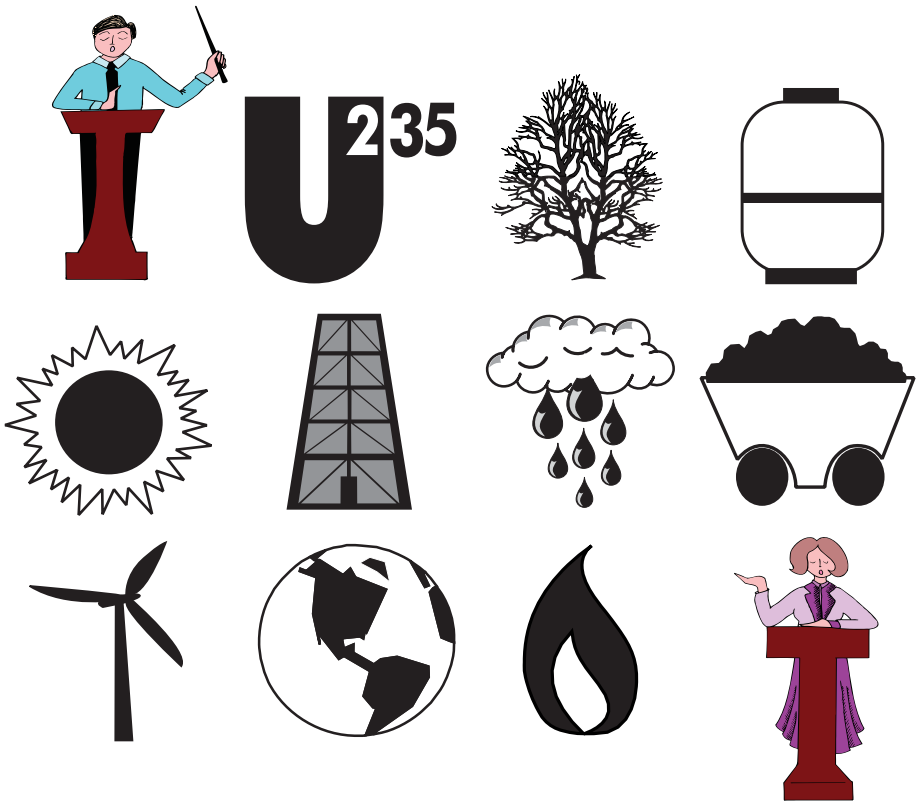
GREAT ENERGY DEBATE

ENERGY SOURCES

GRADE LEVEL
6–12

SUBJECT AREAS
Science
Social Studies
Math
Language Arts

Students evaluate the advantages and disadvantages of the major energy sources in an innovative debate format.



NEED 2010
Putting Energy into Education
NEED Project PO Box 10101 Manassas, VA 20108 1-800-875-5029 www.NEED.org

Teacher Advisory Board

Teacher Advisory Board Vision Statement

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.

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

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Correlations to National Science Standards

(Bolded standards are emphasized in the unit.)

INTERMEDIATE (GRADES 5-8) CONTENT STANDARD–B: PHYSICAL SCIENCE

Transfer of Energy

The sun is the major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths.

INTERMEDIATE–D: EARTH AND SPACE SCIENCE

Structure of the Earth System

The solid earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.

Earth in the Solar System

The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans and rocks underground.

INTERMEDIATE–E: SCIENCE AND TECHNOLOGY

Understandings about Science and Technology

Technological solutions are temporary; technological solutions have side effects and technologies cost, carry risks, and provide benefits.

Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Risk is part of living in a highly technological world. Reducing risk often results in new technology.

Technological designs have constraints. Some constraints are unavoidable, such as properties of materials, or effects of weather and friction. Other constraints limit choices in design, such as environmental protection, human safety, and aesthetics.

INTERMEDIATE–F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

Natural Hazards

Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal.

SECONDARY (GRADES 9-12) CONTENT STANDARD–B: PHYSICAL SCIENCE

Structure of Atoms

Fission is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure, as in the process responsible for the energy of the sun and other stars.

