same scoring procedures for the remaining rounds. For rounds three and four allow only four minutes. After the fourth round, have teams add their scores and check their math.
Step Seven—Discussion (Day Three)
Discuss with the students the following questions about the ten energy sources:

What type of questions might you ask about an unknown energy source?
1. Is the source renewable or nonrenewable?
2. Is the energy source imported?
3. Does the source provide a lot of the energy used in the U.S.,
or only a small amount?
4. What are the major uses of the energy source?
5. How much does the energy source affect the environment?

What things were similar about the different energy sources?
1. Which energy sources can be used as transportation fuels?
2. Which energy sources produce air pollution when consumed?
3. Which energy sources have the primary or sole use of generating electricity?
4. Which energy sources are imported?
5. Which energy sources are free to harness?

Read the following instructions to the students:

One at a time, each team will come to the front of the class and place their eight clues on the overhead projector. Arrange the four clues that you chose to keep on one side of the projector and the four clues that you eliminated on the other side. Explain your reasons for keeping or eliminating the clues. (Follow with discussion.)

Step Eight—Grading
You can use the grading outline below, or come up with your own grading scheme.

Working together as a team while completing Energy Enigma Data Sheets—15 points

Working together as a team during the activity—10 points

The number of points a team receives based on the team’s Energy Enigma Score Card—60 points

Explanation to class—15 points

Energy Enigma Answer Key

1. Coal
2. Natural Gas
3. Biomass
4. Petroleum
5. Solar
6. Geothermal
7. Propane
8. Uranium
9. Wind
10. Hydropower
Petroleum

Petroleum (also known as crude oil) is a fossil fuel that took hundreds of millions of years to form. When tiny sea plants and animals died, they sank to the bottom of the ocean where they were buried by layers of sand and sediment, which turned into sedimentary rock. Over time, this organic matter was subject to enormous pressure and heat, causing it to change into petroleum-saturated rock.

Petroleum is the nation’s leading source of energy. The vast majority of petroleum is used by the transportation (71.46 percent) and industrial (23.37 percent) sectors. Very little is used by the residential and commercial (4.40 percent) and electric power (0.78 percent) sectors. Petroleum must be burned, and therefore can contribute to emissions and pollution.

The U.S. production of petroleum is not enough to meet the nation’s demand of about 19.5 million barrels a day. About 48 percent of the nation’s supply of petroleum is imported, mostly from Canada, Saudi Arabia, Venezuela, Mexico, Russia, and Iraq. Currently, Texas is the nation’s leading producer of petroleum, followed by North Dakota, California, Alaska, and Oklahoma. About one-sixth of domestic production is from offshore wells.

Coal

Coal is a fossil fuel created from the remains of plants that lived and died millions to hundreds of millions of years ago. The dead plant matter fell into swampy water, partially decaying. Under heat and pressure this plant matter was gradually changed into carbon-rich coal deposits.

The U.S. is the world leader in known coal reserves. Depending on consumption rates, the United States has more than a 280 year supply of coal. A little more than 8% of the coal mined in the nation is exported to other countries. The top five coal producing states are Wyoming, West Virginia, Kentucky, Illinois, and Pennsylvania.

The major method for transporting coal is by train. Over 90 percent of the coal is used by electric utility companies, most of the rest is used by industry. A major effort is made to remove the sulfur found in coal before it is burned, and from the sulfur dioxide gas that is formed when it is burned.

Natural Gas

Natural gas, the cleanest burning fossil fuel, was formed hundreds of millions of years ago when plants and tiny marine organisms died and were buried by sand and sedimentary rock. Methane, a colorless and odorless gas, constitutes up to 95 percent of the gas extracted from a gas well. The methane is separated from the other gases and is transported by pipeline to customers. About half of the nation’s homes use natural gas for space heating. Natural gas is used most by the electric power sector (35.23 percent). The industrial sector (33.50 percent) and residential and commercial sectors (28.67 percent) also use a sizeable portion of our nation’s natural gas. A small amount is used by the transportation sector.

Compressed Natural Gas (CNG) can be used to fuel automobiles and buses. CNG vehicles are cleaner than gasoline powered vehicles and they make use of a domestic energy source.

Most of the natural gas consumed in the nation is domestically produced—about six percent from offshore wells. Most natural gas production comes from Texas, Pennsylvania, Alaska, Oklahoma, and Wyoming. The U.S. imports about 10 percent of total consumption, mostly from Canada via pipeline.

