When Sparks Fly!

Getting a charge out of electricity

NBSP Physical Science Institute

Monday July 22, 2002

Standard Connections

- *Students know electrically charged objects attract or repel each other*

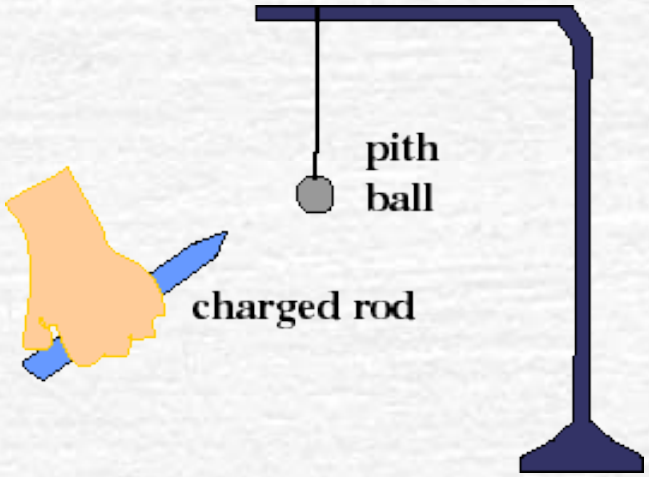
- How do we electrically charge an object?
- How do we create or destroy charge?
- Why do we say “opposites attract?”

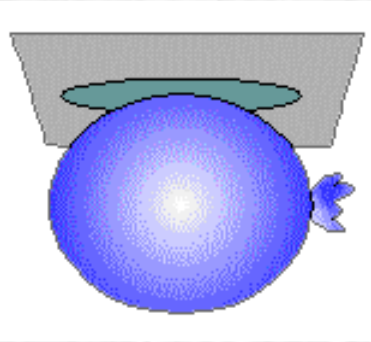
First Activity: A deeper look at charge

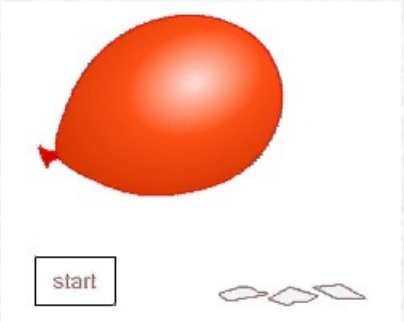
- How do we know that there are two different types of charged particles?
- How can you show that there are two types of charges?
- How can you figure out whether like or unlike charges attract each other?
- Why did we decide that the negatively charged particles were

Equipment for first activity

- Silk
- Fur
- Plastic rods
- Pith balls (styrofoam ball covered with metal foil)
- Balloons
- Small pieces of paper







A few things to try:

- Rub different materials on rod
- Bring rod towards pith balls
- Touch rod to pith balls
- Rub different materials on balloon
- Hold balloon near paper pieces
- Stick balloon to ceiling or other things
- Some investigations of your own!

More questions for first activity

- What happens when you first bring the plastic rod near the pith ball? Why?
- What happens if you touch the rod to the pith ball?
- Why does a balloon stick to the ceiling if you rub it with wool?
- Why does the balloon attract small pieces of paper?

Electrons and the Greeks

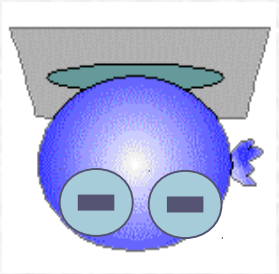
- The ancient Greeks noticed that rubbing amber could cause it to attract bits of straw
- The name we use for this type of attraction, *electricity*, comes from the Greek word for amber, *elect*
- Amber is really fossilized tree re

Key concepts about charge

- There are two and only two types of electrical charge – **why?**
- Electrons are defined to have negative charge
- Electrons are free to move in and between certain types of materials
- The flow of electrons is called electricity

