

Construction Set Curriculum

Grades K-4

Student Edition

Center for Mathematics Science and Technology

Center for Renewable Energy

Illinois State University

Construction Set Curriculum

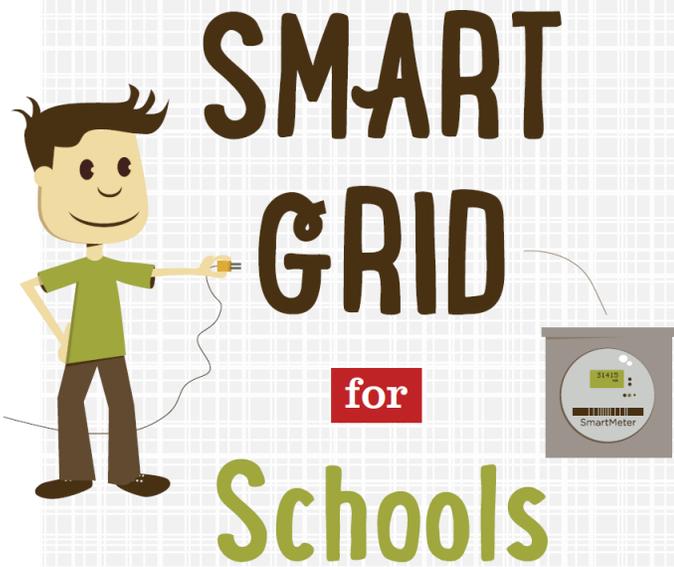
Grades K-4

Look around your classroom for things that run on electricity.

How do we make electricity?

How does it get to your school?

Lets find out.



Almost all work used to be done with muscle power. They did not have machines or power tools. Animals helped to make work easier but both humans and animals get tired quickly.

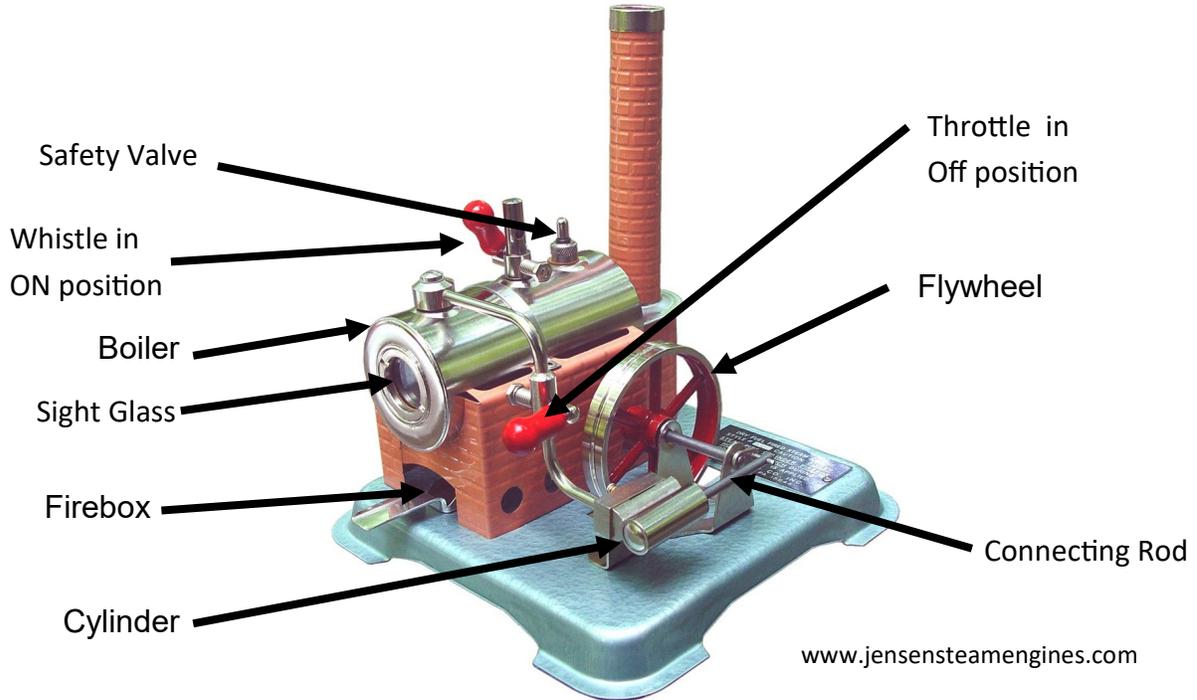
About 2300 years ago inventors started making water wheels to crush grain, saw wood, pump water, and do many other jobs. About 1000 years ago the Dutch started making windmills to do many of the same tasks and to pump water.



<https://web.uml.edu/gallery/var/albums/Tsongas-Industrial-History-Center/Re-Inventing-America/Old-Sturbridge-Village/DSCN0899OSV%20waterwheel.JPG?m=1397825962>

Steam Power (1769-1820): Exploration

About 250 years ago James Watt invented the steam engine. How do you think a steam engine works?

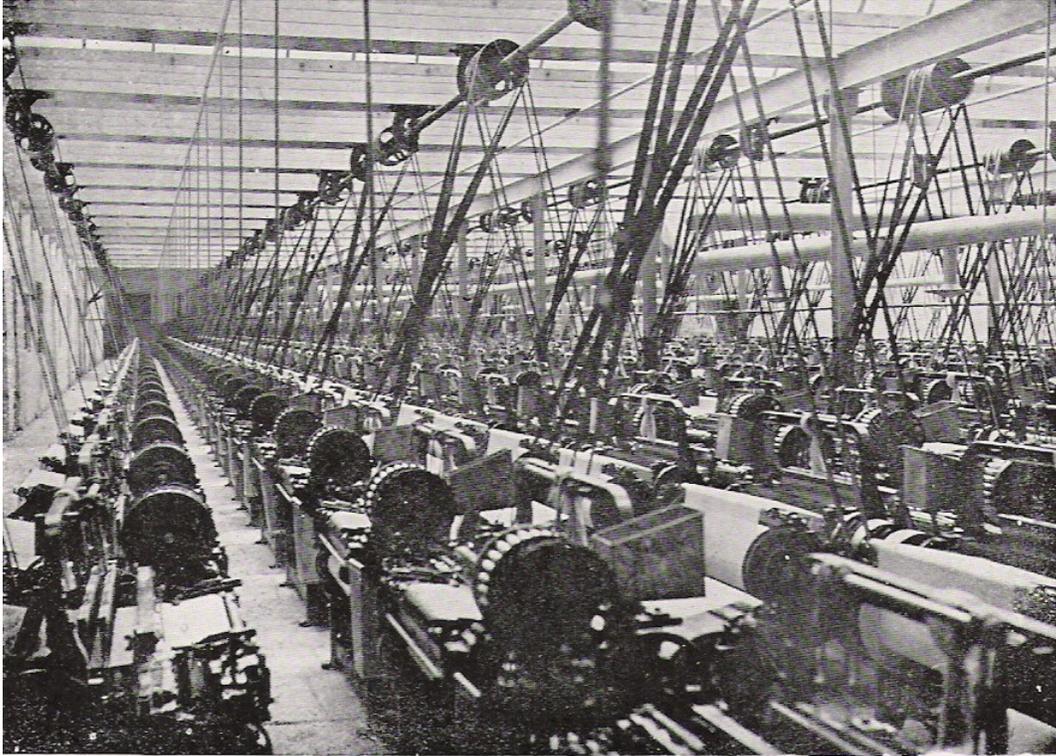


Your teacher will run the steam engine. Watch what happens.

Can you explain how it works?

Steam Power (1769-1820): Discussion

1. What happens to the water as the fuel burns?



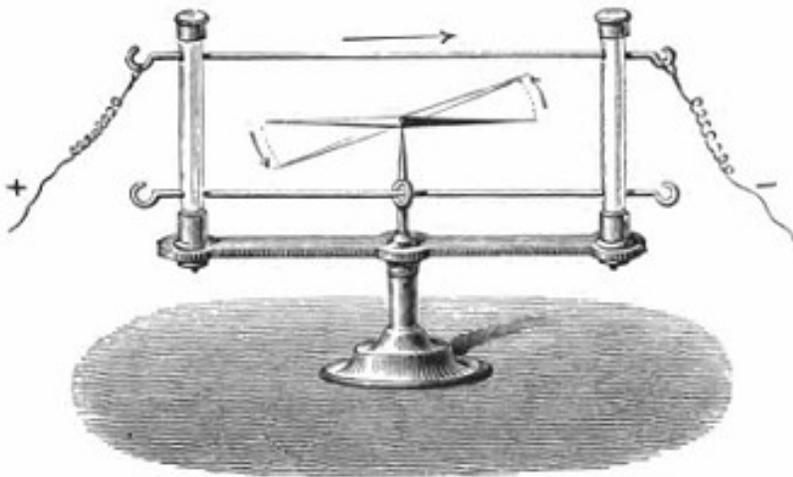
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2. This is an old factory powered by a steam engine.
Would you want to work in this factory?