Uranium

Uranium is energy in the nucleus (core) of an atom. Nuclear power plants use a process called nuclear fission to release this energy by splitting uranium atoms. Once mined and processed, uranium is ready to be used in a nuclear power plant. The atoms are split to release thermal energy that is used to superheat water into steam. The steam turns a turbine generator to make electricity.

The first nuclear power plant began operation in 1957. The U.S. is the number one producer of nuclear power, which generates about 19.45 percent of our electricity. There are 99 nuclear reactors in 61 plants operating in the U.S. The U.S. Navy even uses it to power some submarines and vessels. The majority of the uranium the U.S. uses is imported. Although the United States has a sufficient supply of uranium, the prices are much cheaper overseas.

Nuclear power plants produce radioactive waste. The main concern is not the amount of waste but its radioactivity. There is currently no permanent disposal facility in the U.S. for nuclear waste. Nuclear waste, or spent fuel, is stored on-site at nuclear plants. While nuclear power produces radioactive waste, it does not contribute to air pollution because the fuel is not burned.

Propane

Propane is found in natural gas and petroleum deposits and is separated during processing and refining. Propane, therefore, comes from petroleum and natural gas producing states. Only 10.64 percent of the nation’s propane is imported. Propane is a colorless and odorless gas that can be changed into a liquid by putting it under a moderate amount of pressure, or cooling it to -44o Fahrenheit. When liquefied, it is a portable and clean source of heat energy. Liquid propane is sold by the gallon.

The largest market for propane is in industry (78.60 percent) and in rural and suburban areas that do not have natural gas service. Farms are big users. Propane is used for heating barns and homes, heating water, operating equipment, and cooking.

Because it is so portable, it can be used in hot air balloons and recreational vehicles. About 1.52 percent of propane is used for transportation. Propane-fueled engines emit cleaner exhaust than gasoline engines.
Biomass

Biomass is any organic material—plants, wood, animal and agricultural waste—that can be used as an energy source. During photosynthesis, plants use the sun's energy to combine carbon dioxide and water into carbohydrates. These carbohydrates can be burned to release energy.

About 43 percent of biomass energy comes from burning wood and 45 percent is made into biofuels such as ethanol. About 11 percent comes from burning garbage and agricultural waste. The energy released from burning this waste is used to generate electricity. Although burning biomass produces some air pollution, sophisticated systems reduce the level of emissions significantly.

In a landfill, decaying biomass gives off methane gas. This gas can be captured and sent through pipelines to heat homes and buildings. Another method of using biomass is to change it into ethyl alcohol, or ethanol, through a process called fermentation. Corn is usually the source of this type of biomass. Ethanol can be mixed with gasoline to make gasohol. Much of the nation's motor fuels are a blend of gasoline and ethanol.

Hydropower

Hydropower is energy that comes from the force of moving water. Gravity causes water to flow from higher to lower ground creating a force that can be used to turn turbine generators and produce electricity. The first hydroelectric power plant was built in 1882 on Fox River in Appleton, WI. Currently there are more than 2,200 dams in the U.S. producing 5–10 percent of the nation's electricity, depending on the amount of rainfall.

Hydropower is the cheapest way to generate electricity today. While a hydropower plant is expensive to build, its energy source is free and does not contribute to air pollution. Hydropower plants do change the local environment, however, because of the reservoir formed by the dam. A reservoir can flood thousands of acres of land and disrupt wildlife in the area that is flooded.

Most good sites for hydropower dams in the U.S. are already in use. Many existing dams that are in operation require maintenance and can undergo upgrades to become more efficient.

Geothermal

Geothermal energy comes from thermal energy within the Earth. The high temperatures are produced from the radioactive decay of elements deep below the Earth's surface and the immense pressure from the surrounding layers of the Earth. This thermal energy is absorbed by rocks. When water comes in contact with these heated rocks, it absorbs the energy, sometimes changing to steam. The hot water or steam can be used to heat buildings or to generate electricity.

The major use of high-temperature geothermal energy is to generate electricity. Most geothermal electric power plants are in western states. While the source of geothermal energy is free, the cost to develop a geothermal field is expensive. The pipes and equipment must be maintained carefully because of the corrosive nature of the steam.

Geothermal heat pumps—or geothermal exchange units—use the constant temperature of the Earth under the ground to heat and cool buildings. This low-temperature geothermal energy is available everywhere.

