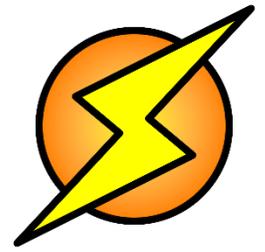


CHARGED UP



SETTING THE SCENE

Energy is a very important staple in today's society because of how much we rely on electrical technology. Sometimes we need to store energy for some of the objects we use everyday.

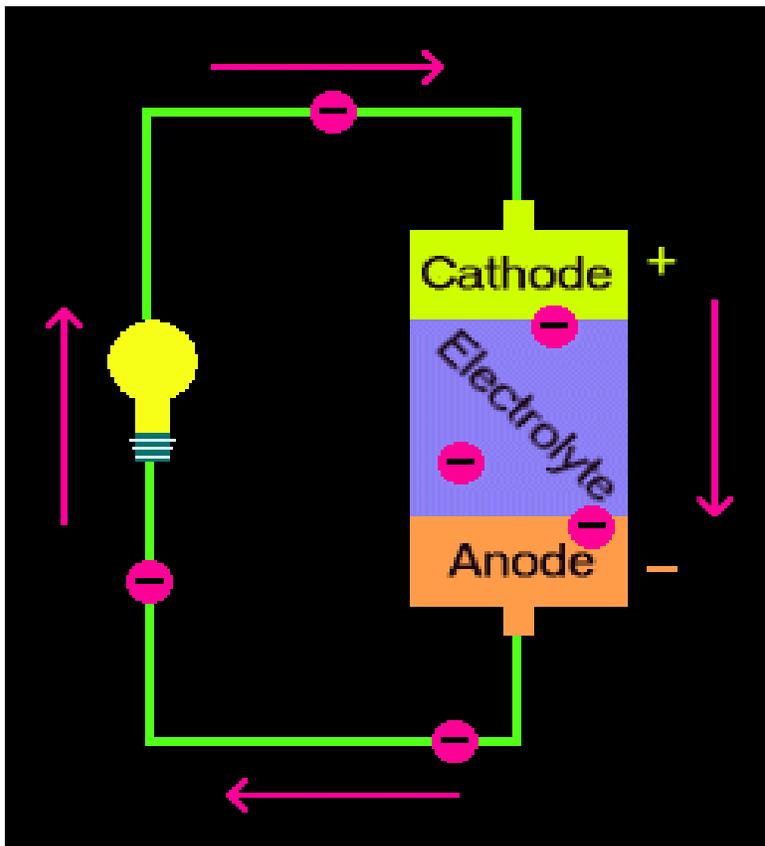


Electricity is being created constantly in many different ways to keep up with the high demand. With all the energy being created, there needs to be a way to store all of it. Two of the main objects that store charge are batteries and capacitors.



Batteries are small cells that have a positive side and a negative side. Inside of them, there is a chemical reaction that occurs very slowly, but creates a constant stream of **electrons**, a particle that carries negative charge, used primarily to create electricity. The positive side gives up electrons, while the negative side accepts

them. Between the two sides, there is an electrolyte that causes the reaction to occur.



Definitions

battery

a cell or container in which chemical energy is converted into electrical energy and is used as a source of power.

proton

particle that carries positive charge (+)

electron

particle that carries negative charge (-)

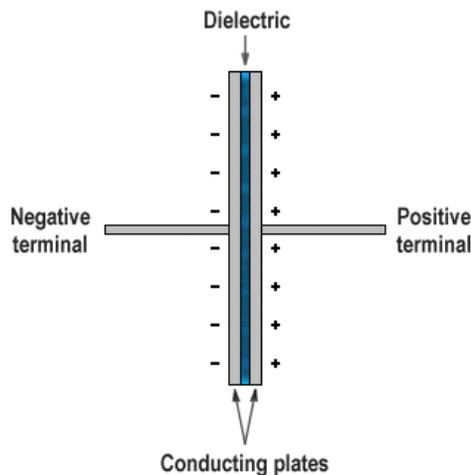
electrolyte

a substance (as an acid or salt) that when dissolved (as in water) conducts an electric current

Do these batteries have an effect on the environment?

Another technology that is able to store electrical energy is a **capacitor**.

