615-3015 (10-099) Friction Rod Kit

Warranty and parts:

We replace all defective or missing parts free of charge. Additional parts may be ordered toll-free at **1-800-875-3214.** We accept Master Card, American Express,Visa, and School P.O's. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse, or normal wear and tear.

Teaching with this kit:

Concepts Taught: Electrostatic charge generation; Electrostatic Attraction and Repulsion; positive/ negative charges; charging and discharging.

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

Introduction:

This is a basic kit for the study of electricity. It concentrates on the nature and behavior of the electrical charge which is the fundamental unit of electrical energy. While designed for primary and secondary age groups as the initial kit of a series of three on electrostatics, it is also simple and safe enough for younger groups.

Use and care:

For best results, maintain the materials in this kit between use.

1. Protect insulating materials from salt spray, chemical flames and perspiration. These leave a film of moisture which conducts away electric charges, affecting your experiments. Remove any moisture film buildup with a rinse of distilled water.
2. Experiments are best in a dry room. Avoid handling materials with moist hands.
3. At high humidities (over 80%), lint may cause short circuits or act as discharge points. If using an electrophorus, note that damp lint decreases the potential of metal surfaces.
4. Watch for radiation, open flames etc. that might ionize the nearby air. These will slowly discharge the bodies you have charged and are testing.

Product description:

Friction rods (acrylic, glass and hard rubber) and **friction surfaces** (silk, cotton and synthetic fiber) are basic materials for generating electrical charges by rubbing rod against surface.

Theory:

What is electricity? It is 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? 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 an opposite charge, the atom as a whole remains neutral or uncharged. Bodies are neutral or uncharged in their normal state. Since by convention we think of electrons as carrying a negative charge, protons are electrically positive.

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	Cloth of all kinds
Soft glass	rubber

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

Friction Generates Electrical Charges

You Need:

Light materials (Paper, straw, feathers)

Procedure:

1. Choose a friction rod and surface (for example, acrylic rod and acetate cloth.)
2. Cut out small bits of lightweight paper (or straw, packing material, feathers etc.) and spread them on the table.
3. Hold one end of rod and rub the other end with fabric.
4. Bring rubbed end close to the material on the table.
5. Watch the bits fly and stick to the rod!

Classroom hints: Different students can use different rods and surfaces. Compare cases!

For **older students,** use uniform paper (as from a hole puncher) to see if the rods pick up equal amounts of material when rubbed more.

Plot a **graph** with the number of paper pieces (Y-axis) against the length of time (or number) of rubs received.

Discussion:

Why do rubbed rods behave this way? Because rods are charged by friction and attract light material electrostatically.

How do the rods become charged? All matter has a fraction of its electrons in a relatively loosely held state. When bodies touch each other or come into close contact by rubbing, the surface electrons from one body "get loose" and move to the other surface. The bodies are no longer neutral; the one which gains electrons is "negatively charged" and the other body which has lost electrons is positively charged.

Different materials have different affinities for gaining or losing electrons. Silk gains electrons when rubbed against glass and leaves it positively charged. Synthetic fiber, flannel and wool lose electrons and charge amber or hard rubber negatively.

Frictional generation of electric charges was how electricity was accidentally discovered by the ancient Greek philosopher Thales 25 centuries ago. He noted that amber (*Elektron*: Greek) attracted light material like straw after being rubbed with fur. He thought amber was lost in the fur, but today we know that amber draws electrons from the fur to become negatively charged.

In generating electric charges, friction does not create more electrons. Electrons simply move between surfaces, keeping their total number the same. Electrons get redistributed and are not created or destroyed.

Like Charges Repel; Unlike Charges Attract

You Need:

Charged Rods
Fishline or string

Procedure:

1. Charge acrylic rod negatively by rubbing it against synthetic fibre.
2. Suspend it with fishline or string from a stand or high surface.
3. Charge another acrylic rod similarly (negatively) and bring its end near the charged end of the suspended rod.
4. The first rod resists the charged end of the other. Two negative charges **repel** each other.
5. Bring positive rod (glass rubbed with silk) toward charged end of suspended rod.
6. Watch as it is pulled toward the other. A positive charge **attracts** a negative one.
7. Suspend the charged glass rod and bring another charged glass rod close. They repel each other. Two positive charges also repel each other. **Like charges repel while unlike charges attract each other.**

P/N 24-0099

References:

1. Blackwood, O.H., Herron, W.B. and Kelly, W.C. High School Physics. Boston: Ginn & Company, 1961. (pp.400-423)
2. Cunningham, J. and Herr, N Hands-on Physics Activities. West Nyack, N.Y: Center for Applied Research in Education, 1994. (pp.538-563).
3. Giancoli, D.C. Physics: Principles with Applications. (3rd.Ed.) Englewood Cliffs, N.J: Prentice-Hall, 1991 (pp 416-458).
4. Thurber, W.A. and Kilburn R.E. Exploring Physical Science. Boston: Allyn and Bacon, Inc. 1970 (pp 337-368).