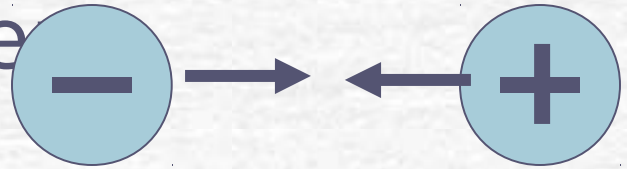
Vocabulary for ELL

- Electron: negatively charged fundamental particle
- Proton: positively charged fundamental particle
- Static electricity: build up of charge
- Electricity: flow of electrons



Vocabulary for ELL

- Attract: cling togethe



- Repel: push apart

- Amber: yellow-orang

fossilized tree resin -

often containing insect

ELD Activities

- How many things can you name that use electricity?
- Can you alphabetize their names?
- Make a table to help remember new words:

Word	Definition	How I remember

Publisher's Materials

- Take some time to look through the state-adopted texts to find activities relating to electric charge and static electricity that could be used in your classroom.

Break – some things to think about

How many things do you see that use electricity while you are on break?

Make a list of the ways you use electricity each day.

Standard Connections

- *Students know how to design and build simple circuits by using components such as wires, batteries and bulbs*

- Why are they called “circuits”?
- What is flowing in the circuit?

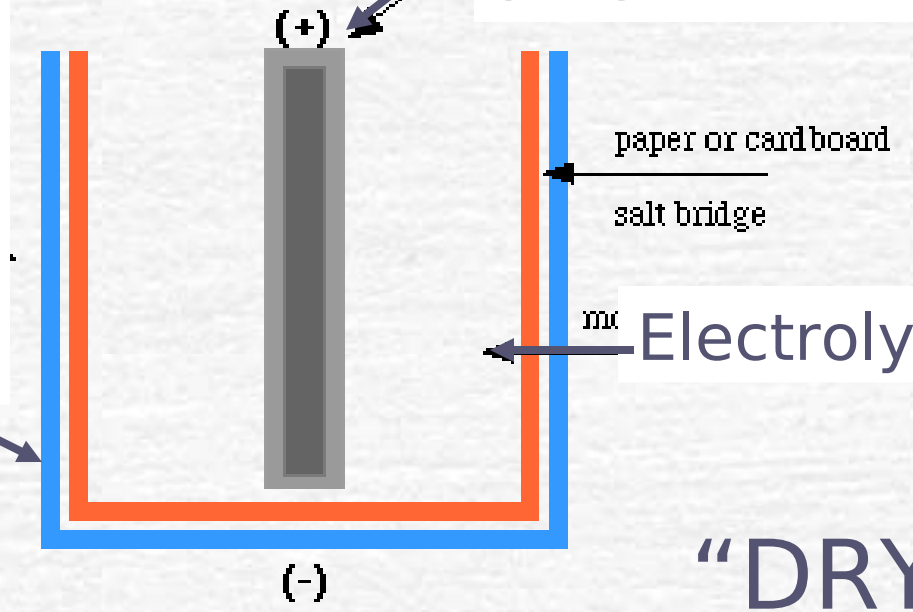
Second Activity – single-bulb circuit

- Given: one battery, one light bulb and one wire
- Connect these in as many ways as you can – draw your experiments
- Which arrangements cause the bulb to light? (You should have at least four)
- What is required in order for the bulb to light?

How does the battery work?

Anode: material connected to the negative terminal of a battery, typically zinc

Cathode: material connected to the positive terminal of a battery, typically graphite or silver.