All capacitors have two capacitor plates with a **dielectric** in the middle, which electrons cannot pass through. One **capacitor plate** becomes more negatively charged and the other plate becomes more positively charged. A capacitor cannot create their own electrons, so they must be charged by an outside source (a battery, a wall outlet, etc.). These electrons are then stored on the two plates and can be released later.



Definitions

capacitor

a device that stores electrical energy

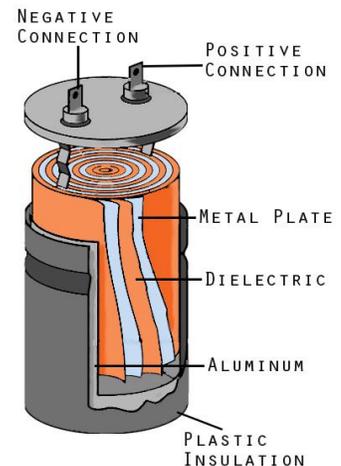
capacitor plate

electrical conductor

dielectric

nonconductor or insulator

Although batteries and **capacitors** work differently, they both store electrical charge. Batteries can produce new electrons but capacitors only store electrons. Unlike batteries, which slowly create chemical reactions and release its energy, capacitors are designed to release their energy quickly. They come in many shapes and sizes, which affects how much charge or electrical energy it is able to store.

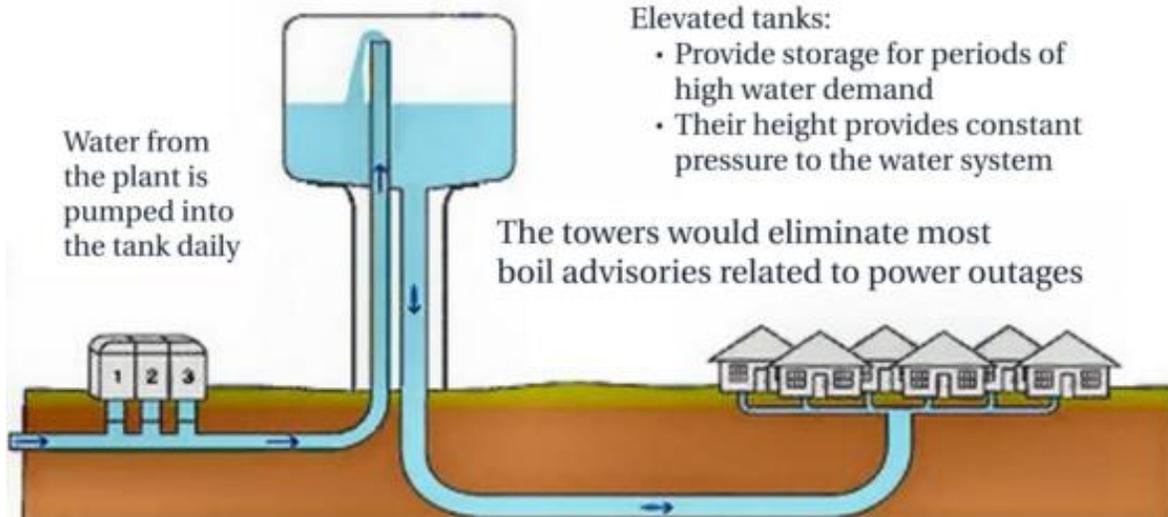


How might we use capacitors in our everyday lives? Guess a few technologies that might use them?

A capacitor functions like a water tower. A water tower “stores” water pressure and excess water when the water system pumps more water than a town needs. The excess water stored in the tower flows out of the water to maintain the pressure when needed.



How the Storage Tanks Work



Like a water tower, a capacitor stores electrons and can release them later. Think of the capacitor plates as the tower and the electrons as the water and pressure.

As water is being pumped into the water tower, it stores more water. Because the water tower is built above the ground, the water tower also stores pressure. When the town needs water, the water tower uses the force of gravity to release the water and the pressure from the water tower to distribute water to the town.

CHALLENGE

You are an electrical engineer applying for a job at Boeing. They have asked you to create a capacitor to store energy. Assemble a capacitor and show that it stores charge with a multimeter.