3. Why were steam engines better than wind or water power?

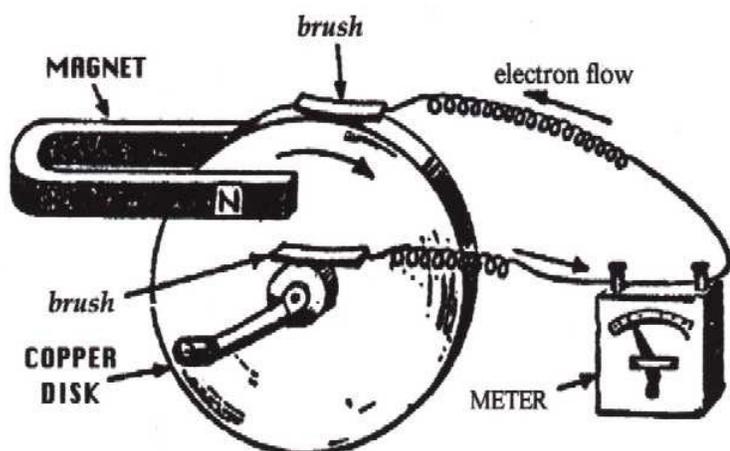
Linking Magnetism & Electricity (1820-1831): Exploration

About 200 years ago Andre-Marie Ampere figured out how to make magnets using electricity. In 1831 Michael Faraday discovered you could make electricity by moving some wires past a magnet. He wrote "Faraday's Law" that describes how electricity and magnetism work together.



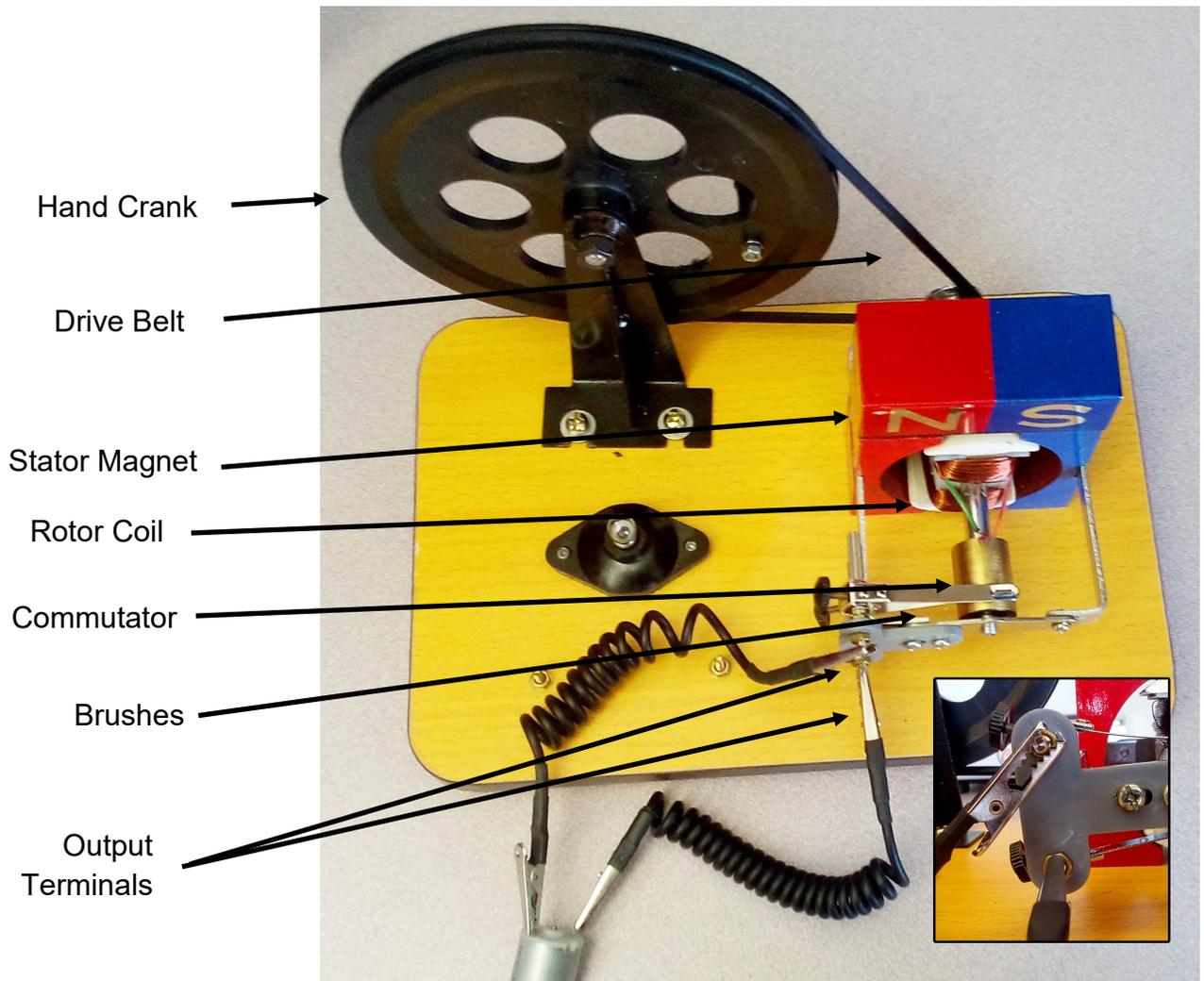
Electricity can make a magnet....

<https://c8.alamy.com/comp/MR6HPR/reconstruction-of-oersteds-experiment-of-1819-when-he-discovered-that-a-magnetised-needle-could-be-deflected-by-an-electric-current-dated-19th-century-MR6HPR.jpg>



<https://emediapress.com/wp-content/uploads/2017/05/faradisk1.gif>

...and a magnet can make electricity.



1. Turn the crank on the generator. What part spins and what part does not move?
2. Connect two wires from the generator to the motor.



2. Turn the crank. What happens?

3. Turn the crank slowly. What happens?

4. Turn the crank fast. What happens?

Linking Magnetism & Electricity (1820-1831): Discussion

1. How do you think the generator is making electricity?

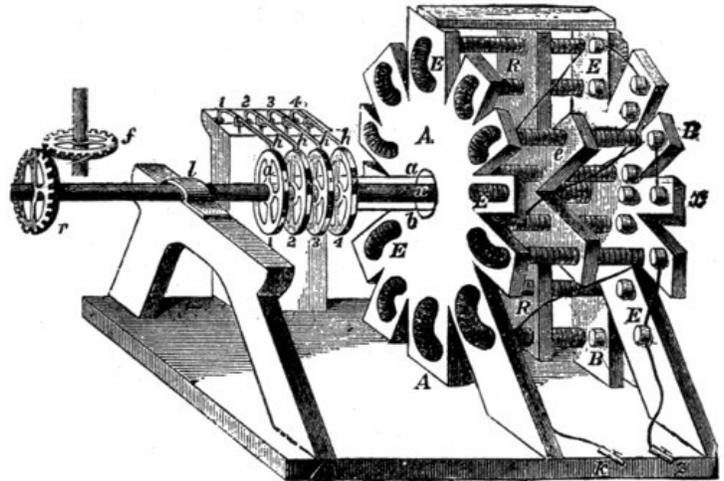
2. How does electricity get from the generator to the motor?

Inventors soon hooked up generators to their steam engines to make electricity. Jacobi invented the electric motor in 1835.



En.wikipedia.org

Moritz von Jacobi



https://www.gutenberg.org/files/41538/41538-h/41538-h.htm#SecVI_4

The Jacobi Motor in 1834



<http://www.ilocis.org/documents/images/tex09fe.gif>

Modern factories with electric machines are much safer for the workers than the old machines powered by steam engines and belts.

Electric Lights (1860-1900): Exploration

For about 50 years electricity was only used in factories.

Nobody thought they needed electricity in their houses until the invention of the light bulb.



https://image.pbs.org/poster_images/assets/amex27_img_edlamp.jpeg.resize.710x399.png