SECONDARY–D: EARTH AND SPACE SCIENCE

Energy in the Earth System

Global climate is determined by energy transfer from the sun at and near the earth's surface.

SECONDARY–F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

Natural Resources

Human populations use resources in the environment to maintain and improve their existence.

The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and depletes those resources that cannot be renewed.

Humans use many natural systems as resources. Natural systems have the capacity to reuse waste but that capacity is limited. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or humans to adapt technologically.

Environmental Quality

Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients. Humans are changing many of these basic processes, and the changes may be detrimental to humans.

Teacher Guide

GOAL

TO INVESTIGATE THE ECONOMIC AND ENVIRONMENTAL ADVANTAGES AND DISADVANTAGES OF THE MAJOR ENERGY SOURCES.

BACKGROUND

In the Great Energy Debate, student teams learn about all of the energy sources, then are assigned to represent the different energy sources. Working cooperatively, students develop arguments on the merits of their source over the others.

CONCEPTS

We use ten major sources of energy in the United States.

Some energy sources are nonrenewable; others are renewable.

Energy is used for transportation, heating, manufacturing, and making electricity.

Some energy sources affect the environment more than others.

Some energy sources provide a lot of the energy used in the U.S.; others provide only a small amount.

Some energy sources provide energy at a low cost; others are more expensive.

TIME

Two–three 45-minute class periods *(see alternative procedure on page 6)*

MATERIALS

A set of **Energy Source Debate** Sheets for each team. *(For younger students, you can use simplified debate sheets found in **Energy in the Balance**.)*

A set of **YES/NO** cards for the judges.

A transparency of the **Game Board**.

PROCEDURE

Step One—Preparation

Decide how many energy sources you will be using, depending upon the number of students in the class or group. For large groups of 30 or more, you can use all ten energy sources. For smaller groups, choose fewer energy sources. You need a minimum of three students in each group.

Make one copy of the **Energy Source Debate Sheets** you will be using for each group.

If you are using fewer than ten energy sources, make transparencies of the energy source sheets that you are not using. Complete these source sheets as a class after you introduce the activity. This will ensure that the students understand the concepts of advantages/disadvantages and learn about all of the energy sources.

Make a transparency of the game board, or download an Excel Spreadsheet game board from www.need.org.

Make sets of YES/NO cards for the judges.

Decide who will be in each of the groups. If your students are not used to working in groups, you may want to give them guidelines for group work.

Step Two—Introduce unit to the class

Introduce the Great Energy Debate to the class, using the concepts as a guide.

Select a panel of judges. The teacher can serve as the judge, or each group can select one person from their team to serve as a judge. Each judge is given a YES/NO card.

Step Three—Monitor group work

Once students are in their groups, explain the procedure. Answer any questions they have about the activity. If you are not using all ten sources, use the transparencies of the sources you are not using to explain the procedure. Have the groups complete the sheet of their source first. This should take about five minutes.

Have the groups complete the sheets for the other energy sources. This should take about twenty minutes.

Step Four—Debate

Begin the game by giving the teams the following instructions:

The object of this game is to be the first team to reach the top of the game board. The game is played in rounds, with each team given the opportunity to move its token up by giving an advantage of its energy source. You may instead choose to move an opponent's token down by giving a disadvantage of the opponent's energy source.

The teams will present their advantages or disadvantages to a panel of judges. If a team gives an advantage of its energy source and the judges agree, then the team moves up one space. An opposing team can object to the judges' decision. The opposing team must convince the judges that the statement is not an advantage. The team that stated the advantage will then have the opportunity to defend its position. The judges will vote again and one of two things will happen. The judges may vote in favor of the defending team. In this case, the defending team maintains its new position and the opposing team moves down one space. Or the judges may decide the statement is a disadvantage or just a fact. In this case, the defending team moves back to its original position.

If a team states a disadvantage to try to move an opposing team down, then the opposing team can defend itself without penalty.