SET UP

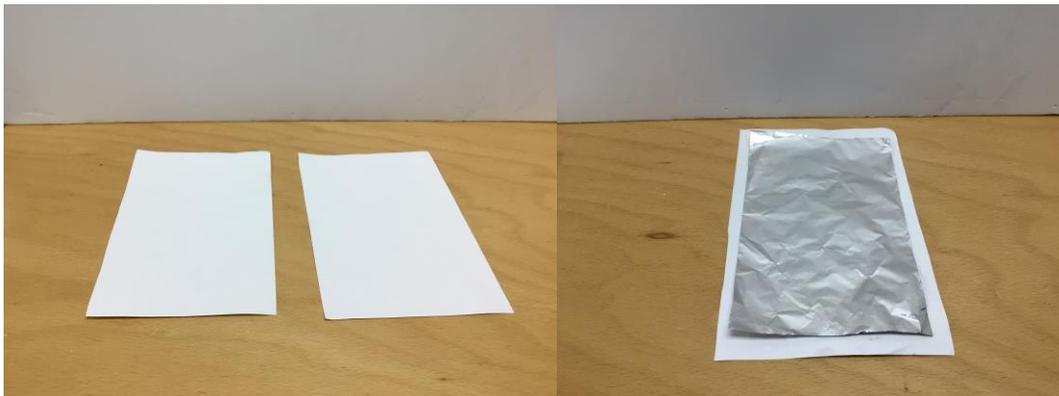
Capacitor #1

Materials

- 2 sheets of 8.5 x 11" white printer paper
- 8.5 x 11" sheet of aluminum foil
- Masking tape
- 2 alligator clips
- Wire

Procedure

1. Take 1 sheet of printer paper and cut it in half. Measure the aluminum foil against it to cut 2 pieces that match the dimensions of the paper.



2. Place the sheet of paper between the two sheets of aluminum foil.

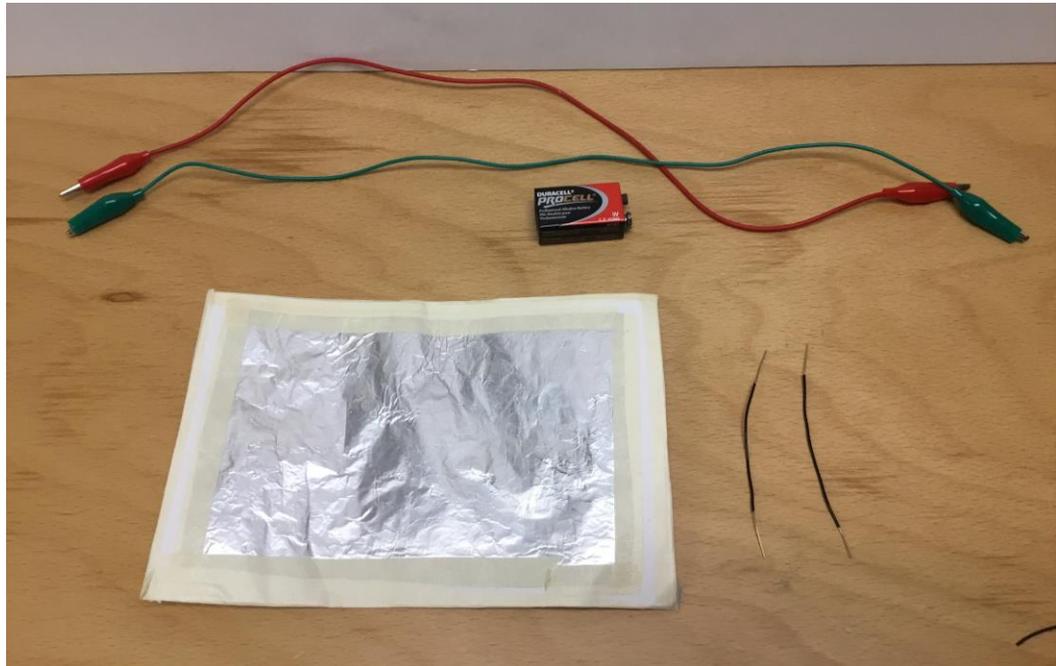


3. Tape the perimeter of the foil-paper-foil with masking tape to secure it.



Charging your Capacitor:

