Name ______________________ Date __________ Class __________

Enrich

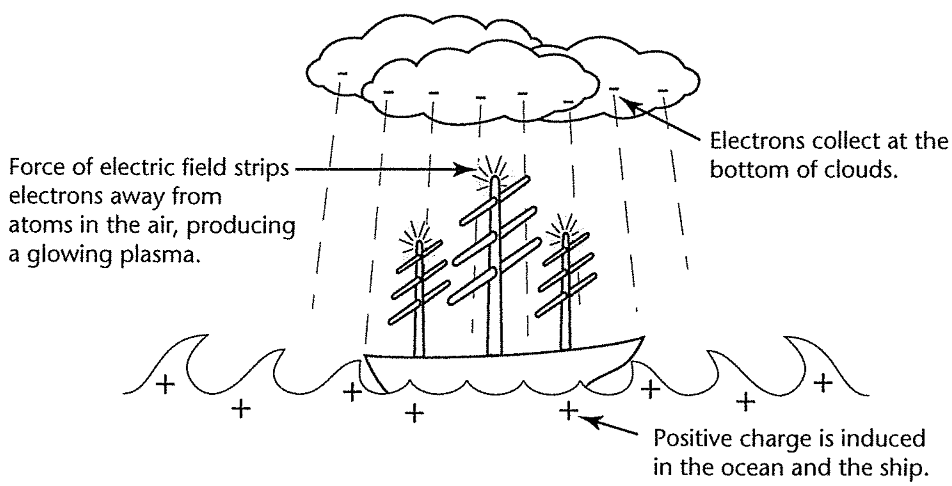
Electric Charge and Static Electricity

Read the passage and look at the diagram below it. Then use a separate sheet of paper to answer the questions that follow.

St. Elmo's Fire

St. Elmo's fire is a bluish glow sometimes seen during stormy weather on the tops of masts of ships, church steeples, and other tall pointed objects. Despite its name, St. Elmo's fire is not a flame and does not burn the objects on which it appears. It is a type of static discharge, like lightning. St. Elmo's fire can last for several minutes.

You know that electrons accumulate on the bottoms of clouds during thunderstorms and induce a positive charge in the ground. If enough charge builds up in this way, atoms in the air can be stripped of their electrons, producing a plasma. A *plasma* is a glowing gas with no net charge. It contains positive ions and free electrons. St Elmo's fire is a plasma. The color of light given off by a plasma depends on the gas involved. The air in Earth's atmosphere is mostly a mixture of oxygen and nitrogen gas. As a plasma, this mixture gives off a bluish glow.



1. An electric field tends to be strongest at the ends of pointed objects. How does this explain the fact that St. Elmo's fire appears on pointed objects such as the masts of ships?
2. Compare and contrast St. Elmo's fire with lightning.
3. The red glow of a neon light is also produced by a plasma. How might the glow of the light change if the neon gas inside it were replaced by air?
4. Why does St. Elmo's fire only occur during thunderstorms?
5. Based on what you have learned about lightning and St. Elmo's fire, do you think air is a good conductor of electric charge?

Name ______________________ Date ____________ Class ____________

Enrich

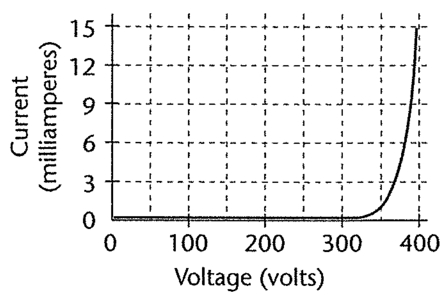
Electric Current

Read the passage and look at the graph below it. Then use a separate sheet of paper to answer the questions that follow.

Surge Protectors

A surge protector is a device used to protect computers and other electronic equipment from surges in current or voltage. An electric surge can be caused by a lightning strike on an electric line or when electronic devices that share a circuit are turned on or off. If you have computers in your classroom, they are probably plugged into a surge protector instead of directly into a wall outlet.

One way to protect electronic devices from high voltage is to use a varistor. A *varistor* is another name for a variable resistor. You have learned that a resistor is something in a circuit that resists current. A variable resistor, however, is designed to provide very low resistance at high voltage and very high resistance at low voltage. Thus, when a surge of electric current travels from the wall outlet to a surge protector, the resistance of the varistor suddenly decreases and current passes through the surge protector instead of through the computer (or other electronic device). At normal voltages, the resistance in the varistor remains high, and the current passes into the electronic device. The graph below shows how the current passing through a typical varistor changes with increasing voltage.



1. According to the graph, at about what voltage does current exist in the varistor?
2. Why do you think the graph shows a large, immediate increase in current after reaching a certain voltage, rather than a small, gradual current increase?
3. Suppose a surge protector had a very low resistance at all voltages. What do you think would happen?
4. Suppose a surge protector had a very high resistance at all voltages. What do you think would happen?