1. Hook the 2 wires to the screws by the light bulb.
2. What happens as you turn the crank?

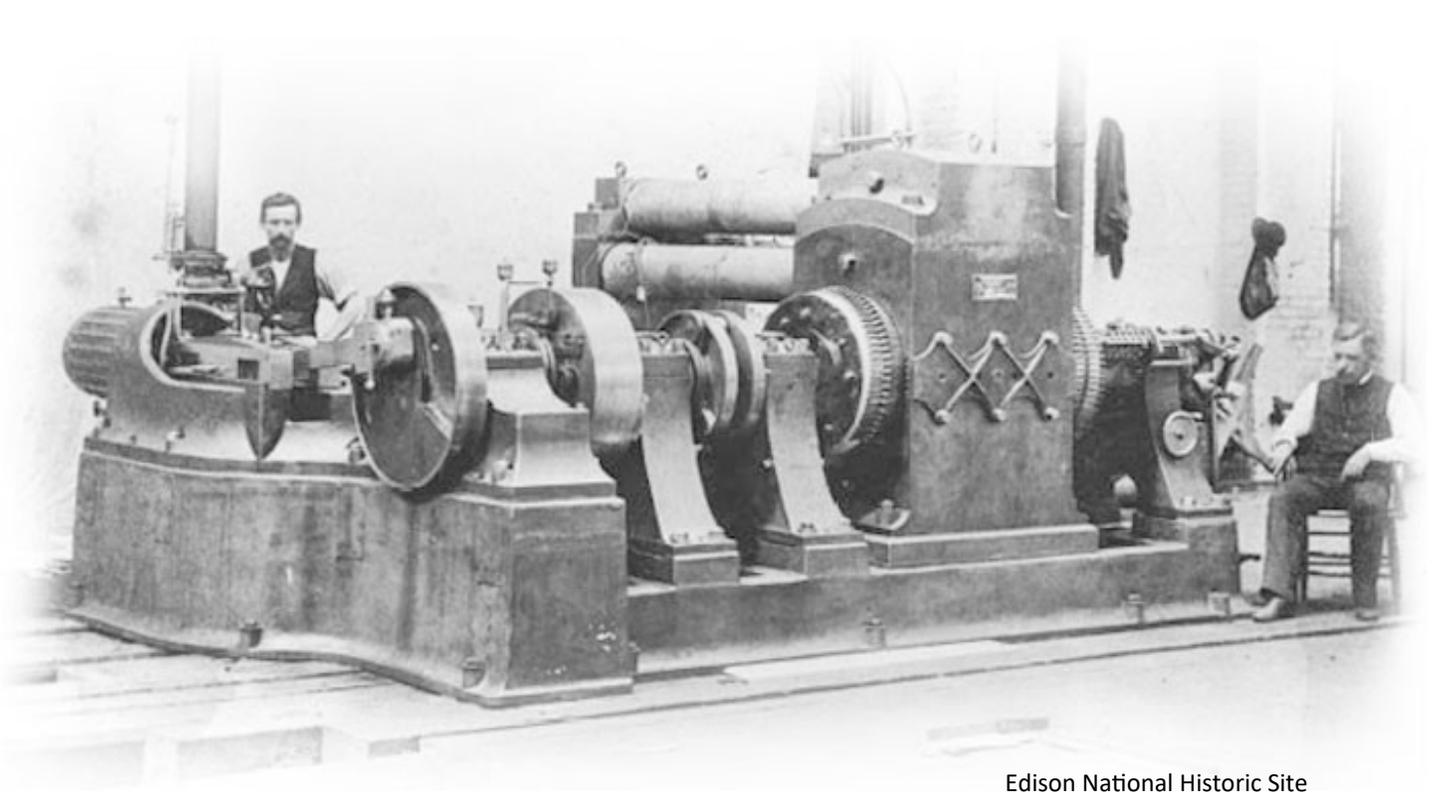
Electric Lights (1860-1900): Discussion

1. What happens when you turned the crank fast?
2. What happens when you turn the crank slowly?
3. How did the electric lightbulb change the way people lived?
4. Why must you never allow the two bare ends of the wires to touch each other?

IMPORTANT !!!!

You will not need the generator any more. Put it away.

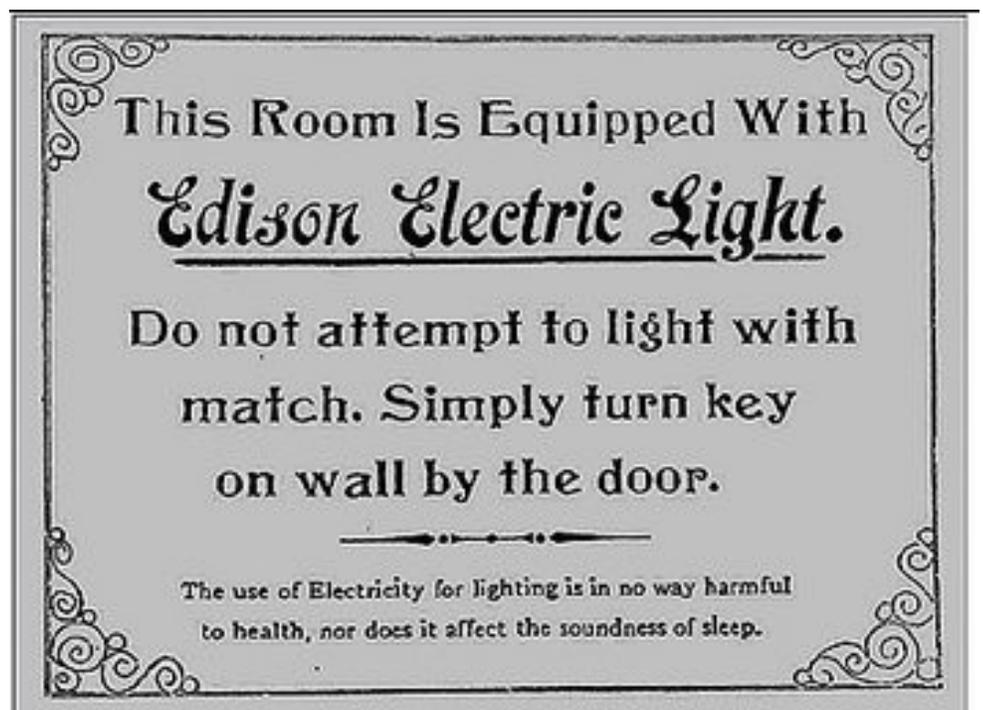
In 1841 Frederik de Moleyns made the first light bulb. Thomas Edison improved the bulb and made a generator and “power grid.” He put electric light bulbs at Pearl Street Station in New York City in 1882. This was one of his huge generators.



Edison National Historic Site

This sign helped people learn how to use the new light bulbs.

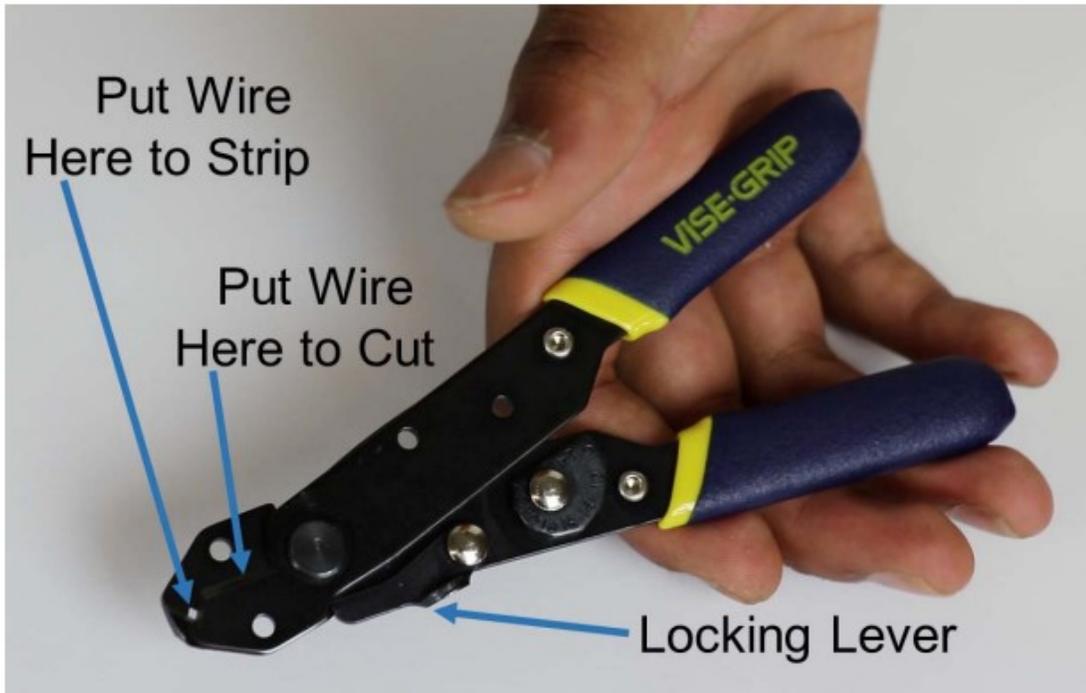
http://news.bbc.co.uk/local/dorset/hi/people_and_places/history/newsid_8155000/8155528.stm

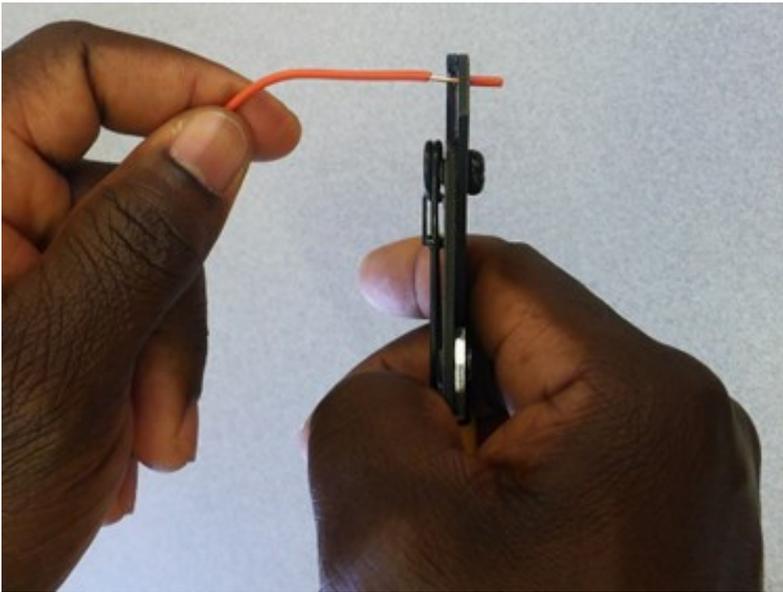


New Skills for Electricity: Exploration

There are a few things you need to know before you can get started hooking up your grid.