Ask the first team to give an advantage or disadvantage. Action continues until one team reaches the top line, until time is called, or until each team has had the opportunity to begin a round.

DAY ONE—complete the first round.

DAY TWO—finish the remaining rounds.

Step Five—Interpret the debate results

At the conclusion of the debate, point out that all sources of energy have advantages and disadvantages. Ask the class the following questions:

Why isn't there an obvious winner in this debate?

Even if the debate continued, would there be a winner? Why or why not?

Why do we use energy sources that have negative impacts on the environment?

What are some other factors that we need to consider in our choice of energy sources?

ALTERNATIVE PROCEDURE

Step One—Preparation

Make one set of **Energy Source Debate Sheets** for each student, plus an additional set for each group.

Make a transparency of the game board.

Make a transparency of one of the debate sheets to explain the procedure, if necessary.

Make sets of YES/NO cards for the judges.

Step Two—Introduce unit to the class

Introduce the **Great Energy Debate** to the class, using the concepts as a guide.

Distribute one set of debate sheets to each student. Explain the procedure for completing the sheets, using the transparency, if necessary.

Instruct the students to complete all of the debate sheets individually as classwork or homework.

Step Three—Monitor group work

Decide who will be in each of the groups. If your students are not used to working in groups, you may want to give them guidelines for group work.

Place students into groups. Distribute a set of debate sheets to each group. Have the students complete the debate sheets as a group, using their individual sheets as guides. This should take about thirty minutes.

Step Four—Debate–use the instructions on page 6

Step Five—Interpret the debate results–use the instructions on page 6

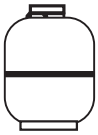
SAMPLE

SOLAR

	IT'S A FACT	RELEVANT: ADVANTAGE	RELEVANT: DISADVANTAGE
1. The sun's energy is renewable.		X	
2. The sun is 93 million miles from the earth.	X		
3. The sun does not always shine.			X

1. The fact that the sun's energy is renewable is considered an advantage.
2. The sun's distance from the earth is a fact that is neither an advantage nor a disadvantage—it is just information about the source.
3. One of the disadvantages of solar as an energy source is the fact that the sun doesn't always shine.

Great Energy Debate
Game Board

									
BIOMASS	COAL	GEOTHERMAL	HYDROPOWER	NATURAL GAS	PETROLEUM	PROPANE	SOLAR	URANIUM	WIND

ADVANTAGES — START HERE — DISADVANTAGES

BIOMASS

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Biomass is a source of energy from plant materials and animal waste.			
2. Biomass is a renewable energy source; we can grow more biomass.			
3. Biomass is difficult to store and transport because it decays.			
4. As biomass decays, more of its energy is available for use as fuel.			
5. Biomass was the first source of energy harvested and used by humans.			
6. Biomass is found throughout the nation.			
7. The amount of energy stored in biomass is less than the amount of energy stored in an equivalent weight of a fossil fuel.			
8. Biomass can be used as a fuel because it captures and stores radiant energy from the sun through the process of photosynthesis.			
9. About two percent of American homes use biomass (burn wood) for heat.			
10. Biomass is abundant and can be produced almost everywhere in the U.S.			
11. Burning biomass can produce odors and emissions.			
12. Burning biomass in a waste-to-energy plant produces electricity and heat.			
13. Biomass provides 3.9 percent of the nation's energy demand.			
14. Almost 53 percent of biomass energy comes from wood at the present time.			
15. Scientists are developing trees that can be grown to full size in less than half the time of the average tree.			
16. Biomass can be made into ethanol, a transportation fuel that is cleaner-burning than unleaded gasoline.			
17. Alcohol fuels made from biomass can be domestically produced.			
18. Mixing 10 percent ethanol with gasoline produces E10, a cleaner burning fuel used nationwide.			
19. Burning biomass in a waste-to-energy plant reduces the amount of garbage sent to landfills.			
20. Waste-to-energy plants use scrubbers and other technologies to reduce emissions and odors.			