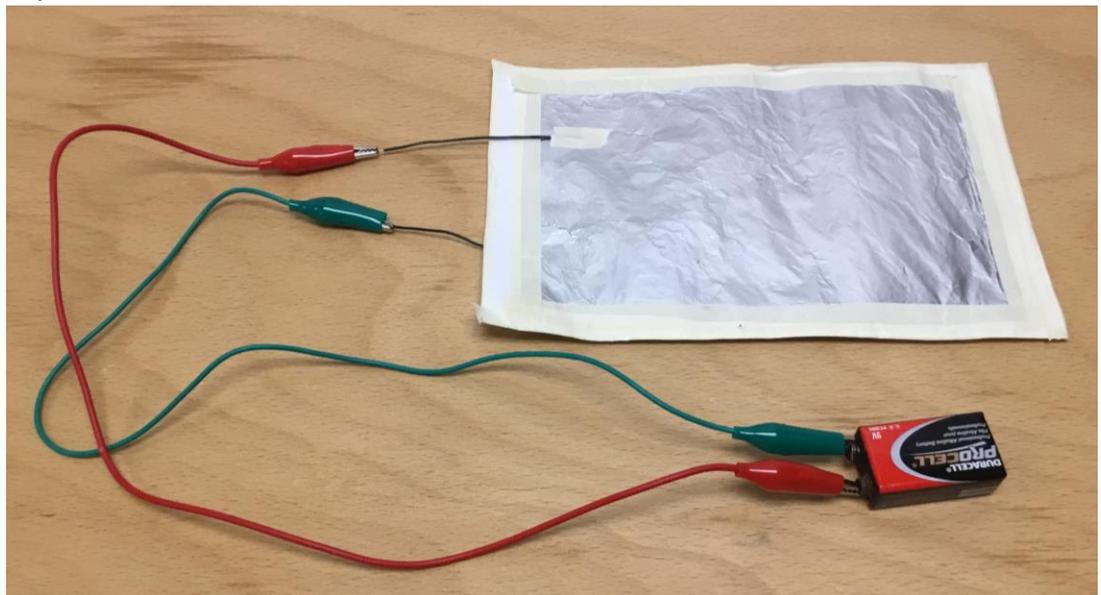
1. Tape the exposed metal on the wires to the aluminum foil. Be sure to tape one per side of your capacitor.



- Using the alligator clips, attach the two wires to the two terminals on the 9V battery



- Using this configuration, It should only take about a minute to charge your capacitor.