1. Your teacher will show you how to cut and strip wires.



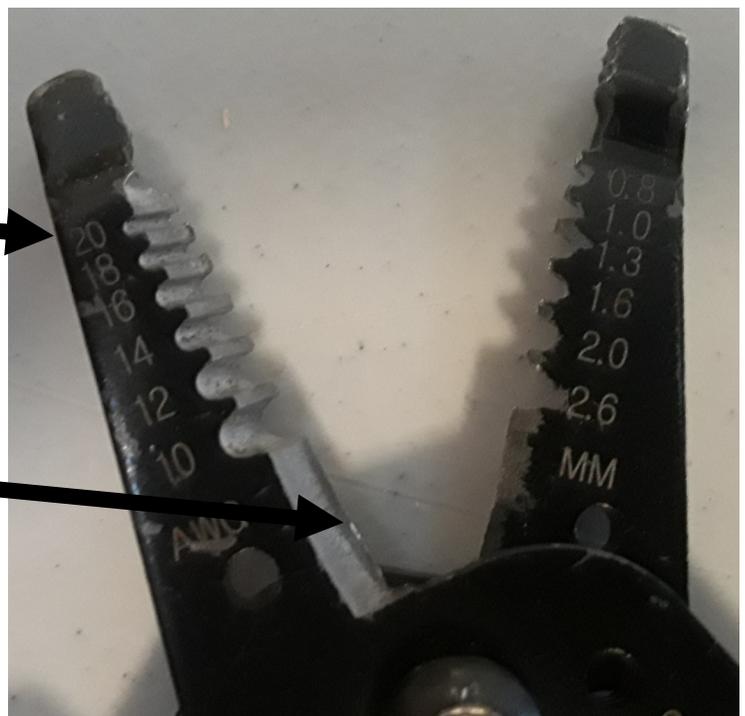


Your wire tool
might look like
this:



Use this notch to
strip the wire.

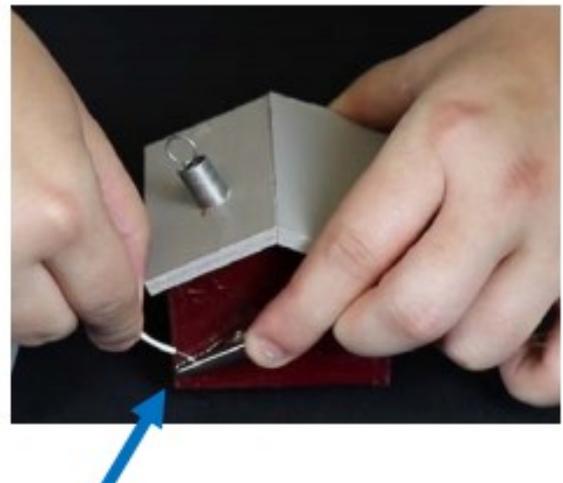
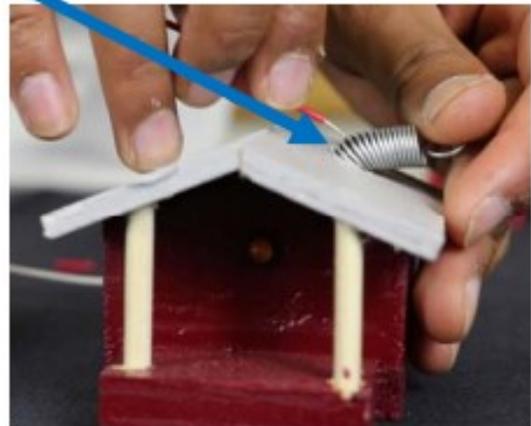
Cut here



2. The color of the wire is very important. Red, Black, and Blue wires connect to springs. White wires connect to alligator clips.

3. To connect wires, push the spring to the side or pull it down. Stick the bare end of the wire into the spring.

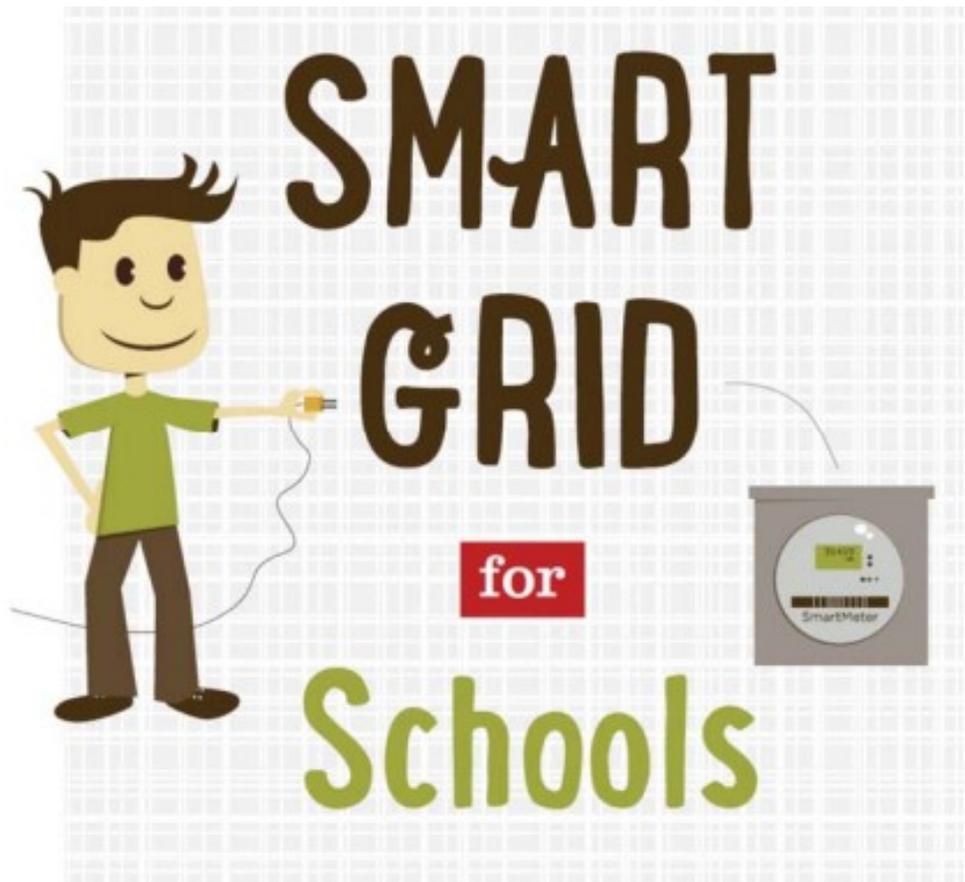
ONLY RED, BLACK, or BLUE wires connect to springs



ONLY WHITE wires connect to alligator clips

New Skills for Electricity: Discussion

1. Show your teacher how to cut a wire.
2. Show your teacher that you can strip the plastic insulation off a wire.
3. Why is it so important to use the right color of wire?



Electricity to Your House (1900-1920): Exploration

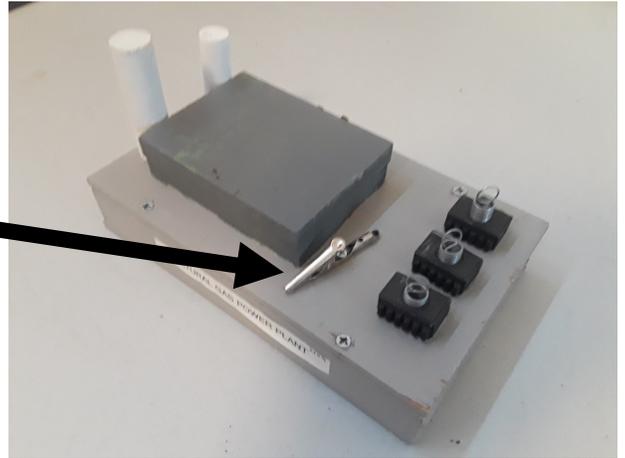
1. Pick a power plant and put a red, black, or blue wire on one of the springs.



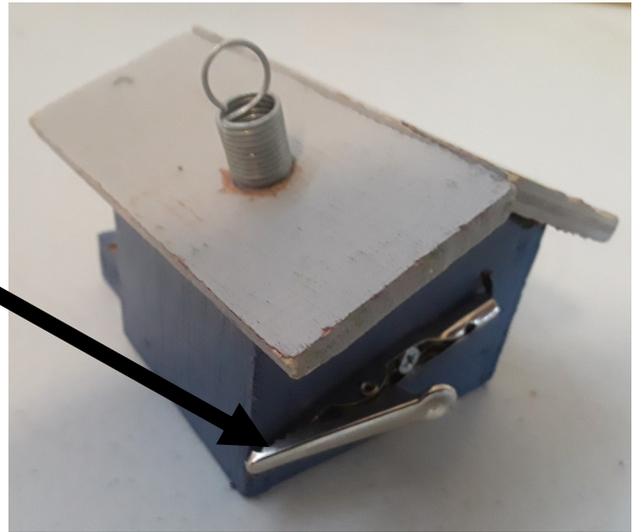
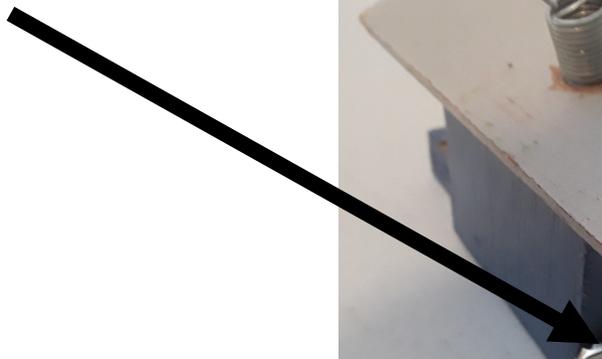
2. Pick a house. Put the other end of the colored wire on the spring.