Wind

Wind is air in motion. It is created by the uneven heating of the Earth's surface by the sun. Hot air expands and rises, and heavier, cooler air rushes in to take its place, creating wind. In the past, windmills were used primarily to grind grain and pump water. Today, wind turbines are used primarily to generate electricity.

Most wind turbines are located on huge wind farms covering hundreds of acres. Many of the nation's wind turbines are located in the midwest or western portions of the country, with Texas as the leading producer of wind energy. While wind energy is free, the equipment must be constructed and maintained. New wind turbines generate electricity about as cheaply as thermal power plants.

Since the wind doesn't blow constantly, wind turbines operate between 65 and 90 percent of the time and not always at full capacity. Wind turbines do not pollute the air or water.

Solar

Solar energy is created in the sun when small atoms are combined to form larger atoms. This process is called nuclear fusion. A small amount of mass is lost during this process and is converted into thermal and radiant energy. The energy radiates from the sun in all directions, but only a small amount reaches the Earth.

Solar energy can be used to heat buildings and water. South-facing windows, brick walls, or solar collectors are used to absorb the solar energy. Water, stones, and other materials are used to store the solar energy at night or on cloudy days. Solar energy is also used to make electricity. One method concentrates the sun's rays on pipes to heat liquids to very high temperatures. The hot liquid creates steam and turns a turbine generator, as other conventional power plants do.

The sun's radiant energy can also be converted directly into electricity using photovoltaic cells. PV cells power homes, calculators, and even emergency phones on highways. Solar energy is free to use and does not contribute to pollution. However, the installation of equipment can sometimes be costly, and cannot be used reliably on cloudy days or at nighttime.
ENERGY ENIGMA GRAPH 1
U.S. Energy Consumption by Source, 2015

- COAL, 15.97%
- PETROLEUM**, 36.57%
- NATURAL GAS**, 28.97%
- GEOTHERMAL AND SOLAR, 0.66%
- WIND, 1.83%
- HYDROPOWER, 2.38%
- BIOMASS, 4.86%
- URANIUM, 8.56%

*Total does not equal 100% due to independent rounding.
**Propane consumption is included within natural gas and petroleum figures.

ENERGY ENIGMA GRAPH 2
U.S. Electricity Generation by Source, 2015

- COAL, 33.08%
- URANIUM, 19.45%
- BIOMASS, 1.57%
- GEOTHERMAL, PETROLEUM, PROPANE, AND SOLAR, 2.69%
- HYDROPOWER, 6.00%
- WIND, 4.66%
- NATURAL GAS, 32.57%

*Total does not equal 100% due to independent rounding.
ENERGY ENIGMA DATA SHEET

ENERGY SOURCE _______________________

1. ___ Renewable   ___ Nonrenewable

2. Contribution to total U.S. energy consumption:
   ___ Majority   ___ Substantial   ___ Moderate
   ___ Small   ___ Very Small

3. Contribution to total U.S. electricity generation:
   ___ Majority   ___ Substantial   ___ Moderate
   ___ Small   ___ Very Small

4. Major Uses: _______________________

5. Nationwide or areas of domestic production: _______________________

6. Does domestic consumption require imports?
   ___ Yes _____%   ___ No

7. Facts particular to your source: _______________________
   _______________________
   _______________________
   _______________________

ENERGY ENIGMA DATA SHEET

ENERGY SOURCE _______________________

1. ___ Renewable   ___ Nonrenewable

2. Contribution to total U.S. energy consumption:
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4. Major Uses: _______________________

5. Nationwide or areas of domestic production: _______________________

6. Does domestic consumption require imports?
   ___ Yes _____%   ___ No

7. Facts particular to your source: _______________________
   _______________________
   _______________________
   _______________________

ENERGY ENIGMA DATA SHEET

ENERGY SOURCE _______________________

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5. Nationwide or areas of domestic production: _______________________

6. Does domestic consumption require imports?
   ___ Yes _____%   ___ No

7. Facts particular to your source: _______________________
   _______________________
   _______________________
   _______________________

ENERGY ENIGMA DATA SHEET

ENERGY SOURCE _______________________

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4. Major Uses: _______________________

5. Nationwide or areas of domestic production: _______________________

6. Does domestic consumption require imports?
   ___ Yes _____%   ___ No

7. Facts particular to your source: _______________________
   _______________________
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Energy Enigma Score Card

Team Number: __________________________ Energy Source: __________________________

Points Won (game leader’s use only)

- Biomass
- Coal
- Geothermal
- Hydropower
- Natural Gas

- Petroleum
- Propane
- Solar
- Uranium
- Wind

NOTES: Subtract 10 points for every incorrect answer. If you have already made a correct choice, do not mark your choice again in subsequent rounds.