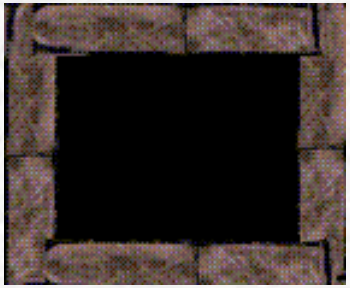
"DRY CELL"

Batteries and charge

- Zinc anode corrodes due to exposure to water in electrolyte paste
- Corroding zinc provides electrons
- Electrons flow through circuit towards positive cathode
- Electrons react with electrolyte paste to produce water and neutral materials
- Cathode structure provides location for paste to interact with electrons

Electrons and Ben Franklin

Ben Franklin's "single fluid theory" showed that a given body possessing a normal amount of electric fluid was called *neutral*. During the process of charging, the fluid was transferred from one body to the other; the body with the deficiency being charged *minus* and the body with the excess charged *plus* . But no fluid is lost. Ben's "single fluid theory" led to the electron theory in 1900: *electrons move about conductors much as a fluid might move.*

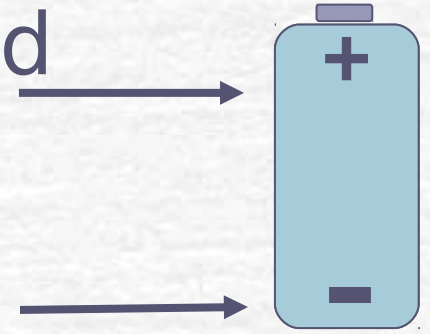


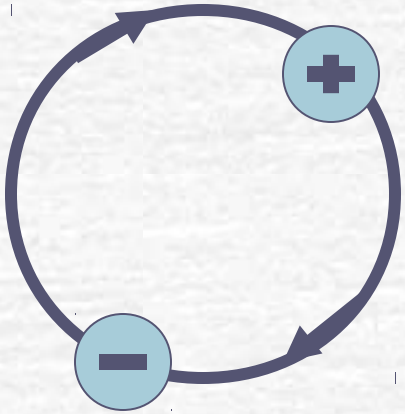
Key concepts

- Circuit: complete path of electrical current flow including energy source
- If the path is not complete, the bulb will not light
- Complete circuit requires flow of electrons from negative to positive terminals **and through the battery itself**
- Bulb is used as an indicator of current flow

Vocabulary for ELL

- Cathode: positively charged terminal of the battery
- Anode: negatively charged terminal of the battery
- Circuit: complete loop through positive and negative terminals and through the battery itself





ELD Activities

- What other word sounds like circuit and means almost the same thing?
- What are other ways to use the word “circuit” ?

Publisher's Materials

- Take some time to look through the state-adopted texts to find activities relating to single bulb circuits and batteries that could be used in your classroom.

Lunch break - Things to think about

- What is the difference between AA, C and D cell batteries?
- How do these types of batteries differ from the 9-volt batteries that are used in smoke detectors (for example.)
- What is the difference between rechargeable batteries like Ni-Cads and alkaline batteries like Duracells?

Standard Connections

- *Students know electrical energy can be converted to heat and light*

- What happens to materials when current flows?
- How do light bulbs make light?

Third Activity: electrons in materials

- What is inside of a light bulb?
- What path does electricity take through a light bulb?
- What types of materials are good conductors?
- What types of materials block electricity?

Equipment for third activity

- Insulated wires
- Battery and holder
- Christmas tree and flashlight bulbs
- Brass fasteners and masking tape
- Cardboard with holes in it
- Film can with holes in it
- Paper clips
- Test materials: rubber, wood, glass, plastic, aluminum, paper clips, etc.

Two types of circuits to build:

- Make and take:use cardboard with holes in it, brass fasteners, paper clip for switch, film can with holes in it, c-cell battery, xmas tree bulb
- More expensive: use battery holder, knife switch, masking tape, d-cell battery, flashlight bulb and holder

A few things to try:

- Examine the two types of bulbs
- Build both types of circuits
- Make sure your circuit lights the bulb
- Stick test materials in different places
- See if the bulb still lights
- Record which materials allow the bulb to light and which do not
- Some investigations of your own!

More questions for third activity

- Were you surprised by some of the items that were conductors?
- Were you surprised by some of the items that were insulators?
- What did the conductors have in common?
- What did the insulators have in common?

