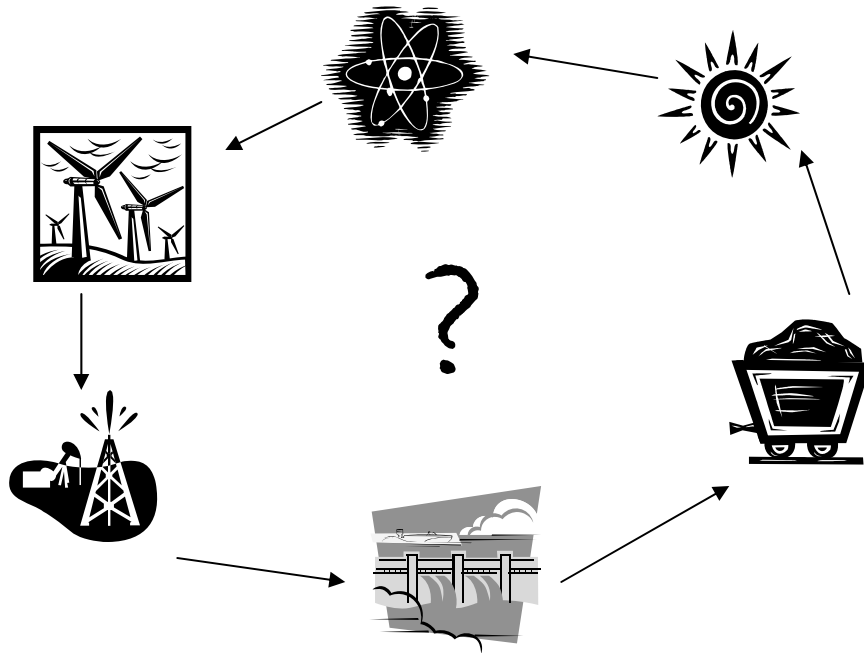


Great Energy Debate Game

SUBJECT AREAS
Science
Social Studies
Math
Language Arts

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



Disadvantages



Advantages



STUDENT EDITION
- Advanced -

Example



Solar

	<i>Advantage</i>	<i>Disadvantage</i>	<i>Just a Fact</i>
1. <i>Sol</i> means sun. Solar energy is energy from the sun.			✓
2. Solar energy is renewable. We will have solar energy as long as the sun shines.	✓		
3. The sun's energy is spread out and hard to capture. The energy is only available when the sun is shining, not 24 hours a day.		✓	



Biomass

	Relevant		
	Advantage	Disadvantage	Just a Fact
1. Biomass is a source of energy from plant materials, garbage and animal waste.			
2. Biomass is a renewable energy source; we can grow or produce 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 is found through out the country and can be produced almost everywhere in the U.S.			
6. The amount of energy stored in biomass is less than the amount of energy stored in the same amount of a fossil fuel.			
7. Biomass can be made into biodiesel and ethanol, transportation fuels that are cleaner-burning than petroleum. Corn, sugar cane and switchgrass are used to make ethanol. Biomass can be made from soybean oil and waste vegetable oil.			
8. Burning biomass produces pollution like ash and smog-forming nitrogen oxides.			
9. Wood requires proper storage and seasoning. Plus, labor is needed to prepare wood for use – cutting, splitting and stacking.			
10. A relatively new way of heating with biomass involves using wood pellets. Pellets are more expensive to purchase than wood, but are more convenient and cleaner burning than cordwood.			
11. Today, 46% of biomass energy comes from wood. 43% comes from ethanol and biodiesel and 11% comes from garbage and landfill waste.			
12. Scientists are developing trees that can be grown to full size in less than half the time of the average tree.			
13. Biomass can be used as a fuel because it captures and stores radiant energy from the sun through the process of photosynthesis.			
14. About 2% of American homes use biomass as their only heat source.			
15. Biomass provides 6% of the nation's demand for energy. 5% of Maine's electricity is produced using biomass.			