Round One 30 Points for each correct answer

- Biomass
- Coal
- Geothermal
- Hydropower
- Natural Gas
- Petroleum
- Propane
- Solar
- Uranium
- Wind

Round Two 25 Points for each correct answer

- Biomass
- Coal
- Geothermal
- Hydropower
- Natural Gas
- Petroleum
- Propane
- Solar
- Uranium
- Wind

Round Three 15 Points for each correct answer

- Biomass
- Coal
- Geothermal
- Hydropower
- Natural Gas
- Petroleum
- Propane
- Solar
- Uranium
- Wind

Round Four 10 Points for each correct answer

- Biomass
- Coal
- Geothermal
- Hydropower
- Natural Gas
- Petroleum
- Propane
- Solar
- Uranium
- Wind
Energy Enigma Clue Order Envelope

LETTER

1. ______________ Least revealing

2. ______________

3. ______________

4. ______________ Most revealing

Team Number: ______________ Team Name: ______________ Energy Source: ______________

Fold Here
### Energy Enigma Source Clues

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1A</strong></td>
<td><strong>1B</strong></td>
</tr>
<tr>
<td>It generates about one-third of U.S. electricity.</td>
<td>A small percent of U.S. production is exported.</td>
</tr>
<tr>
<td><strong>1C</strong></td>
<td><strong>1D</strong></td>
</tr>
<tr>
<td>The U.S. has the largest amount of known reserves.</td>
<td>It is a fossil fuel.</td>
</tr>
<tr>
<td><strong>1E</strong></td>
<td><strong>1F</strong></td>
</tr>
<tr>
<td>It is transported mostly by train.</td>
<td>It supplies less than one-sixth of total U.S. energy consumed.</td>
</tr>
<tr>
<td><strong>1G</strong></td>
<td><strong>1H</strong></td>
</tr>
<tr>
<td>Burning it can produce air pollution.</td>
<td>Western and some of the Appalachian states are some of the major producers.</td>
</tr>
</tbody>
</table>

**Team 1 Coal**
<table>
<thead>
<tr>
<th>2A</th>
<th>2B</th>
</tr>
</thead>
<tbody>
<tr>
<td>It generates almost one-third of U.S. electricity.</td>
<td>It is a fossil fuel.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2C</th>
<th>2D</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is nonrenewable.</td>
<td>Is used most by the electric power sector.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2E</th>
<th>2F</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a colorless and odorless gas.</td>
<td>It supplies more than one-fourth of total U.S. energy consumed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2G</th>
<th>2H</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a cleaner-burning fossil fuel.</td>
<td>It can be used as a transportation fuel.</td>
</tr>
</tbody>
</table>

Team 2 Natural Gas
## Energy Enigma Source Clues

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3A</strong></td>
<td><strong>3B</strong></td>
</tr>
<tr>
<td>It generates a small amount of U.S. electricity.</td>
<td>It is renewable.</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3C</strong></td>
<td><strong>3D</strong></td>
</tr>
<tr>
<td>Methane gas can be made from it.</td>
<td>Burning it can produce air pollution.</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3E</strong></td>
<td><strong>3F</strong></td>
</tr>
<tr>
<td>It gets its energy from photosynthesis.</td>
<td>It supplies a small amount of total U.S. energy consumed.</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3G</strong></td>
<td><strong>3H</strong></td>
</tr>
<tr>
<td>Forty-four percent of its energy production is from wood.</td>
<td>It can be made into a transportation fuel.</td>
</tr>
</tbody>
</table>

**Team 3 Biomass**
<table>
<thead>
<tr>
<th>4A</th>
<th>It is used mostly as a transportation fuel.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4B</td>
<td>Slightly less than half of what the U.S. consumes is imported.</td>
</tr>
<tr>
<td>4C</td>
<td>It is nonrenewable.</td>
</tr>
<tr>
<td>4D</td>
<td>It generates a very small amount of U.S. electricity.</td>
</tr>
<tr>
<td>4E</td>
<td>It is the leading supplier of U.S. energy.</td>
</tr>
<tr>
<td>4F</td>
<td>It is a fossil fuel.</td>
</tr>
<tr>
<td>4G</td>
<td>About one-sixth of U.S. production is from offshore wells.</td>
</tr>
<tr>
<td>4H</td>
<td>Burning it can produce air pollution.</td>
</tr>
</tbody>
</table>

