Curiosity Guide #709
Static Electricity

Accompanies Curious Crew, Season 7, Episode 9 (#709)

Van de Graaff Variety

Investigation #8

Description

See what happens when a fantastic machine separates positive and negative charges.

Materials

- Van de Graaff Generator
- 12 small pie tins
- Metal-coated ping pong ball dangling from a rod on a string
- Volta Hailstorm Jar

Procedure

- For each investigation, predict what will happen before turning the generator on.
- Make sure that you are safe by plugging the wand into the generator to ground it. Hold the plugged-in wand each time you try a new investigation with the generator.
- Touch the wand to the generator before you place any material near the generator.

Investigation 1: Pie tins

1) Place the pie tins on top of the Van de Graaff generator.
2) Pick up the grounded wand. Turn on the generator. Observe what happens to the pie plates. Was your prediction correct?

3) Turn the generator off. Touch the wand to the generator to discharge the generator.
4) Repeat the experiment.

Investigation 2: Metal-coated, suspended ping pong ball

1) Hold the rod with the dangling ping pong ball in one hand.
2) Turn on the generator and pick up the grounded wand in your other hand.
3) Let the dome build up a charge while dangling the ping pong ball near the dome. What happens?
4) Discharge the ping pong ball by holding the grounded wand nearby. What happens to the movement of the ping pong ball?
5) Discharge the generator with the grounded wand and turn the generator off.

Investigation 3: Volta Hailstorm Jar

1) Place the Volta Hailstorm on the base of the switched-off generator.
2) Pick up the grounded wand.
3) Turn on the generator and describe what you see.
4) Discharge the generator dome with the grounded wand. What changes?
5) Turn the generator off. Check to make sure the generator is discharged by touching with the grounded wand.
6) Unplug the device, take the device apart and notice how it works.

My Results

Explanation

Van de Graaff generators were invented by Robert Van de Graaff in 1933 to separate negative and positive electric charges. This is achieved by having two rollers of different materials rotate an insulated belt. As the belt contacts the first roller, the roller becomes charged, while the belt becomes oppositely charged. Depending on the materials of the roller, the belt can become either positively or negatively charged. In either case, the charged particles on the belt travel up and across a metal comb onto the surface of the dome. As more charged particles cover the surface, the particles try to repel. In the case of the pie tins, each one gets charged and allows the top tin to lift away and fall to the ground. As the weight from the upper tin is removed, each successive tin lifts off and falls away. A similar phenomenon occurs with the ping pong ball as it is attracted, but then repels away from the dome. If the charge is transferred to the grounded wand, the ball will once again attract and repel. With the Hailstorm Jar, the top of the device gets charged and attracts the foam particles in the jar up to the top to carry the electric charge to the grounded base. The impressive static discharge is the result of electrons moving from the dome to the grounded wire or wire to the positively charged dome. In either case, the air around the dome gets charged and eventually allows a path for electrons to move with a static discharge that can be heard and seen.

Think some more about static electricity. We have seen how static electricity can build up in the Van de Graaff generator and produce an impressive static discharge with high voltage and little current. Lightning, though, is the most impressive and dangerous example of static electricity. Lightning results from the collision of ice, rain, and snow in the clouds. This collision causes the clouds to become charged. At the same time, objects on the ground get positively charged, and that imbalance among clouds or the clouds and the ground can lead to impressive lighting strikes. Pow! Static discharge!

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