COAL

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Coal is the most abundant fuel in the United States. We have about a 260 year supply at the current rate of consumption.			
2. Although coal is still being formed today, we use it thousands of times faster than it is formed.			
3. Coal generates about half of the electricity in the U.S.			
4. The United States exports about seven percent of the coal it produces to other countries.			
5. Coal has been burned to heat food, living space, and water for thousands of years.			
6. Today, about 93 percent of U.S. coal is used to make electricity.			
7. When coal is burned, carbon dioxide, sulfur dioxide, nitrous oxides, and other residues are produced.			
8. To remove coal buried deep in the earth, mine shafts are constructed to bring the coal to the surface.			
9. An easier way to mine coal near the earth's surface is to remove the layers of earth to uncover the coal. This is called surface mining.			
10. Large amounts of land are disturbed in the process of surface mining.			
11. Surface mines can be restored to grasslands or parks after the coal is removed.			
12. More than two-thirds of the nation's coal is produced from surface mines.			
13. The water that filters through abandoned mines can pick up chemicals that pollute the water if the mines are not closed correctly.			
14. Coal can be turned into other materials or products we can use.			
15. Coal can be turned into a gas. This process is expensive.			
16. Coal mining can be dangerous for miners.			
17. New technologies allow coal to be mined and burned in cleaner ways.			
18. Cleaner coal technologies require less coal to produce the same amount of electricity.			
19. The methane gas that is found in much of the coal in the U.S. is a valuable resource.			
20. The electricity industry spends billions of dollars to reduce emissions from coal.			

GEOTHERMAL

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Geothermal energy comes from heat within the earth.			
2. Examples of geothermal energy are hot springs, volcanoes, and geysers.			
3. Geothermal energy is generated in the earth's core, which is made of magma, or molten iron, surrounding a solid iron center.			
4. Red hot temperatures are continuously produced inside the earth by the slow decay of radioactive particles found in all rocks.			
5. Geothermal energy is renewable. The hot water used by power plants is replenished by precipitation and the geothermal heat is continually produced.			
6. Wells can be built to pump superheated water to the surface.			
7. Geothermal energy is used to produce electricity and to heat buildings.			
8. Geothermal energy was used by ancient people for heating and bathing. Hot springs are said to have therapeutic effects today.			
9. In 1904, the Italians first used steam erupting from the earth to power a turbine generator.			
10. Dry steam reservoirs are the most efficient, but they are very rare.			
11. Geothermal energy is expected to grow in the future. It is estimated that geothermal energy could provide California with a tenth of its electricity in the next ten years.			
12. High temperature geothermal resources capable of producing electricity are not economically available in all parts of the nation.			
13. The most active geothermal resources are found along major tectonic plate boundaries, where magma comes very near the earth's surface.			
14. Geothermal energy produces less than one percent of the electricity consumed in the nation today.			
15. Geothermal energy does little damage to the environment because the plants sit on or near the geothermal reservoirs and do not burn any fuel.			
16. Geothermal steam and hot water contain traces of hydrogen sulfide and other gases, as well as chemicals that are harmful at high concentrations.			
17. The gases and chemicals from geothermal power plants are usually reinjected into the earth.			
18. The temperature of the earth a few feet underground remains constant year round – about 52 degrees Fahrenheit in moderate climates.			
19. Low temperature geothermal energy is available everywhere in the U.S.			
20. Geothermal heat pumps use the earth's constant temperature as an energy source to heat buildings in winter and cool them in summer.			