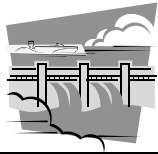
Coal

	Relevant		Just a Fact
	Advantage	Disadvantage	
1. Coal is the most abundant fossil fuel in the United States. We have about a 190-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. There are four types of coal: lignite, sub-bituminous coal, bituminous coal, and anthracite. Bituminous coal is the most commonly used form.			
4. Coal-fired power plants are a very inexpensive way to make electricity.			
5. Burning coal releases pollution such as ash, carbon dioxide (a greenhouse gas) and sulfur dioxide (the cause of acid rain).			
6. To remove coal from deep in the earth, mineshafts are constructed and machines are used to extract coal and bring it to the surface.			
7. 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.			
8. Large amounts of land are disturbed in the process of surface mining, but the mines can be restored to grasslands or parks after the coal is removed.			
9. About two thirds of the nation's coal comes from strip mines.			
10. Water that filters through abandoned mines can pick up chemicals that pollute waterways if the mines are not closed correctly.			
11. Coal can be turned into other materials and products we use, such as steel, linoleum and insulation.			
12. Coal can be turned into a gas. This method removes sulfur, nitrogen compounds, and particulates before the fuel is burned, making it as clean as natural gas. This process is still in the research & development stage.			
13. Coal miners can develop lung disease by breathing too much coal dust in mines.			
14. The main use of coal in the United States is to generate electricity. In 2009, 92% of all the coal mined in the U.S. was used for electricity production.			
15. 37% of the electricity we use in the U.S. comes from coal. In Maine, about 5% of our electricity comes from coal.			



Geothermal

	Relevant		
	Advantage	Disadvantage	Just a Fact
1. Geothermal energy comes from heat within the earth. Examples of Geothermal energy are hot springs, volcanoes and geysers.			
2. Geothermal energy can be used to heat homes in several ways: through direct use in heating systems (these use hot water from springs or reservoirs near the surface), by electrical generation (which is then used for heat), and by geothermal heat pumps (using stable ground or water temperatures near the earth's surface to control building temperatures above ground). The last method is the one used by some Maine people to heat their homes.			
3. Geothermal energy is used to produce electricity and to heat buildings.			
4. Geothermal energy is renewable. The water used by geothermal systems is replenished by precipitation and the earth's heat is continually produced.			
5. High-temperature geothermal resources capable of producing electricity are not economically available in all parts of the country.			
6. Because no fuel is burned in a geothermal system, this process does not create any air pollution. However, heat pumps do require electricity to run.			
7. People in Maine typically access geothermal heat through their wells.			
8. Geothermal power plants have high installation costs. To get geothermal energy, requires installation of power plants, to get steam from deep within the earth and this requires a huge one-time investment.			
9. Once installed, Geothermal energy does not cost much money since no fuel is used to generate the power.			
10. Geothermal sites can run out of steam over a period of time due to drop in temperature or if too much water is injected to cool the rocks and this may result in huge loss for the companies which have invested heavily in these plants.			
11. The most active geothermal resources are found along major tectonic plate boundaries, where magma comes very near the Earth's surface.			
12. Low temperature geothermal energy is available everywhere in the U.S.			
13. The temperature of the earth a few feet underground remains constant year-round: about 52 degrees Fahrenheit in temperate climates.			
14. Geothermal steam and hot water contain traces of hydrogen sulfide and other gases, as well as chemicals that can be harmful at high concentrations.			
15. The United States, geothermal energy produces less than 1% of the energy consumed.			



Hydropower

	Relevant		
	Advantage	Disadvantage	Just a Fact
1. Hydropower is the energy of moving water.			
2. Water is continuously evaporated from earth's surface. It condenses in the atmosphere to form clouds. When the clouds cool down, the water falls to the earth as precipitation. This water cycle replenishes our streams, rivers and lakes.			
3. Hydropower is used primarily to make electricity.			
4. For hundreds of years, water wheels have been used to grind grain, pump water and run sawmills and other machines.			
5. We can capture the energy in moving water by constructing dams across rivers. The dams contain turbines which, when turned by moving water, run generators to make electricity.			
6. The nature of hydropower allows us to make electricity without burning any fuels. Because of this, it is considered a "clean" energy source.			
7. Installing a hydro dam can cause flooding upriver. This new body of water is called a reservoir. While a reservoir can flood riverside communities and animal habitat, it can also be a source of recreation and drinking water.			
8. Most of the good places to put dams in the U.S. are already taken. We will not build many more hydropower dams. Some dams are actually being removed due to their impacts on aquatic populations.			
9. Some fish species need to swim upriver each year to spawn. Fish ladders are a popular method to assist these fish in passing through the dams, but they do not solve the problem entirely.			
10. Even when you factor in the expense of building a dam, hydropower is the most cost effective way to make electricity.			
11. We can use the energy in the rise and fall of the ocean's tides to make electricity, but it may only be practical close to shore due to challenges with transmitting the electricity.			
12. Hydro plants are about 95 percent efficient at converting the kinetic energy of the moving water into electricity.			
13. We can also get energy from ocean waves. The waves can be used to force air through pipes, turning turbines to make electricity.			
14. The states that make the most hydropower are Washington, Oregon and Idaho.			
15. Only about 7% of the electricity we use in the U.S. comes from hydropower. In Maine, 33% of our electricity comes from dams. China and Canada are the world's biggest hydropower producers.			