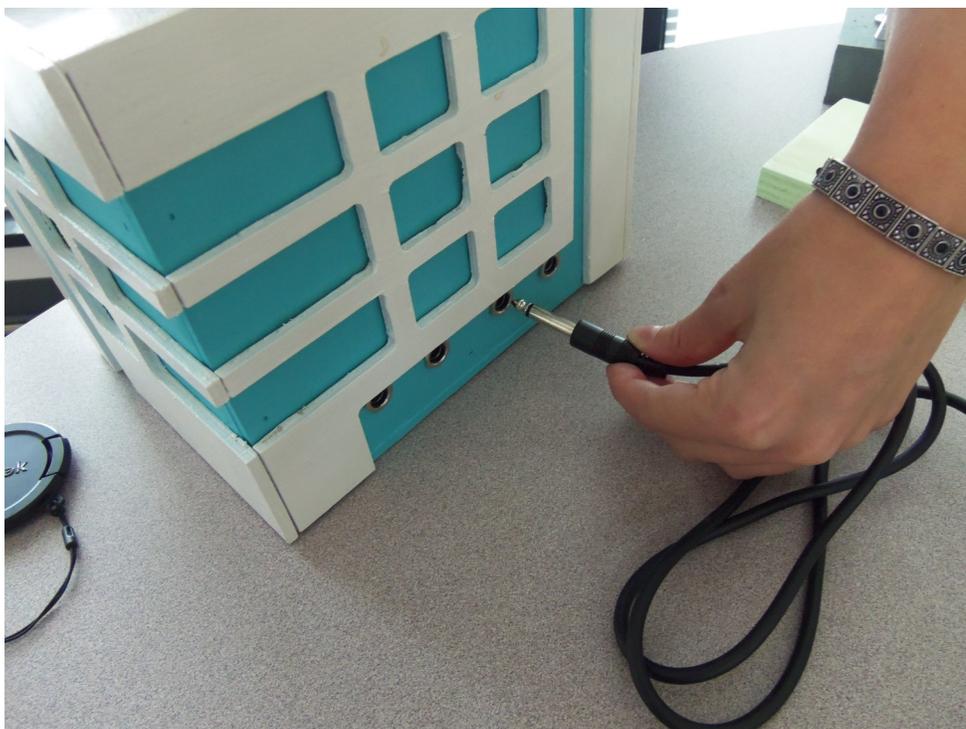
3. Put a white wire here.



4. Connect the other end of the white wire here.



5. Your teacher will check it and turn on the power.



6. Did your home get power?



Electricity to Your House (1900-1920): Discussion

1. What type of power plant did you use?

- ◇ Natural Gas
- ◇ Coal
- ◇ Nuclear
- ◇ Renewable



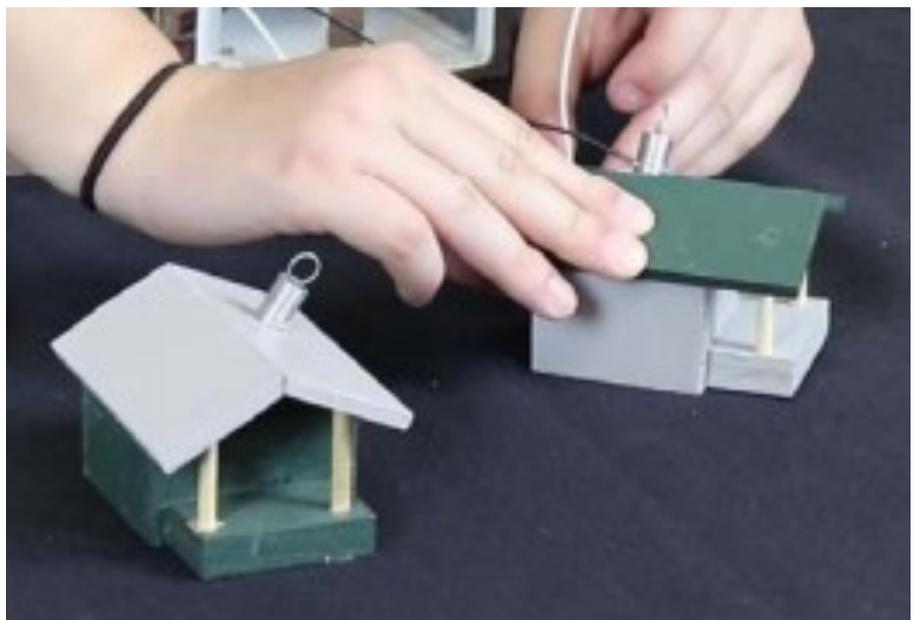
www.energy.gov/eere/wind/how-do-wind-turbines-work

2. Have you seen a wind farm?

3. What is the best kind of power plant?

One Power Plant, Lots of Houses (1920-1940): Exploration

1. Unplug the power.
2. Connect a colored wire from the spring on the house to the spring on another house.
3. Connect a white wire from on alligator clip to the other.



4. Call your teacher to check your wires.

Did both homes light up? Why or why not?

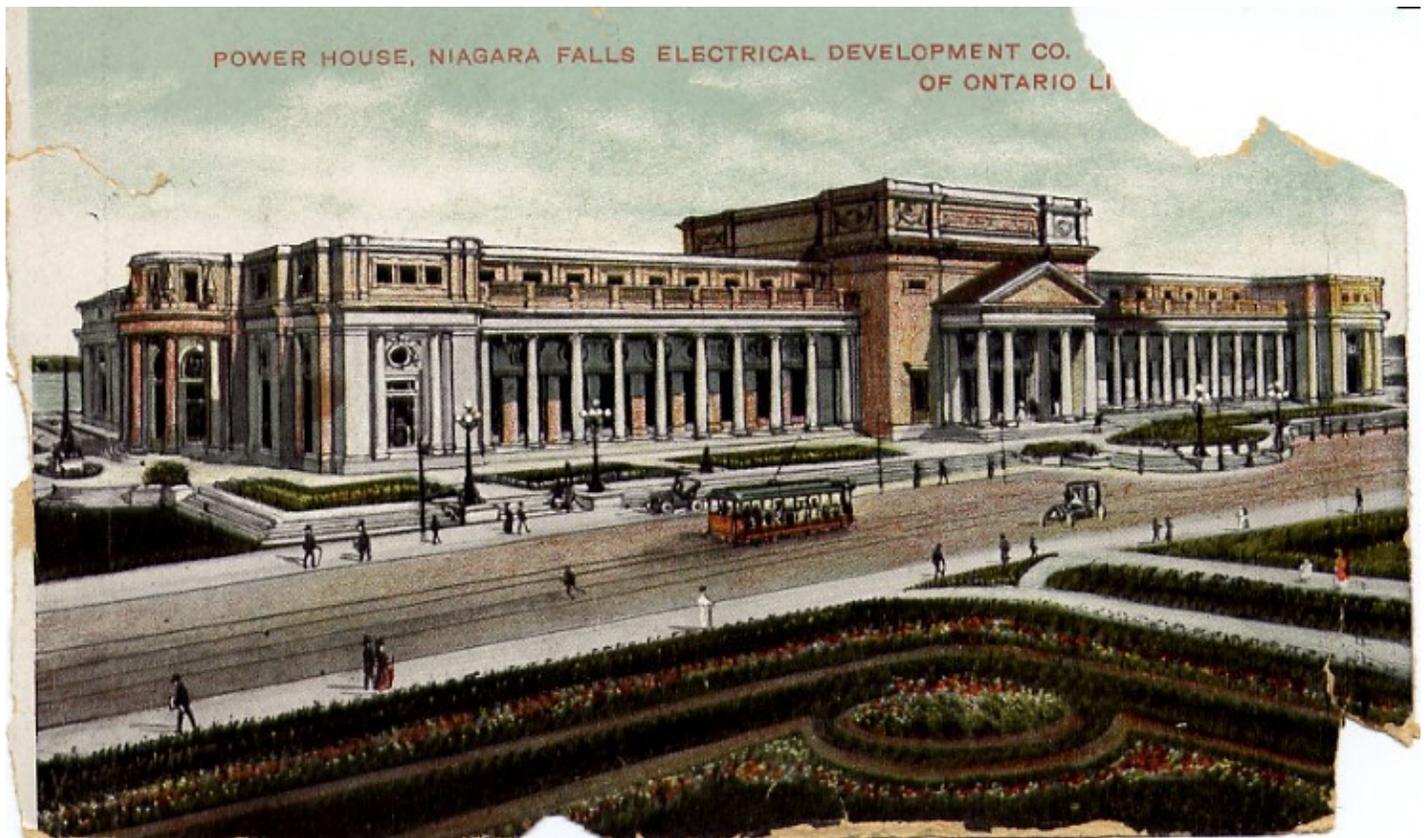
One Power Plant, Lots of Houses (1920-1940): Discussion

1. Has your electricity ever shut off at your house? Did the whole neighborhood go dark? Why?

2. Why does every house not have their own generator?



Thomas Edison, Frank Sprague, George Westinghouse and Nicola Tesla were all inventors. They figured out how to get electricity to your house.