HYDROPOWER

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Moving water has been used as a source of energy for thousands of years.			
2. Hydropower is considered one of the cleanest and cheapest energy sources in widespread use today.			
3. Moving water is considered a renewable energy source.			
4. Moving water can turn a turbine to generate electricity.			
5. Hydropower was first used to turn water wheels to grind grain.			
6. Hydroelectric power is considered reliable because dams can be built to store water. Controlling the flow of the stored water allows a power plant to operate in all weather conditions.			
7. About 5-10 percent of total U.S. electricity is generated by hydropower plants, depending on the amount of rainfall.			
8. Hydropower provides the U.S. with almost three percent of our total energy consumption.			
9. In the last 60 years, hydropower production in the United States has increased by 900 percent.			
10. The nation's largest producer of hydroelectric power is the federal government, which operates many large dams and power plants.			
11. There are about 2,000 hydroelectric power dams in the U.S. today.			
12. There are about 63,000 dams that *do not* have generating plants on them.			
13. If we build generating stations at the most suitable dams and build new dams on suitable rivers, we could nearly double our hydroelectric capacity.			
14. When a hydro dam is built, thousands of acres of nearby land are flooded to create a reservoir.			
15. Projects using wave and tidal energy to generate electricity are being tested around the world.			
16. Dams can disturb the migration and spawning of fish populations in the river.			
17. Dams can alter the natural flow of the river and change the amount of water that reaches communities downstream.			
18. Reservoirs are often developed for recreational purposes, such as boating and fishing.			
19. The use of hydropower in the United States is not expected to increase significantly in the future, but wave/tidal projects are expected.			
20. Some countries use hydropower as their main source to produce electricity. South America produces 75 percent of its electricity from hydropower.			

NATURAL GAS

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Natural gas was formed from the decomposition of tiny sea plants and animals that lived millions of years ago.			
2. The chemical name for natural gas is methane.			
3. Natural gas is odorless; an odorant is added for safety.			
4. Natural gas can be processed and other products recovered from it.			
5. Natural gas is the cleanest burning fossil fuel.			
6. Usually, natural gas and petroleum are found together in underground deposits.			
7. In the past, oil drillers were not interested in the natural gas that was found at the site of an oil well. Today, it is as valuable as the oil.			
8. The invention of high pressure pipelines has made it possible to transport gas all over the U.S.			
9. Leaks can occur in natural gas pipelines. Fires and explosions can result from these leaks if proper safety precautions are not taken.			
10. About 16 percent of the natural gas we use comes from offshore wells.			
11. Natural gas is considered a nonrenewable resource.			
12. Today, the U.S. has a large supply of natural gas. There are large reserves of natural gas offshore, on the outer continental shelf, and in the Gulf of Mexico.			
13. Industry is the number one consumer of natural gas.			
14. Natural gas can be used as a cleaner burning transportation fuel.			
15. It is estimated that natural gas supplies will last from 30 to 50 years at today's prices and consumption rate.			
16. Natural gas accounts for 23.5 percent of total U.S. energy consumption.			
17. It is estimated that natural gas supplies could last 200 years at higher prices.			
18. More than half of the homes in the U.S. use natural gas for heat.			
19. Natural gas is used to produce peak load electricity because gas furnaces can be brought on line and shut down quickly and efficiently.			
20. Methane is a greenhouse gas. Increasing the levels of greenhouse gases in the atmosphere can affect the global climate.			

PETROLEUM

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. The word petroleum is derived from the word *petro* meaning rock and the word *oleum* meaning oil.			
2. Petroleum deposits were formed over millions of years from the remains of marine plants and animals.			
3. Petroleum is a nonrenewable energy source.			
4. Oil deposits are found in many areas, onshore and offshore.			
5. The U.S. imports about two-thirds of the petroleum it uses from other countries.			
6. The U.S. has large petroleum deposits in Alaska and offshore.			
7. Until recently, many offshore resources have been off limits to development due to state and federal regulations.			
8. About one third of the oil the U.S. produces comes from offshore wells, mostly in the Gulf of Mexico.			
9. Petroleum straight from the well – crude oil – is not usable. It must be refined into gasoline and other products.			
10. Refining petroleum at different temperatures makes the hydrogen and carbon atoms combine in many different ways to produce different products.			
11. We get many fuels from refining petroleum – gasoline, kerosene, jet fuel – that can be burned to produce heat, light, electricity, or motion.			
12. Many chemical products from petroleum can be used to make plastics, medicines, fertilizers, and other products.			
13. When petroleum products are burned, harmful emissions are produced.			
14. To protect the environment, oil drilling and production are regulated by federal and state governments.			
15. Oil is transported by pipeline, truck, or tanker to where it is refined and/or used.			
16. If oil is spilled into the water or onto the land, it can cause damage to the environment.			
17. Petroleum products are efficient, economical transportation fuels. Most transportation in the United States is fueled by petroleum products.			
18. Today, gasoline powered vehicles produce fewer emissions than they did in the 1970s because of advances in engine design and fuel formulation.			
19. Petroleum is the United States' leading source of energy, supplying 37 percent of the energy used in the U.S.			
20. At current rates of consumption, there is a 75-125 year worldwide reserve of petroleum.			