Name ______________________ Date __________ Class __________

Enrich

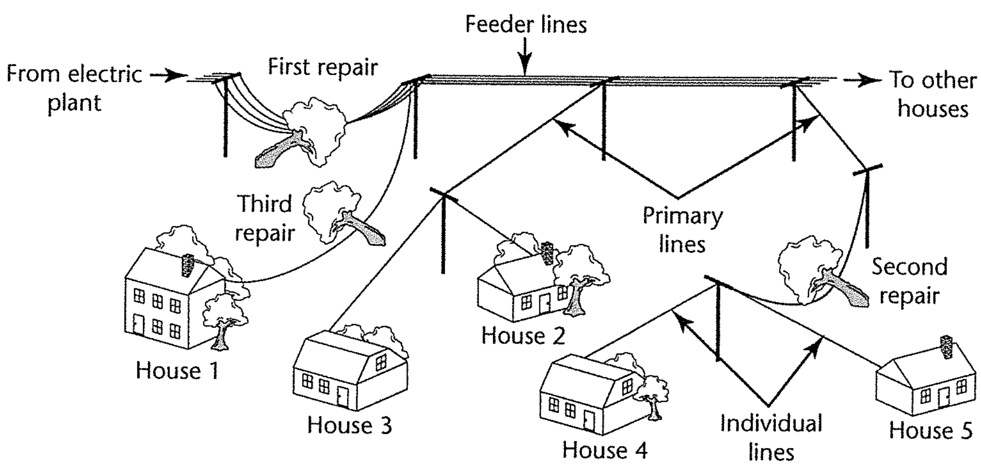
Electric Circuits

Read the passage and look at the diagram within it. Then use a separate sheet of paper to answer the questions that follow the passage.

Electrical Energy Outages

An *electrical energy outage* is the loss of electric current to a home, business, neighborhood, or even an entire city. Electric current is fed into homes and businesses with heavy-duty wires called lines. Feeder lines deliver current to several thousand homes and businesses. Primary lines branch off of feeder lines and deliver current to between five and thirty buildings. Finally, individual lines to homes and businesses branch off of primary lines.

An electrical energy outage can occur when any of these lines is damaged or broken. The diagram below shows a simplified version of three electrical energy outages due to fallen trees.



To repair the circuit, workers would first repair the feeder lines. This would restore electric current to houses 2 and 3. Next, the primary line would be repaired, restoring current to houses 4 and 5. Finally, the individual line to house 1 would be prepared.

1. If the primary line had been repaired first, would electric current have been restored to houses 4 and 5? Explain.
2. Suppose that a week later the current in house 4 goes out, but the current in house 5 stays on. Where should a repair worker look for a damaged line?
3. The next week, the electric current in both houses 2 and 3 goes out, but it stays on in houses 1, 4, and 5. Where should a repair worker look for a damaged line?
4. Suppose that houses 1 through 5 were connected by a series circuit. What would happen if one of the lines in the circuit was damaged?

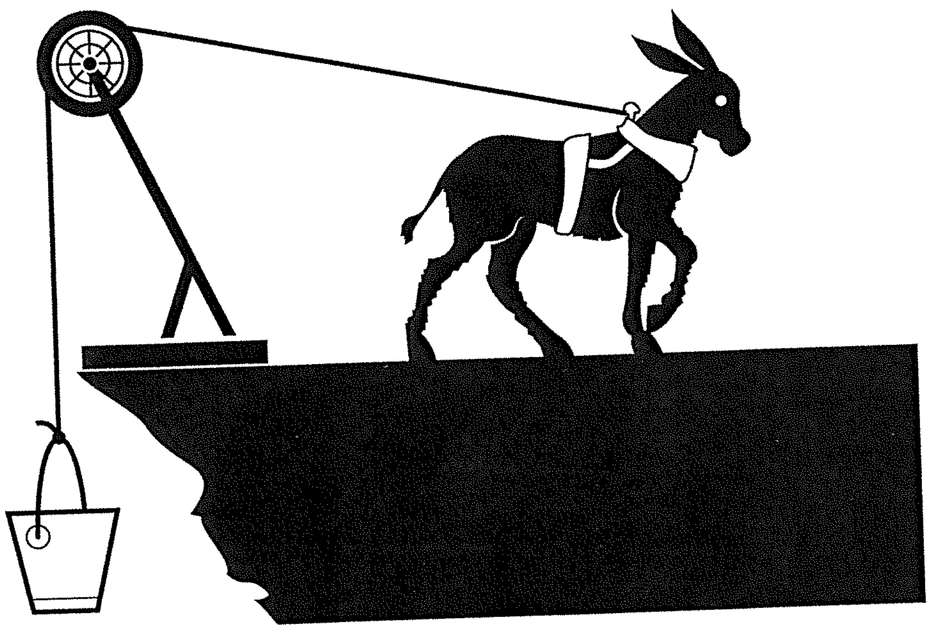
Name ______________________ Date ____________ Class ____________

Enrich

Electric Power and Safety

Read the passage and look at the diagram above it. Then use a separate sheet of paper to answer the questions that follow the passage.

James Watt and Horsepower



James Watt was a Scottish engineer who invented a practical and efficient steam engine in the late 1700s. To tell people about how powerful his steam engine was, Watt decided to compare it to the power of the horses that were used to do heavy work at the time. Watt observed horses at a local mine using a rope to lift buckets of coal up from the mine at a rate of 220 pounds of coal 100 feet in 1 minute, or 22,000 foot-pounds of work in 1 minute. To overestimate, the horses' work, he increased that number to 33,000 foot-pounds of work in 1 minute. That unit of measurement he called "1 horsepower." The unit of *horsepower (hp)* is still used today in the United States when referring to the power of engines.

In honor of the work of James Watt, the metric unit of power was named the watt. Watts (W) or kilowatts (kW) are used when referring to the power of electric devices. You can convert horsepower to watts by using this equation: 1 hp = 746 W.

1. What is 1 horsepower equal to in the metric system?
2. A lawnmower is advertised as having 1.5 horsepower. What is the lawnmower's power rating in watts?
3. Suppose the unit horsepower actually replaced watt as the unit of power for electric appliances. What would the power rating of a 500-W refrigerator be in horsepower?