Team 4 Petroleum
### Energy Enigma Source Clues

<table>
<thead>
<tr>
<th></th>
<th>5A</th>
<th>5B</th>
<th>5C</th>
<th>5D</th>
<th>5E</th>
<th>5F</th>
<th>5G</th>
<th>5H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>It generates a very small amount of U.S. electricity.</strong></td>
<td><strong>It is renewable.</strong></td>
<td><strong>It is free to use, but you must build and maintain its equipment.</strong></td>
<td><strong>It can be used to directly heat buildings with specialized materials.</strong></td>
<td><strong>It supplies a very small amount of total U.S. energy consumed.</strong></td>
<td><strong>It cannot provide energy all of the time.</strong></td>
<td><strong>Its energy is a result of a nuclear reaction.</strong></td>
<td><strong>Photovoltaic cells convert it into electricity.</strong></td>
</tr>
</tbody>
</table>

**Team 5 Solar**
<table>
<thead>
<tr>
<th>6A</th>
<th>6B</th>
</tr>
</thead>
<tbody>
<tr>
<td>It generates a very small amount of U.S. electricity.</td>
<td>It is renewable.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6C</th>
<th>6D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most energy production is in western states.</td>
<td>It supplies a very small amount of total U.S. energy consumed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6E</th>
<th>6F</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is used for generating electricity and heating.</td>
<td>Its energy is a result of radioactive decay and pressure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6G</th>
<th>6H</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is used to heat buildings directly with heat exchange units.</td>
<td>It is free to use, but you must build and maintain its equipment.</td>
</tr>
</tbody>
</table>

Team 6 Geothermal
<table>
<thead>
<tr>
<th>7A</th>
<th>7F</th>
</tr>
</thead>
<tbody>
<tr>
<td>It can be used as a transportation fuel.</td>
<td>It supplies a small amount of total U.S. energy consumed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7B</th>
<th>7G</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is nonrenewable.</td>
<td>It turns into a liquid under moderate pressure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7C</th>
<th>7H</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a by-product of natural gas and crude oil processing.</td>
<td>It is a cleaner-burning fossil fuel.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7D</th>
<th>7I</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a colorless and odorless gas.</td>
<td>It is often used in rural and suburban areas.</td>
</tr>
<tr>
<td>8A</td>
<td>8B</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>It was first used commercially in 1957.</td>
<td>It is nonrenewable.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8C</th>
<th>8D</th>
</tr>
</thead>
<tbody>
<tr>
<td>The U.S. Navy uses it to fuel some submarines and vessels.</td>
<td>There are 99 reactors in 61 locations in the U.S.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8E</th>
<th>8F</th>
</tr>
</thead>
<tbody>
<tr>
<td>The majority of its supply is imported.</td>
<td>Its waste products are stored at the power plant.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8G</th>
<th>8H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using it doesn’t produce air pollution.</td>
<td>It generates almost one-fifth of U.S. electricity.</td>
</tr>
</tbody>
</table>
## Energy Enigma Source Clues

<table>
<thead>
<tr>
<th>9A</th>
<th>9B</th>
<th>9C</th>
<th>9D</th>
<th>9E</th>
<th>9F</th>
<th>9G</th>
<th>9H</th>
</tr>
</thead>
<tbody>
<tr>
<td>It generates a small to moderate amount of U.S. electricity.</td>
<td>It is renewable.</td>
<td>It is free to use, but you must build and maintain its equipment.</td>
<td>Texas is the leading producer.</td>
<td>Using it doesn’t produce air pollution.</td>
<td>It supplies a very small amount of total U.S. energy consumed.</td>
<td>Its production facilities require lots of land.</td>
<td>It cannot provide electricity all of the time.</td>
</tr>
</tbody>
</table>

Team 9 Wind
<table>
<thead>
<tr>
<th>10A</th>
<th>10B</th>
</tr>
</thead>
<tbody>
<tr>
<td>It generates a small to moderate amount of U.S. electricity.</td>
<td>It is renewable.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10C</th>
<th>10D</th>
</tr>
</thead>
<tbody>
<tr>
<td>It supplies a small amount of total U.S. energy consumed.</td>
<td>There are more than 2,200 generating locations in the U.S.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10E</th>
<th>10F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production facilities may disturb large areas of land.</td>
<td>It was first used to generate electricity in Appleton, WI in 1882.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10G</th>
<th>10H</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is free to use, but you must build and maintain its equipment.</td>
<td>Using it doesn’t produce air pollution.</td>
</tr>
</tbody>
</table>

Team 10 Hydropower
Let's Get Digital!