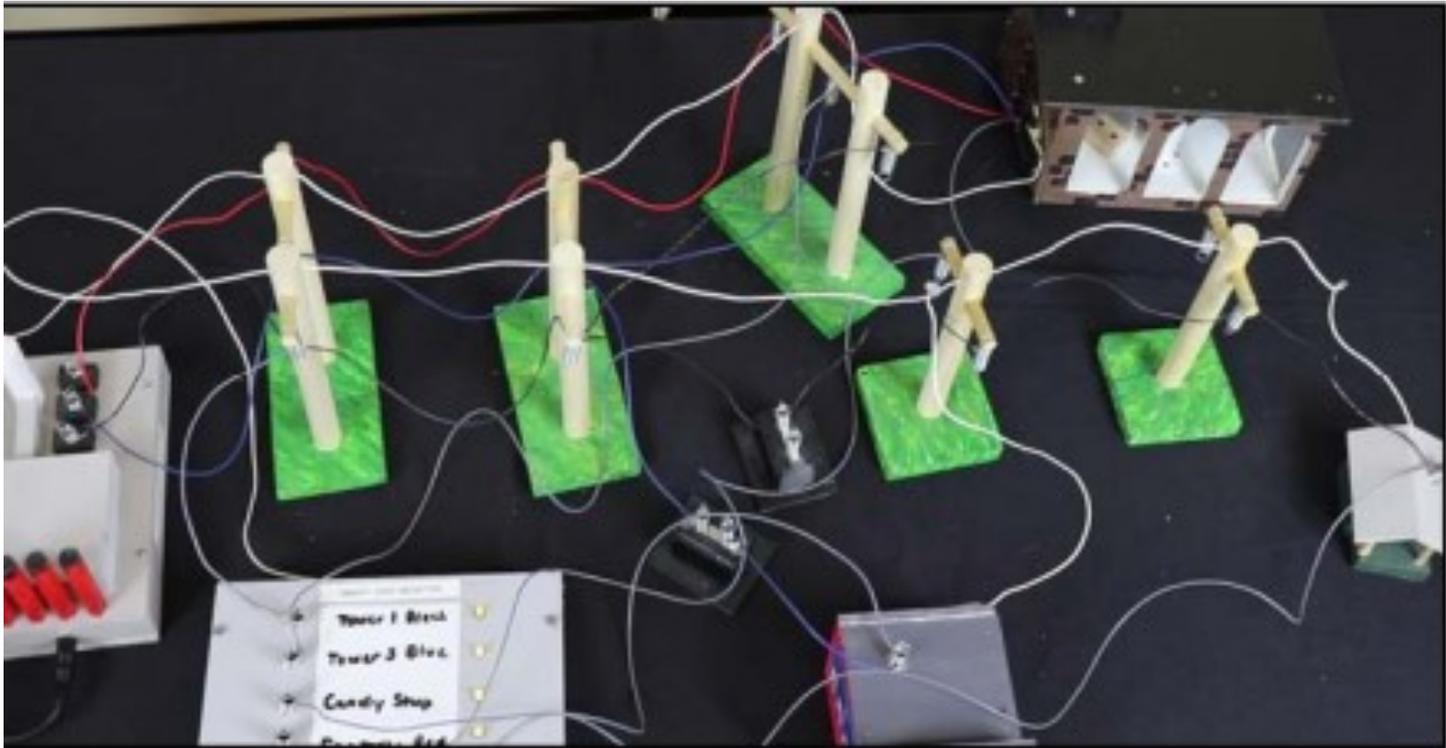
<https://www.niagarafallsmarriott.com/niagara-seasons/toronto-power-generating-station/>

High Voltage (1886-1917): Exploration

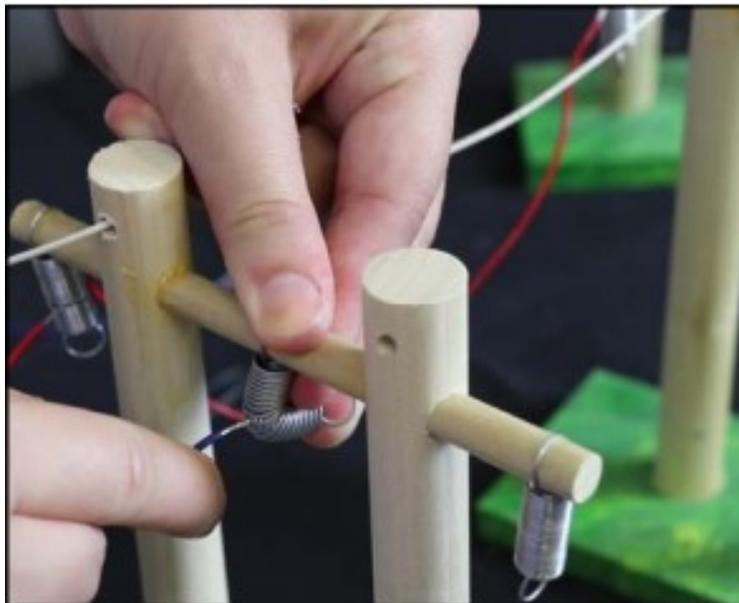
1. Unhook all of your wires.

2. Put the power plant at one end of your table.

3. Put your homes at the other end of the table.



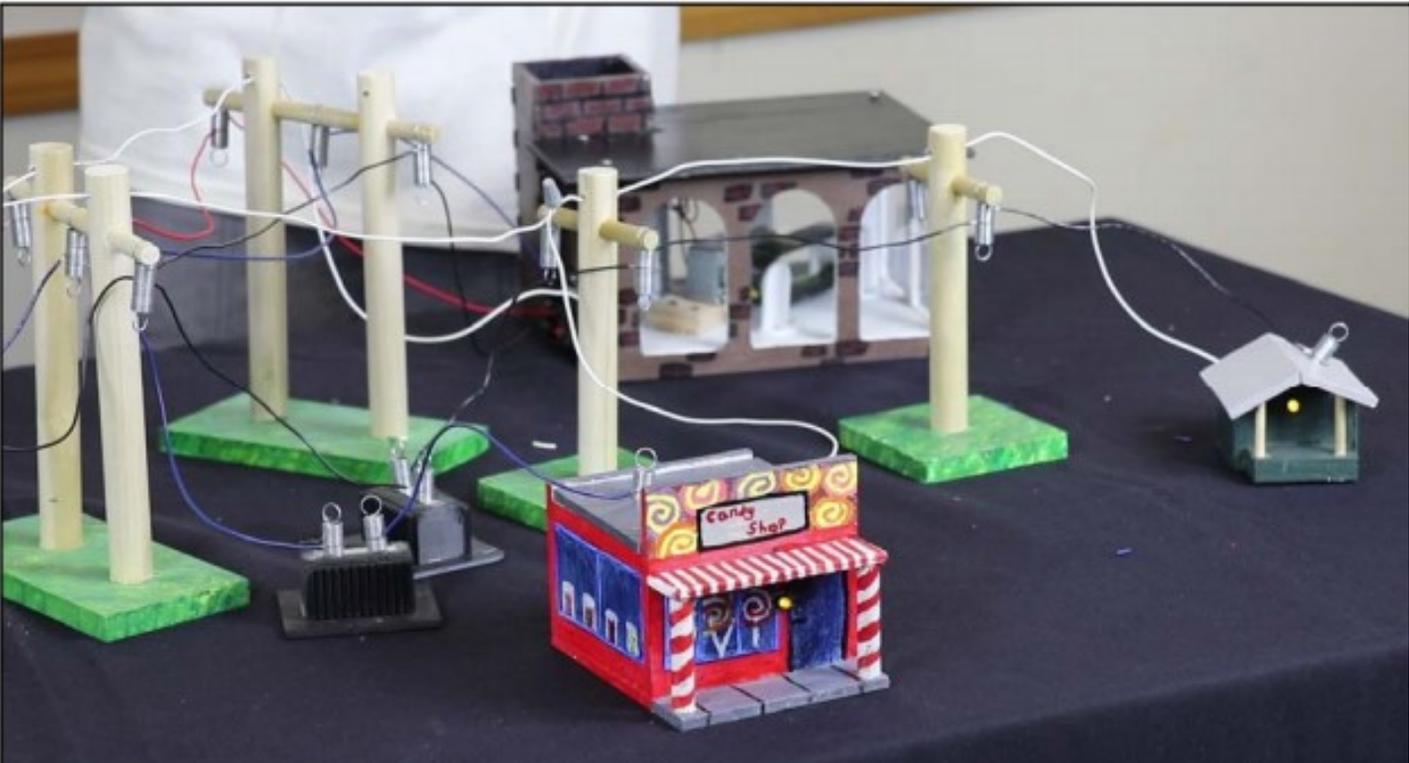
4. Hook up a colored wire on the tall poles.