More questions for third activity

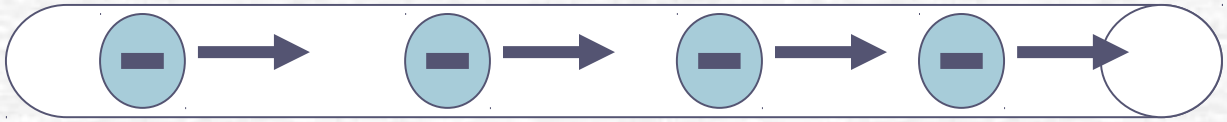
- Did it make any difference where you put the test materials in the circuit?
- Did it make any difference which way you put the battery in the holder?
- Did it make any difference which way you connected the (xmas tree) light bulb in the circuit?

Key concepts

- Conductors are usually (but not always) metals – they have electrons that move easily
- Insulators are materials that block the flow of electrons
- It does not matter which way the battery is oriented – but sometimes the battery holder won't connect if the battery is not oriented properly
- It does not matter which way the (xmas tree) light bulb is oriented

Vocabulary for ELL

- Conductor: material that allows the flow of electricity



- Insulator: material that blocks the flow of electricity

ELD Activities

- The person who leads an orchestra or a band is called a *conductor.* How is an orchestra conductor similar to an electrical conductor?
- Buildings stay warm because of *insulation* material. How is insulation material similar to electrical insulators?

Publisher's Materials

- Take some time to look through the state-adopted texts to find activities relating to conductors and insulators that could be used in your classroom.

Break – things to think about

- What is a semi-conductor?
- Can you think of everyday items that depend on semi-conductors?
- Can you think of any materials that are used to make semi-conductors?

Hint: they named a Valley after one elemental semi-conductor material

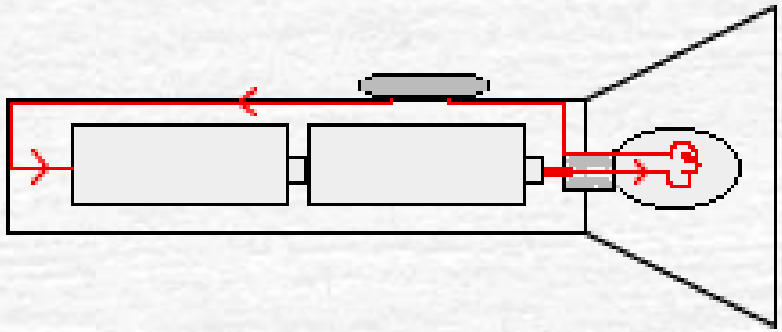
Standard Connections

- *Students know how to design and build simple **series and parallel circuits** by using components such as wires, batteries and bulbs*

- What is the difference between series and parallel circuits?