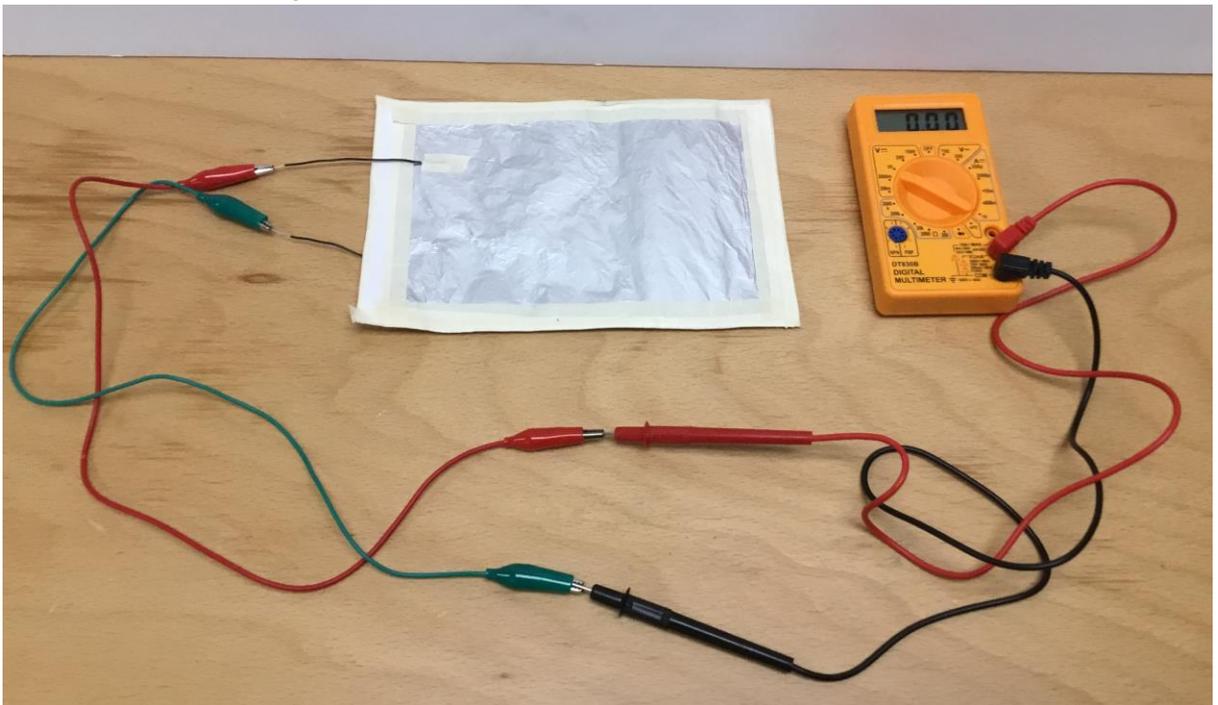


Testing Your Capacitor:

1. Disconnect the alligator clips from the 9V battery.



2. Without disconnecting the alligator clips from the capacitor, attach them to the leads on the digital multimeter,



Capacitor	Voltage (V)
1	
2	
3	
Average (Trial 1 + Trial 2 + Trial 3)/3	

Old Design

Your first capacitor was very large and flat. How might you change your design/shape if you didn't have as much space? Sketch out your prototype below.



Your Design

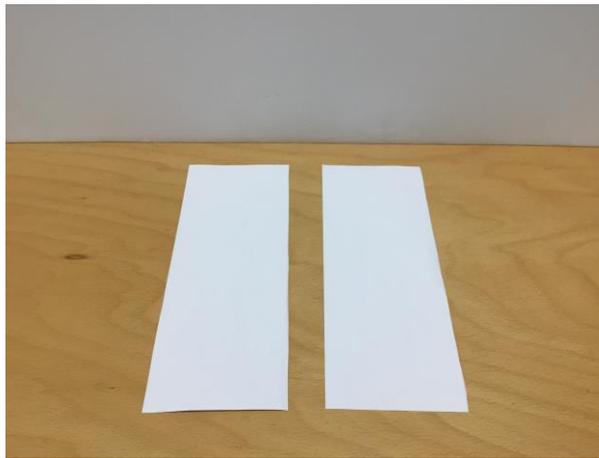
Capacitor #2

Materials

- Foil
- 8.5 x 11" white printer paper
- Masking tape
- Wire
- 2 alligator clips

Procedure

1. Cut the printer paper in half lengthwise.



2. Cut foil to match the dimensions of the two pieces of printer paper. On one side of each paper, tape the cut sheets of aluminum foil with a tab of foil sticking out over the edge of the paper. Tape along the margins of the paper.

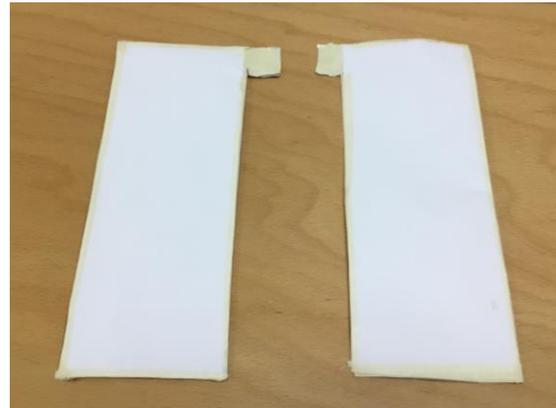


3. Reinforce the back of the tab of foil with tape.

Top



Bottom



4. Repeat with the second sheet of paper. Make sure the aluminum foil tab is facing in the opposite direction as the first sheet of paper
5. Obtain a cylindrical object (marker, dowel, etc.)
6. Take your 2 pieces and overlap them over each other.
7. With the foil side of each piece facing inward, roll the pieces on the cylindrical object.



8. After rolling the pieces around the cylinder, secure with masking tape to maintain the shape around the cylinder.



Final Capacitor #2

Capacitor	Voltage (V)
1	
2	
3	
Average (Trial 1 + Trial 2 + Trial 3)/3	

REFLECTION

What might be an example of a capacitor in nature?

What might be some items you use every day that store energy?

How might capacitors be used to increase the production of renewable energy?