Want More Awesome Energy Content?

Check out www.NEED.org for NEED's entire curriculum library in PDF and as digital e-publications! Also check out NEED's graphics library for download and use in classroom presentations (www.need-media.smugmug.com).

Digital Energy encourages NEED's philosophy of Kids Teaching Kids as students are tasked with researching energy topics and creating digital media presentations that incorporate student-generated graphics, assessments, and discussion points for the class to use. This activity is great for the differentiated classroom and multi-disciplinary environments.
Energy Enigma Evaluation Form

State: ___________ Grade Level: ___________ Number of Students: __________

1. Did you conduct the entire activity? □ Yes □ No

2. Were the instructions clear and easy to follow? □ Yes □ No

3. Did the activity meet your academic objectives? □ Yes □ No

4. Was the activity age appropriate? □ Yes □ No

5. Was the allotted time sufficient to conduct the activity? □ Yes □ No

6. Was the activity easy to use? □ Yes □ No

7. Was the preparation required acceptable for the activity? □ Yes □ No

8. Were the students interested and motivated? □ Yes □ No

9. Was the energy knowledge content age appropriate? □ Yes □ No

10. Would you teach this activity again? □ Yes □ No

Please explain any ‘no’ statement below.

How would you rate the activity overall? □ excellent □ good □ fair □ poor

How would your students rate the activity overall? □ excellent □ good □ fair □ poor

What would make the activity more useful to you?

________________________________________
________________________________________
________________________________________

Other Comments:

________________________________________
________________________________________
________________________________________

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Manassas, VA 20110
FAX: 1-800-847-1820
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James Madison University
Kentucky Department of Energy Development and Independence
Kentucky Power – An AEP Company
Kentucky Utilities Company
League of United Latin American Citizens – National Educational Service Centers
Leidos
Linn County Rural Electric Cooperative
Llano Land and Exploration
Louisville Gas and Electric Company
Mississippi Development Authority–Energy Division
Mississippi Gulf Coast Community Foundation
Mojave Environmental Education Consortium
Mojave Unified School District
Montana Energy Education Council
The Mountain Institute
National Fuel
National Grid
National Hydropower Association
National Ocean Industries Association
National Renewable Energy Laboratory
NC Green Power
New Mexico Oil Corporation
New Mexico Landman’s Association
NextEra Energy Resources
NEXTracker
Nicor Gas
Nisource Charitable Foundation
Noble Energy
Nolin Rural Electric Cooperative
Northern Rivers Family Services
North Carolina Department of Environmental Quality
North Shore Gas
Offshore Technology Conference
Ohio Energy Project
Opterra Energy
Pacific Gas and Electric Company
PECO
Pecos Valley Energy Committee
Peoples Gas
Pepco
Performance Services, Inc.
Petroleum Equipment and Services Association
Phillips 66
PNM
PowerSouth Energy Cooperative
Providence Public Schools
Quarto Publishing Group
Read & Stevens, Inc.
Renewable Energy Alaska Project
Rhode Island Office of Energy Resources
Robert Armstrong
Roswell Geological Society
Salt River Project
Salt River Rural Electric Cooperative
Saudi Aramco
Schlumberger
C.T. Seaver Trust
Secure Futures, LLC
Shell
Shell Chemicals
Sigora Solar
Singapore Ministry of Education
Society of Petroleum Engineers
Society of Petroleum Engineers – Middle East, North Africa and South Asia
Solar City
David Sorenson
South Orange County Community College District
Tennessee Department of Economic and Community Development–Energy Division
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Tesor Foundation
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TXU Energy
United Way of Greater Philadelphia and Southern New Jersey
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University of Maine
University of North Carolina
University of Tennessee
U.S. Department of Energy
U.S. Department of Energy–Wind for Schools
U.S. Energy Information Administration
United States Virgin Islands Energy Office
Wayne County Sustainable Energy
Western Massachusetts Electric Company
Yates Petroleum Corporation

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