PROPANE

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. About half of the propane we use comes from natural gas processing and half from petroleum refining. We import about 10 percent.			
2. Under normal conditions propane is a gas, but under moderate pressure or low temperature, propane becomes a liquid.			
3. Propane is stored as a liquid in pressurized tanks because it takes up 1/270 of the space and is very portable.			
4. Propane becomes a gas when it is released from the pressure in the tank. As a gas, it is used to fuel appliances.			
5. Like natural gas, propane is colorless and odorless. An odorant called mercaptan is added as a safety measure.			
6. Propane is a nonrenewable energy source.			
7. Propane is a cleaner burning fossil fuel.			
8. Propane is moved through pipelines to distribution terminals.			
9. Propane is taken from distribution terminals to bulk plants by trains, trucks, barges, and supertankers. Local dealers fill their small tank trucks and distribute it to their clients.			
10. Propane is mostly used in rural areas that do not have natural gas service. Homes and businesses use it for heating, hot water, cooking, and clothes drying.			
11. Half of all America's farms rely on propane to dry crops, power tractors, heat greenhouses, and warm chicken houses.			
12. Propane is also used by taxicab companies, government agencies, and school districts to fuel their vehicles.			
13. As a vehicle fuel propane is cleaner burning and leaves car engines free of deposits. Engines fueled by propane also have fewer emissions.			
14. There is a slight drop in miles per gallon when propane is used to fuel vehicles.			
15. Propane isn't widely used as a transportation fuel because it is not as conveniently available as gasoline or diesel.			
16. An automobile engine must be adjusted to use propane.			
17. Propane gas is heavier than air and can explode if the propane is ignited.			
18. Propane is more expensive than natural gas, heating oil, or kerosene.			
19. Propane is cleaner burning; and is often used to power indoor vehicles such as forklifts.			
20. Propane supplies and price are tied to oil and natural gas supplies and costs.			

SOLAR

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. The sun radiates more energy in one second than people have used since time began.			
2. The sun is a star made up mostly of hydrogen and helium gas. It produces radiant energy in a process called nuclear fusion.			
3. Harnessing radiant energy from the sun is difficult because the energy that reaches the earth is very spread out.			
4. Only a small part of the solar energy radiated ever reaches the earth.			
5. It takes the sun's energy just over eight minutes to travel 93 million miles to the earth.			
6. Solar energy is a renewable energy source.			
7. Solar energy is used to heat passive solar buildings and water and to generate a small amount of electricity.			
8. The amount of solar energy reaching an area depends on the time of day, season of the year, cloud coverage, and geographic location.			
9. Most of the solar energy we use every day cannot be measured.			
10. A solar collector can be used to capture sunlight and change it into usable heat energy.			
11. An active solar home in the Northern Hemisphere uses special collectors facing south to absorb sunlight and change it into heat. Air or water flows through the collector and is warmed by the heat.			
12. Passive solar homes do not depend on mechanical equipment to transform radiant energy into heat energy.			
13. Photovoltaic cells can convert radiant energy from the sun directly into electricity.			
14. Photovoltaic comes from the words *photo* meaning light and *volt*, a measurement of electricity.			
15. Photovoltaic – or PV – systems have a longer payback period.			
16. Small PV cells are used to power roadside telephones, calculators, and toys.			
17. PV cells convert about 10 percent of the energy they receive into electricity.			
18. Electricity from PV cells costs about $0.21-0.81/kWh. The average cost of electricity in the U.S. today is about $0.11/kWh.			
19. Large solar systems can take up a large amount of land or can be placed on large flat roofs.			
20. Solar energy does not pollute the air.			

