Electrostatics Demonstration

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Main concepts:
Electricity is made of electrons
Electrons are a part of the atom
Charge can be Positive or Negative. Electrons have negative charge
Like charges repel (+,+) and opposite charges attract (+,–)
Electric Force (or Coulomb force) is the force that holds atoms together.
Charge flows on conductors (metals) but charge sticks in one spot on insulators (plastics, Styrofoam...)

What to do:
Rub balloon on hair, pick up some pieces of styrofoam with balloon, or stick the balloon on the wall
Question: Why does it do that ?
That is caused by **static electricity**. Today we are going to talk about Electro-statics.
"**Electro" means electrons and "Static" means not moving**, or still. (as opposed to Flowing elec.).
Review Atoms
Show Box of atoms (remind the kids of solid, liquid, gas). Remind kids how small atoms are.
Now we want to go even smaller than the atom to an electron. An electron is a part of an atom
Show picture of an atom. How much smaller is the electron than an atom ?

Charged Rods
Charge up a rod and suspend it from a string (hanging horizontally), then bring another charged rod (same type) near it. The rods should push apart because electrons repel each other. Let the kids try different combinations of Cloth + Rod. Be observant. They should learn that some rods repel, but others attract. **Question:** Ask the kids, what is the simplest thing we can conclude from this ?
Answer: there must be two kinds of charge (+,–). We could name them anything (Black & White), (North & South), (Happy & Sad) (Push & Pull) but Benjamin Franklyn named them **Positive and Negative.**

Electric Force is not the same as Magnetism.
Show Permanent magnets. They are made of metal. This electric charge is on plastics, not metal. Have you ever seen permanent magnets made of plastic. No. Hold a magnet up to the charged plastic rod to show that there is no attraction.

Show the **Triboelectric Series.** Some materials want extra electrons (Negative) and others want to give away their electrons (Positive).

Electroscope
Charge one rod and bring it near the electroscope. The leaves spread apart because the electrons repel each other. If you **ground** the metal ball by touching it, the leaves come back together again.

Induction (older kids only)
Use wool to charge up a PVC pipe and transfer the negative charge to the small hanging metal sphere. Charge up the PVC pipe more and show that the sphere repels away from the charged PVC (again,

same charges repel). Next ground the sphere by touching it so that the charge goes away. Hold the sphere so the charge has a path to ground, and bring the charged PVC rod near it. This will push the electrons away to ground. Now let go of the sphere so that it will be charged positively. Now the sphere will be attracted to the PVC pipe (opposite charges attract).

Light (or Plasma)

Need a dark room.

Electrophorus – pick up some electric charge. Touch it to the little mercury bulb. This indicates that the charge we have generated really is electricity.

Demonstrate the Fluorescent Tube. Ask for two volunteers. One wears the Nylon jacket, stands on a plastic stool, and holds one end of the tube. The other person acts as the ground and holds the other end of the tube. It may work better if you also connect a ground wire from that end of the tube, to any large metal object. Then I need to whip the back of the nylon jacket with a black trash bag. The Fluorescent tube should light up !

Show the Plasma Globe. All these work because at low pressure it is easier to rip the electrons off of the atoms. When the electron falls back onto the atom (because + attracts -) the atom emits some light.

Van DeGraaf Generator

Some clever person realized that you could rub these materials together over and over again by driving a belt with a motor. At the bottom the rubber belt runs over a wool roller. Then the belt carries electrons up to the top where they spread out on the metal sphere. Now hold the grounded sphere near the charged sphere. This causes a high electric field because the charged sphere is at high voltage and the grounded sphere is at zero voltage. When the voltage of the charged sphere builds up high enough you will get a spark to the grounded sphere (you have ionized the air by ripping electrons off of molecules in the air). This is the same phenomena as lightning.

- Show some sparks
- Nail on Top – Sparks stop because the sharp tip causes high E-field and sprays electrons into the air.
- Take the Sphere off Show the parts
- Demonstrate the ion motor - high E-fields spray electrons into the air and cause the wire to turn.
- Face and Wig – Our Van de Graaf Generator needs a personality. Put the wig on the VDG. Ask the children to predict what will happen. Hair stands up. Why does it do that ? Ans: because electrons repell each other. They get on the hairs and push apart.

Triboelectric Series

Positive (+)
Air
Rabbit Fur
Glass
Human Hair
Nylon
Wool
Silk
Paper
Cotton
Polystyrene
Styrofoam
Hard Rubber
Acetate, Rayon
Polyester
Saran Wrap
Acrylic
Polyethylene
Polypropylene
PVC
Teflon
Silicone Rubber
Negative (-)

Equipment needed

Balloons
Little pieces of styrofoam
Magnet
Atoms in a Box
Extension Cords
Grounding wire w/ banana clips
Laptop
Electroscope (from www.ArborScientific.com)
Kit of Electrostatic rods & cloths (from www.ScienceFirst.com)
Hanging metal sphere
Metal stand, dowel, black thread & clothes pins to hang rods & sphere
PVC pipes (~2' long)
Extra wool cloths (visit a fabric store or cut up an old sweater)
Fluorescent tube
Nylon Jacket.
Black Plastic Trash bags
Stool
Plasma toy
Van de Graaf generator with grounding sphere
Hair Dryer
Ion Motor (metal cap, wire, board, nail)

View graphs to show attract/repel, induction, Triboelectric series
Handouts – How to build a simple Van de Graaf generator at home. Gonzo Gizmos

Electrostatics Summary

Balloon & Hair

Box of Atoms

Electron is part of the Atom

Electroscopes

Charged Rods

Triboelectric series

PVC pipes + Wool

Light

- **– Mercury bulb**
- **– Fluorescent Tube**
- **– Plasma Globe**

Van De Graff Generator

- **– Sparks**
- **– Nail on Top**
- **– Wig & Face.**

Electrostatics Summary (Kindergarten)

Balloon & Hair

Electroscopes

Charged Rods

Triboelectric series

PVC pipes + Wool

Light

- **– Fluorescent Tube**
- **– Plasma Globe**

Van De Graff Generator

- **– Sparks**
- **– Wig & Face.**

Electrostatics Summary (Pre-K Version)

PVC pipes + Wool

Light

– Mercury bulb

Van De Graff Generator

– Sparks

– Wig & Face.