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Energy and Your Environment

Teacher's Guide

Energy and Your Environment presents energy concepts in an interdisciplinary context. This presentation guide provides answers to questions and problems, as well as extension and discussion tips for each page.

Page 2: Your Environment is Energetic (Physical Science)
Answers: Illustration questions

- Energy is released when ice melts; therefore ice exhibits potential energy.
- The ocean waves depict kinetic energy. The water at the top of the waves posses' potential energy.
- The sprinters represent kinetic energy. There is stored energy within their muscles (& whole bodies).
- The jelly beans depict potential energy that can be released when the beans are eaten.

Page 3: We Get Energy From the Environment (Physical Science)
Answers: *What Do You Think?*

1. The electric dryer method depends on the kinetic energy of either water-driven turbines (hydropower) or steam-driven turbines (fossil fuel or nuclear energy) to generate the electricity needed to power the dryer. The clothesline approach depends on the kinetic energy of the wind and the sun (heat) to dry the clothes.
2. The electric dryer method uses non-renewable resources unless the electricity was generated by water, wind or solar power. The clothesline method uses renewable resources.
3. The energy that is in fossil fuels came from plants and animals that stored the sun's energy in their tissues.

Extension:
Ask students to work in small groups to explain why wood is a renewable form of energy, while coal is not.

Page 4: Energy Use in the Environment Has Changed Over Time (Language, Social Studies)
Answers: *Imagine*
Have students work in groups to come up with answers that reveal logical thinking skills as well as an understanding of the timeline. (Students can assume that fire has been discovered for the prehistoric time period.)

Discussion:
Discuss as a class how to prepare a meal in the three different time periods. What technologies would be used? What kinds of fuel would be used? (e.g. prehistoric — open wood fire; 200 years ago — wood or coal burned in fireplace or brick oven; 1990's — gas fire or electric heat in kitchen range or oven.)

Extension:
Ask students to look at the timeline and consider the various types of energy besides fossil fuels that have been used over the millennia. Note how the use of renewable energy is coming back into play the way it was in 1,000 B.C.!

Page 5: Energy Production Affects the Environment in Many Ways (Environmental Science)
Answers: *Environmental Impacts Chart**

- Fossil Fuels: smog, release of greenhouse gases, acid precipitation, water and soil contamination, hazardous waste generation
- Nuclear: highly hazardous waste, accidental radiation exposure
- Hydropower: destruction or alteration of plant and animal habitats
  Wood: deforestation, air pollution (release of greenhouse gases, soot)
- Solar: no significant environmental impacts from power generation
- Wind: some wind turbines can be noisy or can harm flying birds; turbines can block scenic views

* All energy resources have environmental impacts associated with manufacture of equipment used in energy production and delivery of electricity. Some have impacts associated with transportation of fuel.

Discussion:
You may help students get started on the Community Connection by discussing the environmental effects that are experienced locally.

Page 6: Everybody Needs Energy (Social Studies)
Discussion Tips: *Is It Fair?*
Drawing on your students' knowledge of other countries (whether first-hand or from videos, books, or the Internet), ask students to describe common ways people use energy outside of the United States. Compare and contrast this energy use in other countries with how students and others use energy in the U.S. Specifically discuss the use of common household appliances (washers, dryers, dishwashers), and transportation vehicles. Utilize mapping/charting to see the differences and similarities by country, continent, and/or hemisphere.

Page 7: Paying the Price for Our Energy Use (Math, Social Studies)
Answers: *How Many Hours . . .?*

- It would take 300 hours at $10/hour to pay a $3000 energy bill. This would take 7 ½ work weeks, or about 15% of a 50-week work year.
- Ideas for reducing the country's energy bill may include the following: encouraging alternatives to automobile use; improving vehicle fuel efficiency and use of alternative fuel vehicles; increasing purchase of recycled products; improving building insulation; encouraging people to buy things that require little transportation, processing, and packaging, etc.

Page 8: Living in a Global Greenhouse (Physical Science)
Answer: *Make a Mini Greenhouse*

- The ice in the covered bottle should have melted faster. Students should explain that the plastic wrap holds in heat just as the clear greenhouse gases trap the Earth's heat.
- Extension: The problem is not that greenhouse gases exist but that their concentrations have increased due to human activities. Discuss what life would be like if there were no greenhouse gases in the atmosphere. (Without greenhouse gases the Earth would have an average temperature of -18ºC, instead of the current 15ºC.)