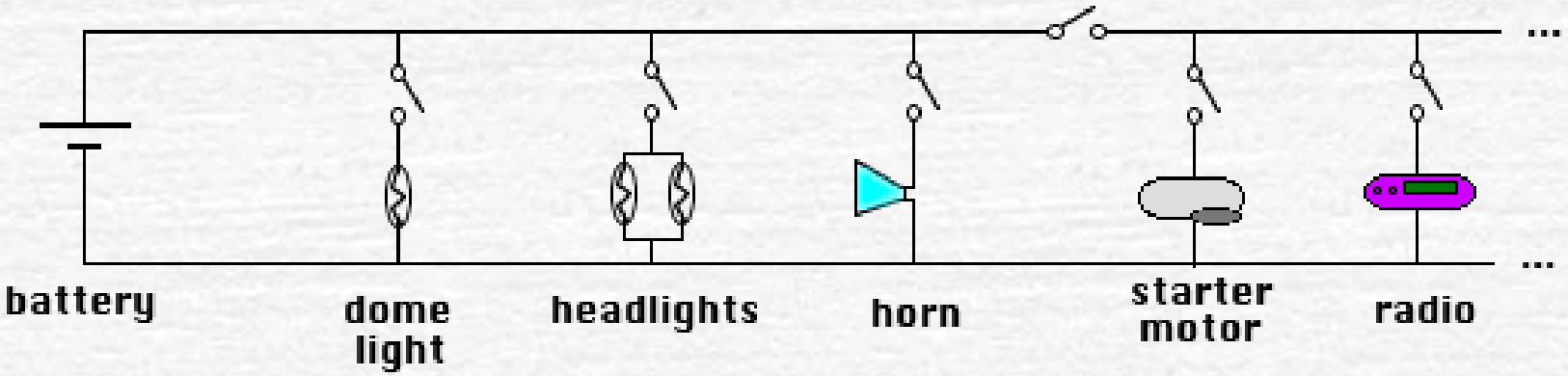
Series Circuits

- A series circuit has all the elements arranged one after the other, so all the electrons follow one single path through the circuit
- Example: A flashlight



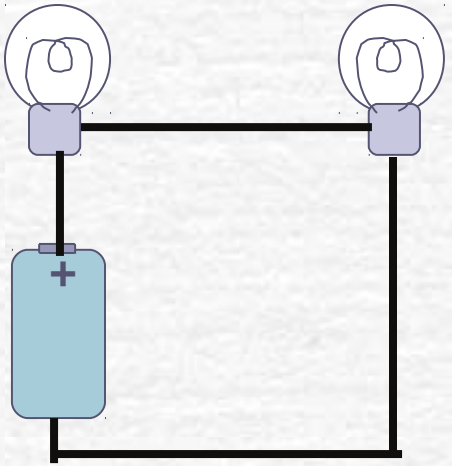
Parallel Circuits

- A parallel circuit has more than one path for the electrons to take through the circuit – and only some of the electrons go through each path
- Example: electrical system in a car



Two-bulb circuit

- Set up the circuit as shown
- Compare the brightness of each of the bulbs with that of an identical bulb in the single-bulb circuit
- What can you conclude about the amount of current through each bulb?



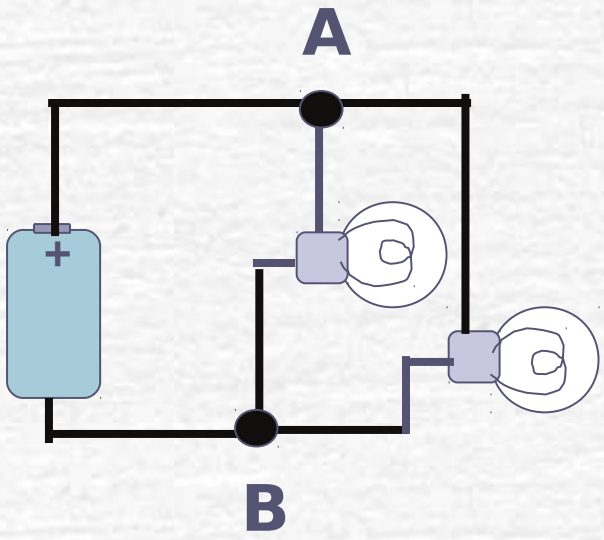
- Is the current “used up” in the first bulb?

Questions about 2-bulb circuit

- Do you think the order of the bulbs makes a difference to their brightness?
- How can you find out?
- Do you think there is more or less current flowing through each of these bulbs than through the bulb in the single-bulb circuit?
- Is this circuit series or parallel?

Another two-bulb circuit

- Set up the circuit as shown
- Compare the brightness of each of the bulbs with that of an identical bulb in the single-bulb circuit
- What can you conclude about the amount of current through each bulb?
- Is the current "used up" in the first bulb?



