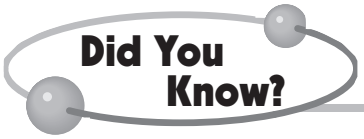
Energy: A Delicate Dilemma



By the beginning of the 21st Century new cars will be expected to emit 70% fewer nitrogen oxides (the main ingredient in smog) and 30% fewer hydrocarbons (one cause of lung disease). The cost is about $60 per car.

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS

Unifying Concepts and Processes:

Evidence, Models, and Explanations

Physical Science:

Transfer of Energy

Life Science:

Regulation and Behavior

Earth Science:

Structure of the Earth system

Science in Personal and Social Perspectives:

Risks and Benefits

Is the Answer Nuclear?

Day in and day out, the steam flows from the tower that cools the heat of one of the nation's largest nuclear power plants. The plume of steam rises so high that it can be seen for 60 miles in any direction. The cooling tower is over 500 feet (150 meters) high. Now, for the first time since the use of nuclear power as an energy source, we are faced with the issue of disposal of nuclear waste. What do we do with the first load of spent radioactive fuel that's about to be discharged from the plant?

Everyone understands what garbage is, but this garbage is different—it contains the elements strontium and cesium. Both of these elements emit gamma rays (which can penetrate lead) and both stay radioactive for generations, meaning they will still be generating gamma rays over one thousand years from now.

What to do with radioactive waste is the most difficult energy question facing the United States. As of 1998, the United States had already accumulated over 100,000 tons of spent nuclear fuel. This figure doesn't include the 2 million tons of radioactive clothing and medicines discarded and buried underground in the last twenty-five years. It also doesn't include the 100 million gallons of hot waste generated by the nuclear weapons program.

Thirty-six of the nation's 110 nuclear power plants have run out of room to store their waste. Between 1971 and 1986 152 accidents were documented in 14

In 1998, there were approximately 110 nuclear power reactors in the United States and a potential of 150 reactors available by the middle of the 21st century. In the year 2015, nuclear power could be supplying energy equal to that of 2 billion tons of coal per year. A few of the many advantages of nuclear power as an energy source follow.

- The United States has domestic uranium resources vast enough to support a huge nuclear power industry for many centuries.
- Uranium mining is environmentally preferable to strip-mining less energy intensive fuels such as coal or oil shale.
- One uranium miner's daily output equals that of twenty-six coal miners.
- A single truckload of refined uranium holds energy equal to that contained in four thousand cars, full of 100 tons of coal.
- Nuclear power is a proven technology that generates electric power at economic rates.
- Nuclear fuel can be stockpiled to keep several years supply in inventory at a plant; thus eliminating the risk of a strike.
- Nuclear power is safe. There have only been minor accidents involving humans and technology.
- The disposal of radioactive wastes is a manageable problem, involving comparatively small volumes of solid

Did You Know?

By the time 1 calorie of food reaches your table approximately 9 calories of energy have been used to get it there.

Each day, the average American uses energy equivalent to:

13.6	pounds of coal
3.3	gallons of oil
297.0	cubic feet of natural gas
3.7	kWh of hydro-electric power, and
0.7	kWh of nuclear power.

Light is one of the most important forms of radiant energy for living organisms. All life processes ultimately depend upon the ability of green plants to capture light energy and use it to produce food.

The amount of sugar that a green plant produces is directly proportional to the amount of light energy supplied to the leaves. Chlorophyll absorbs sunlight and convert it to a form of chemical energy. The chemical energy can then be used to produce sugar.

Since photosynthesis consumes less than 13% of the solar energy that reaches the earth, and about 28% is sufficient to operate the earth's heat machine, almost 72% of our solar energy or about 180,000 calories per square centimeter per year is returned to space.

Energy Expense Account

ENERGY COST OF EXERCISE	
SPORT OR EXERCISE	**TOTAL CALORIES EXPENDED PER MINUTE OF ACTIVITY**
Climbing	10.7-13.2
Cycling	
5.5 mph	4.5
9.4 mph	7.0
13.1 mph	11.1
Dancing	3.3-7.7
Football	8.9
Golf	5.0
Gymnastics	
Balancing	2.5
Abdominal exercises	3.0
Trunk bending	3.5
Arm swinging	6.5
Rowing	
51 strokes per minute	4.1
87 strokes per minute	7.0
97 strokes per minute	11.2
Running	
Short distance	13.3-16.6
Cross-country	10.6
Tennis	7.1
Skating	(fast)11.5
Skiing	
Moderate speed	10.8-15.9
Uphill, maximum speed	18.6
Squash	10.2
Swimming	
Breaststroke	11.0
Backstroke	11.5
Crawl (55 yards per minute)	14.0
Wrestling	4.2