5. Put in a transformer.



6. Hook up shorter poles.



7. Hook a colored wire from the last pole to your house.
The pole closest to the house should have a bucket transformer on it



8. Connect a white wire from your house to the power plant. It goes through the holes in the top of the poles.



9. Call your teacher to check it.

Did your homes light up? Why or why not?

High Voltage (1886-1917): Discussion

1. Did you put in transformers?



https://energyeducation.ca/encyclopedia/Electrical_substation



electrical-engineering-portal.com

2. Is there a transformer by your house?



<https://internationalelectricalsuppliers.weebly.com/>

Electric companies made long power lines to connect lots of customers. But, long power lines make it hard to find problems.



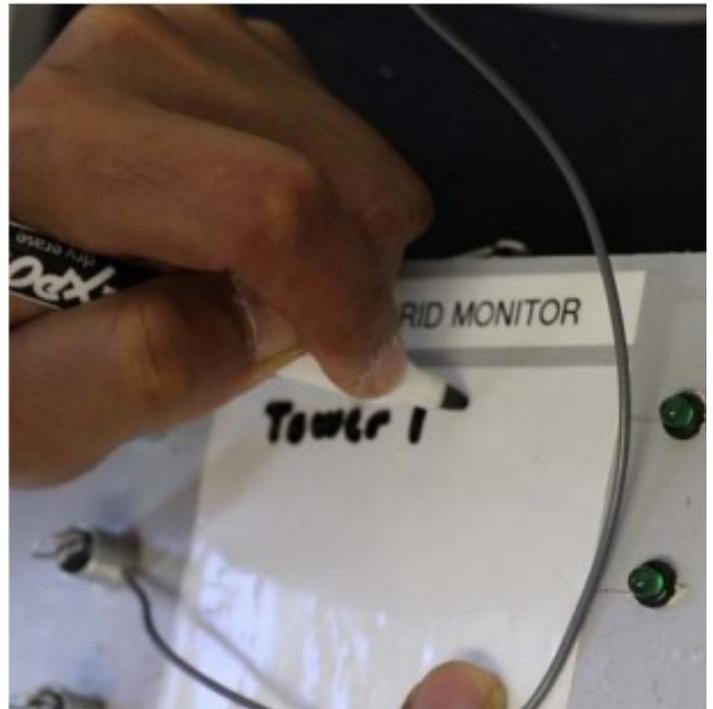
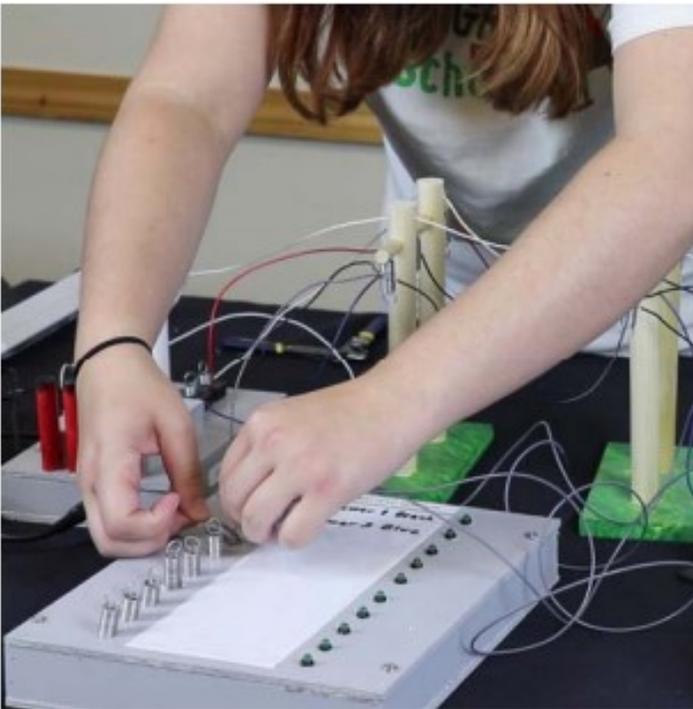
<https://woodpoles.org/>



PHOTOGRAPH BY STATE ARCHIVES OF NORTH CAROLINA

Monitors (1950-2000): Exploration

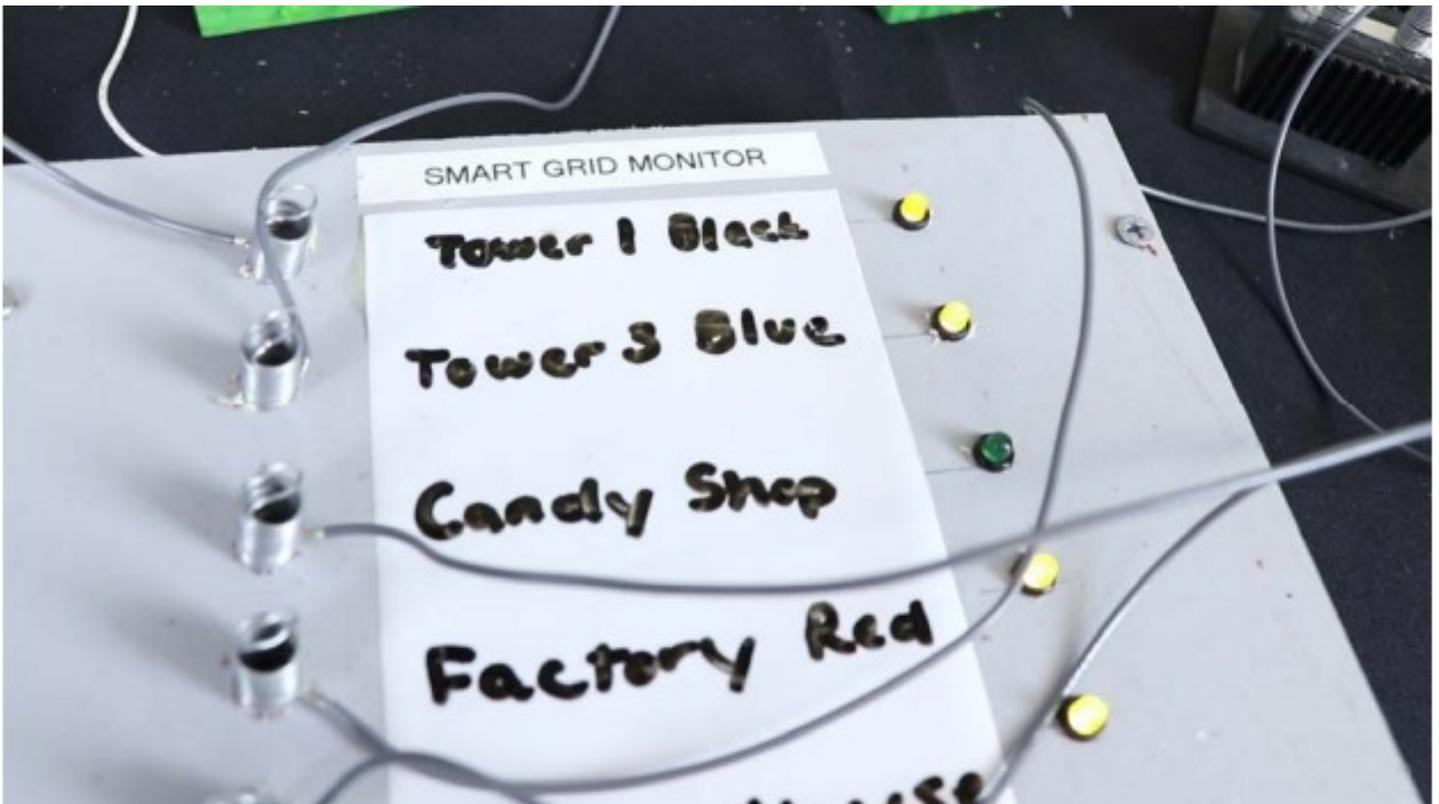
1. Connect a white wire from the alligator clip on the power plant to the alligator clip on the monitor.
2. Connect a gray wire to any spring on your grid.
3. Connect the other end of the gray wire to the top spring on your monitor.