Natural Gas

	Relevant		Just a Fact
	Advantage	Disadvantage	
1. Natural gas is a fossil fuel, formed millions of years ago as tiny sea creatures died and sank to the bottom of the ocean. Heat and pressure from the earth transformed these creatures into methane, the main component of natural gas.			
2. We have a 100-year supply of natural gas at the rate we use it today. We could get more natural gas if we were willing to pay more for it.			
3. Natural gas was first burned by the Chinese people thousands of years ago. In the 19th century, Americans first used it in gas lamps.			
4. Natural gas generates 30% of the electricity in the United States.			
5. Today, natural gas is primarily used by industry, to heat homes, and to make electricity. Over half of the homes in the U.S. are heated with natural gas.			
6. Natural gas must be transported via pipeline. These pipelines are expensive and take a long time to build. Some parts of the country do not have access to natural gas due to a lack of pipelines.			
7. Natural gas is the cleanest burning fossil fuel. However, when it is burned, carbon dioxide and some sulfur dioxide, nitrous oxides and particulate matter are produced.			
8. Natural gas is typically found with coal and petroleum, but geologists also seek other sites for gas.			
9. Only about half of the sites where we drill actually contain natural gas. This is one reason why natural gas is more expensive than coal.			
10. Hydraulic fracturing (also called fracking) is a method of breaking apart rocks to release natural gas.			
11. It is estimated that there are many years worth of natural gas available through fracking.			
12. Hydraulic fracturing has resulted in the contamination of groundwater by dangerous chemicals.			
13. A renewable form of natural gas can be captured by drilling into landfills. When garbage and other materials decompose, they release methane, which can be captured and burned for heat or electricity.			
14. Compressed natural gas (CNG) is a promising transportation fuel. It is cleaner than gasoline and diesel, but harder to store.			
15. Nationally, about 34% of our total energy comes from natural gas. In Maine, 30% of our electricity is produced with natural gas.			



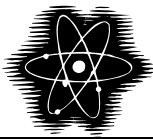
Petroleum

	Relevant		Just a Fact
	Advantage	Disadvantage	
1. Petroleum is a fossil fuel, formed millions of years ago from tiny sea creatures that died and sank to the bottom of the ocean. Heat and pressure from the earth transformed these organisms into this liquid fuel that we also call oil.			
2. Although petroleum is still being formed today, it takes special geological conditions to form. We use it thousands of times faster than it is formed.			
3. Petroleum was first used by the Chinese and Egyptians, who burned it in oil lamps. In the U.S., it was first used in 1859, when it was refined into kerosene for lighting.			
4. Over two-thirds of the petroleum we use for energy goes towards gasoline for transportation. Another quarter is used by industry, and the rest is consumed by heating buildings and making electricity.			
5. We also use petroleum to make plastic, medicines, paints, soaps, wax, and many other products.			
6. When petroleum is burned, pollutants such as carbon dioxide, sulfur dioxide, nitrous oxides, particulate matter are produced.			
7. To extract petroleum from the earth, a well is drilled 6,000-20,000 feet deep. A typical well produces about 11 barrels of oil per day.			
8. Drilling for petroleum risks spills on the land and in the water. Oil spills are difficult to clean up and are a major threat to wildlife. Oil can also spill during transport.			
9. Petroleum is typically transported by truck, tanker or pipeline. This mobility allows oil to be brought to some of the most remote communities in the U.S.			
10. Petroleum prices fluctuate daily. Since it is used to make gasoline, heating oil, diesel and jet fuel, these changes affect the prices of these other fuels, too.			
11. About two-thirds of the oil we use comes from other countries including Canada, Mexico, Saudi Arabia, Venezuela, Nigeria and the Persian Gulf.			
12. There are untapped oil resources off the coast of California and in the Arctic National Wildlife Refuge (ANWR) in Alaska.			
13. The biggest petroleum-producing states in the U.S. are Texas, Alaska, California, Louisiana and New Mexico.			
14. The U.S. has a three-month supply of oil saved up for emergencies. This is called the Strategic Petroleum Reserve.			
15. In the U.S., about 15% of our total energy is made by burning petroleum. In Maine, approximately 6% of our electricity is generated with petroleum.			