URANIUM

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. In 1939, scientists discovered that certain atoms could be split. The splitting of these atoms releases a great amount of energy.			
2. Over one hundred nuclear power plants operate in the U.S.			
3. Nuclear plants provide about 20 percent of the electricity generated in the U.S.			
4. A nuclear reactor can supply a large amount of energy using a very small amount of fuel.			
5. The construction of nuclear power plants is very expensive compared to fossil fuel plants.			
6. Nuclear reactors do not burn uranium to generate electrical power, they split the uranium atoms—so their emissions are minimal.			
7. Uranium is easy to transport.			
8. Uranium is inexpensive.			
9. The U.S. has abundant supplies of uranium. However, we import most of the uranium used in power plants because it is cheaper to do so.			
10. Nuclear power plants produce electricity by heating water into steam in the same way as fossil fuel plants.			
11. Workers at nuclear power plants receive less radiation from the plant than they do from other sources like medical x-rays.			
12. Some parts of reactors become radioactive after they have been used.			
13. Radioactive waste from nuclear power plants is stored underground in spent fuel pools or dry cask containers at the plant sites.			
14. In 2002 the Department of Energy determined that Yucca Mountain, NV would be a suitable site for a permanent nuclear waste repository. The final decision is still subject to political debate.			
15. Uranium is a nonrenewable energy source.			
16. A nuclear power plant produces a lot of waste heat. If this heat is put into a moving water system, the water temperature can increase.			
17. The main health risk from a nuclear power plant is potential radiation exposure.			
18. Nuclear power plants in the U.S. are highly regulated.			
19. An accident at a nuclear power plant could cause widespread damage if people or the environment were exposed to high-levels of radioactivity.			
20. There has been renewed interest in nuclear power in the U.S. in the last few years as concern over global climate change has increased.			

WIND

	IT'S A FACT	RELEVANT	
		ADVANTAGE	DISADVANTAGE
1. Wind is air in motion caused by the uneven heating of the earth's surface by the sun.			
2. Wind turbines do not cause air or water pollution because no fuel is burned to generate electricity.			
3. Wind is a renewable source of energy.			
4. Wind turbines operate on average about three-fourths of the time, though not always at capacity.			
5. For hundreds of years, windmills were used to grind wheat and corn, to pump water, and to cut wood at sawmills.			
6. Wind turbines have turning blades to harness the wind's kinetic energy. The blades are connected to drive shafts that turn generators to make electricity.			
7. Wind plants can convert 30-40 percent of the wind's kinetic energy into electricity.			
8. When the wind is not blowing, other sources of energy must be used to generate needed electricity.			
9. The locations of wind farms are carefully planned—good sites include the tops of smooth, rounded hills, open plains or shorelines, and mountain gaps.			
10. Wind turbines provide the U.S. with enough electricity to power several large cities.			
11. Wind power plants, or wind farms, are clusters of dozens of wind machines spread over a large area. The land around the wind turbines can also be used for grazing or growing crops.			
12. Wind farms are often owned and operated by business people who sell the electricity to utility companies.			
13. Wind turbines can be used in remote areas that do not otherwise have access to electricity.			
14. Almost every state has the capacity to produce electricity from wind.			
15. The U.S. produces about a tenth of the world's wind energy.			
16. Older wind turbines are very noisy; new technologies have eliminated most noise.			
17. Wind turbines can injure birds or bats that fly into the spinning blades.			
18. It costs about $.04/kWh to produce electricity from wind power plants.			
19. New wind turbines can generate electricity at about the same cost as coal-fired plants.			
20. Wind turbines can be located in offshore areas where there are plentiful wind resources.			

GREAT ENERGY DEBATE
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.	Were the allotted times 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 use the activity again?	Yes	No

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:

Please fax or mail to:
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PO Box 10101
Manassas, VA 20108
FAX: 1-800-847-1820

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