4. Write the location of where the gray wire it attached. Use the dry erase marker.

Monitors (1950-2000): Discussion

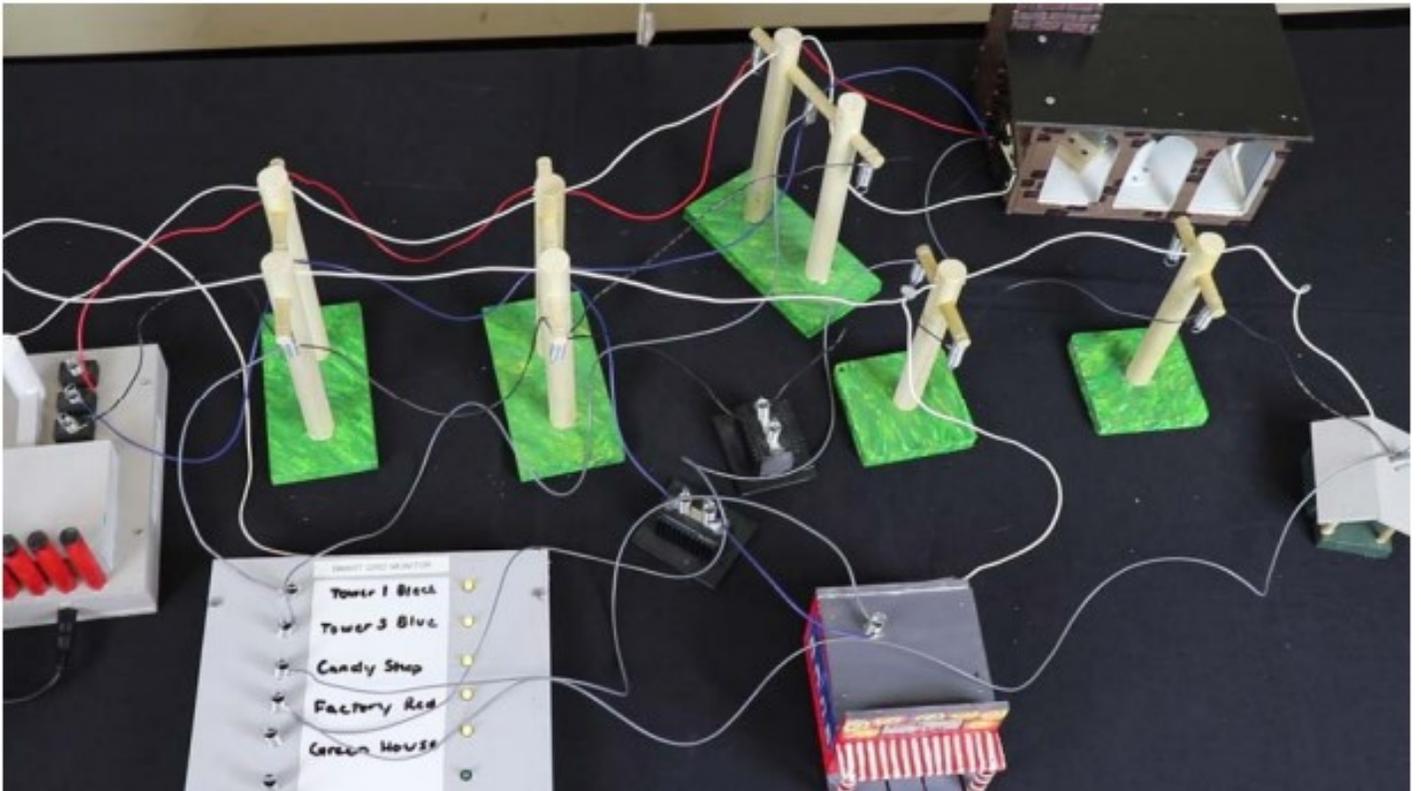
1. What happens when you connect the gray wire to the monitor?
2. What does the Smart Grid Monitor tell you?



In 1953 American Electric Power built a grid system that connected seven states. This grid allowed companies to share power plants and cover demand in case one of them went off line.

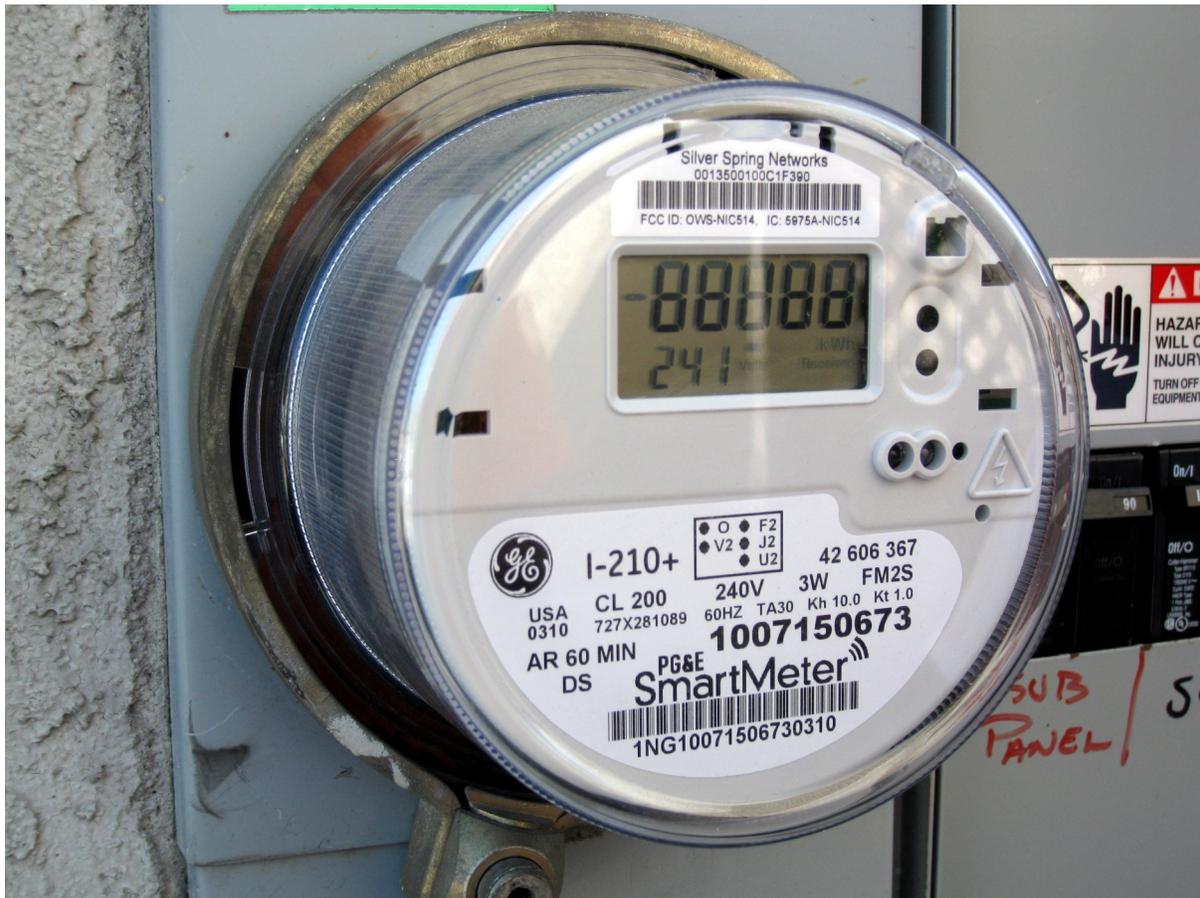
Smart Grid (2000-2020): Exploration

1. Hook up more gray wires on your Monitor and grid.
2. Your teacher is going to take off a wire.
3. Find the problem using your Smart Grid Monitor.



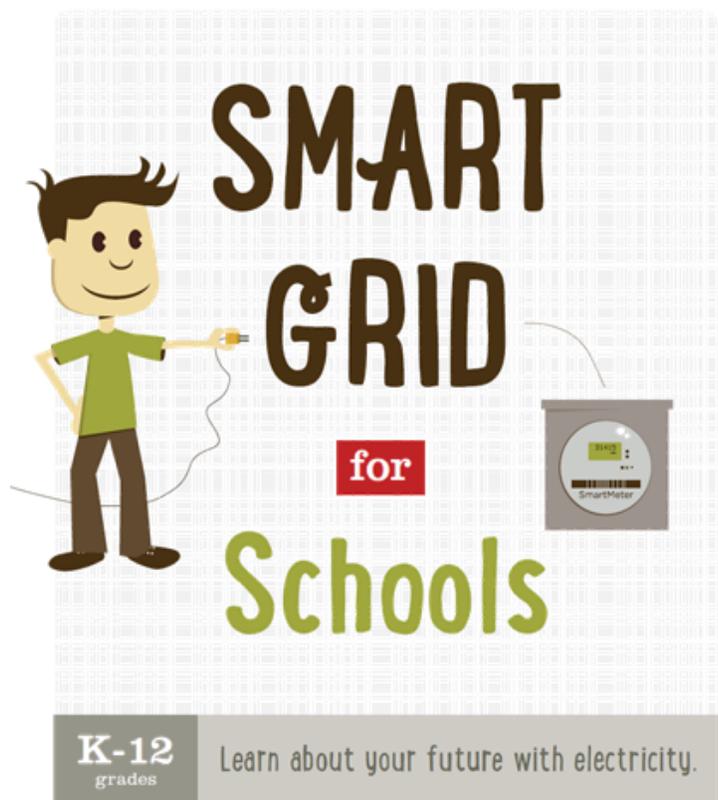
Smart Grid (2000-2020): Discussion

1. How does a power company know if a customer's power goes off?
2. With Smart Meters how does the power company know if a customer's power goes off?



Follow Up Discussion Questions

- What did the students like about making their electrical grid?
- Tell your students about the power plants in your area.
- Take your class outdoors and point out the wires and transformers near your school.
- Remind your students to NEVER play around wires.
- Draw a picture of your school with a wind turbine or solar panels. Would it work?
- How could you save electricity at your home or school?
- Are you going to drive an electric car? Why or why not?



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