Solar

	Relevant		
	Advantage	Disadvantage	Just a Fact
1. Solar power is radiant energy – light and heat – from the sun.			
2. The sun continuously shines on earth, warming the surface and fueling wind and the water cycle. The sun emits more energy each second than humans have used since time began.			
3. Harnessing the sun’s energy is difficult because the sunlight that reaches earth is very spread out. The amount of solar energy reaching earth depends on the time of day, season, weather conditions and geographic location.			
4. We can use energy from the sun to light and heat buildings. This is called passive solar energy. Buildings that have windows facing the sun can take advantage of this free energy source. An example of this is a greenhouse.			
5. Special solar collectors or tubes can be used to capture the sun’s energy, which then heats water or air inside a building. This is called a solar thermal system.			
6. One of the challenges with a passive solar thermal system is finding a way to store the heat for a time when it is needed.			
7. We also use photovoltaic (PV) cells, also known as solar panels, to make electricity. We call this a solar electric system.			
8. The electricity made by solar panels can be stored in large, rechargeable batteries for use when the sun is not shining.			
9. Solar panels can be used in places where there are no power lines.			
10. Electricity from PV cells is more expensive than the electricity you get from the power company because solar panels and batteries are very expensive.			
11. Solar panels are found on calculators, roadside signs, satellites and electronic gadgets such as cell phone chargers.			
12. About 15 percent of the energy that reaches a solar panel is converted into electricity.			
13. Solar panels do not pollute the air since no fuel is burned to make the electricity.			
14. Large solar power plants, like those in the Southwestern U.S., use curved mirrors to focus the sun's energy onto a pipe containing a liquid with a low boiling point. Steam is created to spin a turbine, which makes electricity. This is called concentrated solar power.			
15. Solar power currently produces less than 1% of the electricity we use in the U.S.			



Uranium

	Relevant		Just a Fact
	Advantage	Disadvantage	
1. Uranium is a metallic chemical element that, while abundant, is considered a nonrenewable energy source.			
2. Uranium atoms contain huge quantities of energy in their nuclei. In 1938, scientists discovered that splitting the nucleus of an atom can result in the release of that energy. This is called nuclear fission.			
3. Nuclear fission was first used during World War II – to make a bomb. However, under the controlled environment of a power plant, fission was used to make electricity starting in 1957.			
4. In a power plant, the heat produced by splitting uranium atoms is used to boil water. The resulting steam spins a turbine which runs a generator, making electricity.			
5. Nuclear power plants need to be very safe and contain advanced equipment. Because of this, they are very expensive to build and it can take up to a decade before they are up and running.			
6. Because no fuel is burned in a nuclear power plant, this process does not create any air pollution.			
7. Once uranium atoms are split, there is a small quantity of radioactive waste left over. This waste can harm humans and animals if not properly stored.			
8. Scientists are exploring ways to store this waste permanently, which will continue to emit harmful radiation for thousands of years.			
9. Nuclear waste can be partially reused; however, mostly it is stored at the power plants due to the fact that it is cheaper to mine more uranium.			
10. Currently, the U.S. has no permanent structure to store nuclear waste. Yucca Mountain, located in Arizona, is being considered as a potential storage site.			
11. Nuclear power plants are usually located on lakes or rivers, where they have a constant supply of fresh water. These plants often dump warm, uncontaminated water back into the lakes or rivers.			
12. Nuclear power provides the U.S. with 19% of its electricity from 65 power plants.			
13. If you only compare the costs of fuel, nuclear power is a much cheaper way to make electricity than burning coal.			
14. The United States, France, Japan and Germany are the world's leading producer of nuclear energy. France supplies its population with 75% of its electricity.			



Wind

	Relevant		Just a Fact
	Advantage	Disadvantage	
1. Wind power is energy in moving air.			
2. Wind is a product of the uneven heating of the planet. The sun warms the land faster than it warms the water. Warm air over the land rises and cooler air over the water rushes in to take its place, creating wind.			
3. Wind will always be produced as long as the sun continues to warm the earth. This makes it a renewable resource.			
4. Wind power is used primarily to make electricity.			
5. Early in America's history, windmills were used to grind corn and wheat, pump water, and cut wood. During the 1920s, wind turbines were also used on rural farms to create electricity in areas not accessible to the power lines.			
6. Wind can be harnessed using wind turbines to generate electricity. The wind spins the turbine, which activates a generator, creating electricity. Higher wind speeds mean that more electricity is made.			
7. The term "wind farm" refers to a group of wind turbines. Working together, these turbines can create large amounts of electricity. However, wind farms take up lots of land and can harm animals such as birds and bats.			
8. Turbines require a certain speed of wind in order to generate electricity. Despite wind farms operating 24 hours a day, their capacity to make electricity is around 30 to 35 percent.			
9. Since wind turbines are so tall, their visual appearance creates mixed feelings on local population. They can ruin visual landscapes for some and to others they can be a symbol of alternative energy.			
10. Wind power is less expensive than electricity from a conventional power plant.			
11. Wind energy does not require the burning of fuels. Thus, wind farms do not create air and water pollution.			
12. Offshore wind farms are being created because wind over water is stronger and more consistent than over land.			
13. Currently, wind farms create 10 billion kWh of electricity a year or enough to power 1 million homes.			
14. Wind turbines only produce around 3.5% of the U.S. electricity. In recent years, it have become the fastest growing technology in the world. Production of wind turbines is expected to triple in the near future.			