Questions about 2-bulb circuit

- Do you think the order of the bulbs makes a difference to their brightness?
- How can you find out?
- Do you think there is more or less current flowing through each of these bulbs than through the bulb in the single-bulb circuit?
- Is this circuit series or parallel?

More questions about 2-bulb circuit

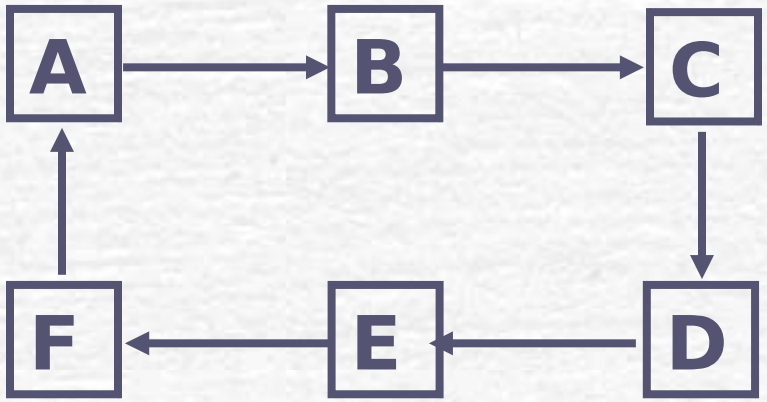
- What do you think would happen if the bulbs were located on different sides of the battery?
- Describe the current flow through the circuit. What happens to the current at point A? At point B?
- Does the amount of current that comes out of a battery appear to remain constant or does it depend on the number of bulbs in a circuit and how they are connected?

Key concepts

- Series circuits – all of the electric current flows through all of the circuit elements
- Parallel circuits –the electric current splits - part flows down each parallel branch of the circuit

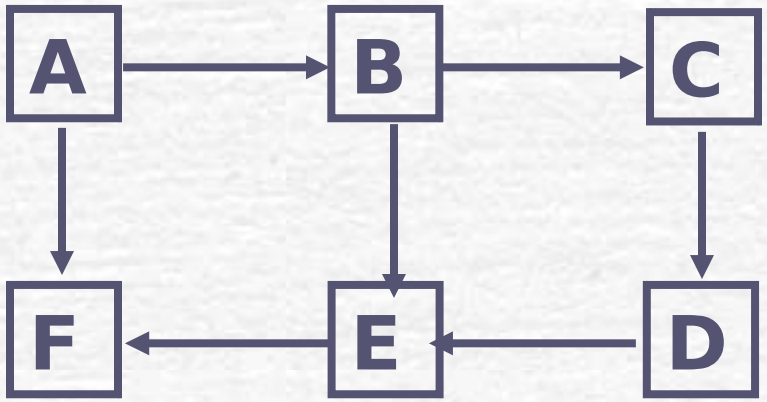
Vocabulary for ELL

- Series: elements are arranged in a sequence



Vocabulary for ELL

- Parallel: elements are arranged in branches



ELD Activities

- Draw pictures of other things that you have seen that are part of a *series*
- Draw pictures of other things that you have seen that are *parallel* to each other

Publisher's Materials

- Take some time to look through the state-adopted texts to find activities relating to series and parallel circuits that could be used in your classroom.

Lesson Study Activities

- Identify a key concept from today's lecture for further development
- Review the publisher's materials about this key concept
- Discuss the best way to present this key concept in your classroom

Resources

- http://www.bbc.co.uk/education/gcsebitesize/science_physics/electricity_and_magnetism/electric_charge_and_current_rev.shtml#charge
- http://blueox.uoregon.edu/~courses/dlivelyb/ph161/L6.html#charge
- http://www.thetech.org/exhibits_events/noyce_center/topics/13g.html
- http://www.uvi.edu/Physics/SCI3xxWeb/Electrical/Circuits.html
- Physics by Inquiry – L. McDermott and the PEG at U Washington

Resources (continued)

- http://www.proteacher.com/110016.shtml
- http://www.franklinbusybody.com/