615-3080 (10-046) Pith Ball Electroscope

Warranty and Parts:

We replace all missing or defective parts free of charge. For additional parts, use part numbers above. We accept Mastercard, Visa, checks, school P.O.'s. All products guaranteed free from defect for 90 days. This guarantee does not include accident, misuse, or normal wear and tear.

Theory:

What is electricity? It is, as we know today, a *flow* of electrons between two points (of a conducting body) much like the flow of liquids from a higher to a lower level.

What are electrons? They are tiny particles carrying an electric charge. All bodies contain electrons in their atoms. Even though the electrons are charged particles, the atoms and the bodies which they make up are normally electrically neutral (uncharged.) This is because each atom holds its electrons revolving around a nucleus which contains an equal number of particles called protons. Since protons carry the opposite kind of charge as electrons carry, the atom as a whole remains neutral or uncharged. Therefore the bodes are neutral or uncharged in their normal state. Since by convention we think of electrons as carrying a negative charge, protons are electrically positive.

Accessories:

You will need a way to generate static charges to use your electroscope.

615-3015 Friction Kit - A good basic kit for making static electricity the old-fashioned way - glass, acrylic, hard rubber rods; cotton, rabbit fur and acetate pads. Instructions. *Individual rods are also available for separate sale. Call for information.*

Experiment 1:
Charge an Electroscope by Induction.

An electroscope detects the presence of an electrostatic charge by being "charged" by it. Try charging the electroscope, first with a positive charge and then with a negative charge by following this procedure.

1. Place the aluminum rod into the base and fasten it to the underside with the hex nut provided.
2. Hang pith balls over the end of the aluminum rod.
3. **Charge a glass rod positively** by rubbing it with silk and bring the charged (rubbed) end close to, but not in contact with, the pith balls.
4. Observe the balls diverge (go apart from each other).
5. Remove the charged rod and observe that the balls collapse.
6. Repeat the entire procedure above, and observe the balls repeat their behavior, diverging and collapsing just the way they did before.
7. Repeat this procedure with an uncharged glass (or other) rod. The balls do not diverge.
8. Instead of a positive (glass) rod, use a negatively charged rod (rub acrylic with wool or flannel or **hard rubber** with **fur**) and repeat the experiment. Observe that the balls behave exactly as they did before for a positively charged rod.
9. Induction is actually a consequence of the forces of attraction and repulsion between charges in an electrostatic "field".

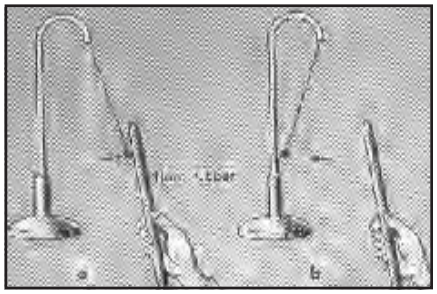

Diagram 1 - The pith ball is first attracted by the charged rubber rod and after contact is later repelled by it.

CONCLUSION: Any charged body (either positive or negative) brought close to, even though not in contact with, an electroscope terminal, makes the balls diverge. And they collapse when the charged body is taken away.

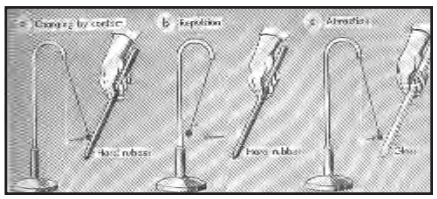

Diagram 2- Bodies with like charges repel and those with unlike charges attract.

Discussion:

This a case of charging the electroscope by *electrostatic induction,* where a charged body (the rod) *induces* an opposite charge in an uncharged body (the balls, which are really an extension of the electroscope as they are connected through electrically conductive parts). Molecules in the uncharged body are reoriented so their electrons will be closest to the positive end of the charged body. In other words, more electrons are drawn toward the rod, causing the balls to have less; or, electrons are driven to the balls from the rod, as the case may be. The balls thus acquire the same charge as the rod, and the rod the opposite charge, by induction.

Why the divergence of balls? Both balls acquire a similar charge by induction, positive or negative, with the result that they repel each other.

What makes the balls collapse? In induction, there is no contact between bodies, no actual transfer of electrons, only a temporary rearrangement by the reorienting molecules. Once the "charge inducing" rod is removed, the molecules return to their normal state, with the result that the balls no longer carry the charge, and they collapse (no need to repel each other).

You can use an electroscope to verify the presence or absence of an electrostatic charge on a body. A diverging electroscope would indicate the presence of a charge on the rod; and a non-diverging electroscope (with collapsed leaves) would mean that the rod had no charge on it.

It was Benjamin Franklin who named these two kinds of charges: he called the charge produced on glass when rubbed with silk *positive* and that produced on rubber when rubbed with fur *negative*. These names and symbols + to designate a positive charge and the symbol - to designate a negative charge.

How to Teach with Pith Ball Electroscope

Concepts Taught: Electrostatic Attraction and Repulsion; Electrostatic Conduction and Induction; Charge Identification. Charge distribution if a conductor; Electrostatic field

Curriculum Fit: Physics Sequence Electricity and Magnetism. *Static Charge*. **Grades 3-8**

Common Materials and their Performance as Charge Generators:

Excellent at all humidity conditions are:

Sulfur	Paraffin wax
Polystyrene	Polyethylene
Pure gum rubber	Vinyl plastic.

Excellent at low humidities are:

Porcelain	Glass
Mica	Acrylic plastic
Epoxy plastic	Polyester resins
Shellac	Bees wax.

Unreliable at moderate humidities are:

Wood products	Paper products
Hard rubber	Phenolic resins
Synthetic fibre fur	Cloth of all kinds
Soft glass	rubber

(some rubber and plastic products are treated to make them slightly conducting).

Related Products:

Science First manufacturers many low-cost science labs that are available from most science education dealers. For more information, call us at 1-800-875-3214

- **615-3078 Metal Electroscope** - With 2 pairs die-cut foil leaves, 10 cm glass panels, metal case, instructions.
- **615-3100 Van de Graaf Generator** - 200,000 volt potential. Create your own lightning. Safe for all ages.

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