Page 9: Energy Efficiency (Math)
Sample calculations for problems

- Refrigerators: A newer energy efficient model would use 1150 kWh less per year. (1,400 – 350.) That's 82% less kWh/yr of energy being used by the more efficient refrigerator.
- Automobiles: Yearly gallons of gas used by average midsize car = 15,000 miles/year ÷ 25 mpg = 600 gallons/year
  Yearly gallons of gas used by average gasoline electric hybrid car = 15,000 miles/year ÷ 45 mpg = 333 gallons/year
  Savings in gallons = 600 - 333 = 267 gallons. Dollar savings with gasoline at $2.80/gallon = $747.60

Page 10: Conserving Energy at Home (Community Involvement)
<u>Discussion Tip</u>:
Ask students to discuss in groups how they tried to change their families' energy consumption patterns, and how their families responded to these efforts.

<u>Bonus Question Answers</u>:
Transportation changes would conserve fossil fuel use. Lighting and appliance and some water use changes would reduce electricity use, and natural gas use in the case of gas dryers. Heating, shower and water heater changes would reduce natural gas, fuel oil, or electricity use depending on the type of fuel used.

Page 11: Energy: How Much Does it Take? (Math)
Additional Information about energy measurement conversions:

Just as there are multiple units for measuring distance (meters, yards, fathoms), there are multiple units for measuring energy. These different units arose out of practical needs to quantify amounts, such as the heat generated by a furnace, or the work that a horse could do in a given period of time. Because energy is the same thing, whether it's in a furnace or a horse, these quantities can all be converted to equivalent units. By multiplying a quantity in one measurement unit (e.g., calories) by a conversion factor, you get the quantity in another measurement unit (e.g., joules). Joules is the standard scientific unit of measurement for energy.

Answers to *Brain vs. Car*

1. 2500 food calories/day x 20% x 100 days = 50,000 food calories
   Conversion to joules: 50,000 food calories x 4184 joules/food calorie = 209,200,000 joules
2. If the car gets 25 miles/gallon, then it takes 4 gallons of gasoline to go 100 miles. 4 gallons of gasoline x 1.5 gallons crude oil/gallon gasoline = 6 gallons crude oil.
   Conversion to joules: 6 gallons x 146,000,000 joules/gallon of crude oil = 876,000,000 joules.

The 100-mile car trip takes a little more than 4 times the energy needed for a brain to work for 100 days.

Page 12: Youth Can Make a Difference (Community Involvement)
<u>Research Tip</u>:
Contact your local business organizations and community nonprofit associations to find out about sponsorship possibilities for youth activities in energy efficiency or environmental improvement.

Page 13: Investigate Your School's Energy Habits (Math, Community Involvement)
Sample Calculation for a School Relighting Project
(Costs, hours, and number of lights will vary with location. Use this worksheet to complete the numbered steps and calculate cost savings for a new system.)

1. Type of existing lights: _______________
2. Type of recommended replacement lights: ________________________
   Energy use of each replacement light: ___________________
   Cost of each replacement light: ________________________
3. Number of replacement lights needed: _____________________
4. How many hours lights are on per year: ______
   Energy use per year in kWh:
   Current system: Hours per year x number of lights x wattage: __________ /1,000 = ________kWh
   New system: Hours per year x number of lights x wattage: ____________/1,000 = _________kWh
   (Note: Dividing answers by 1,000 yields kWh per year)
5. Yearly operating costs:
   Current system: kWh per year x school's cost per kWh = _________________
   New system: kWh per year x school's cost per kWh = ___________________
   Difference in operating costs: _______________
6. Challenge: Calculate how long it will take to pay off the new lights.
   Cost of new lights _______ divided by difference in yearly operating costs _____= number of years it will take to pay off the new lights: _________.
7. Use this worksheet to share results with your school custodian and principal.
8. Other energy uses at schools include gasoline used by people traveling to and from school, energy for heating and air conditioning, electricity for classrooms, offices, and cafeteria equipment, etc.

Page 14: Reuse News (Community Involvement)
<u>Discussion Tip</u>:
Display a number of everyday items: bag of chips, a shoe, can of soda, magazine, computer disk. Challenge students to think of: (1) ways to reuse the object, or (2) how the item could be changed to require less packaging or allow for reuse.

Page 15: Test Your Energy Savvy (Review)
<u>Answers</u>: Word Search:

- Bicycle
- Reusing
- Person
- Renewable
- Infrared
- Brain
- Osage
- By-Products
- LED

Page 16: Creating Our Energy Future (Environmental Science, Art, Community Involvement)
<u>Research Tip</u>:
Invite a government planning or transportation department member, or local industry representative to discuss plans for reducing energy use. Students may also get ideas for reducing energy use in the community by studying city or county general plans, which have sections that deal with energy-related issues, such as transportation, housing, and waste management.