SNC1D/1P The Characteristics of Electricity/Electrical Applications

Teacher Demo: Dancing Paper

Topics	**Timing**
static electricity, transfer of charge charging by induction	preparation: 3 min demonstration: 5 min

Specific Expectations

SNC1D

A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research

A1.8 analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models)

E2.1 use appropriate terminology related to electricity, including, but not limited to: *ammeter, amperes, battery, current, fuse, kilowatt hours, load, ohms, potential difference, resistance, switch, voltmeter,* and *volts* [C]

E3.2 explain the characteristics of conductors and insulators and how materials allow static charge to build up or be discharged

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E2.1 use appropriate terminology related to static and current electricity, including, but not limited to: *ammeter, ampere, battery, conductivity, current, energy consumption, fuse, kilowatt hours, load, ohm, potential difference, resistance, switch, voltmeter,* and *volts* [C]

E3.1 compare conductors and insulators, and explain how materials allow static charge to build up or be discharged

E3.2 explain the law of electric charges with reference to common electrostatic phenomena (e.g., charging by contact or by induction)

Introduction

In this demo, a polyethylene strip is charged by rubbing with wool. The charged strip is then used to make paper circles stand on their edges inside a Petri dish. This demo introduces students to the charging of materials by induction as opposed to charging by contact.

Materials

10–20 hole-punch paper circles
glass Petri dish with lid
masking tape
polyethylene strip
wool (sheep's fleece)

Safety Considerations

- None

Procedure

1. Place 10–20 hole-punch paper circles inside a glass Petri dish.
2. Place the lid on the Petri dish and tape it shut with masking tape.
3. **Predict**
   Ask students to predict what will happen when the charged strip is held just above the glass Petri dish with paper circles inside it.
4. **Explain**
   Ask students to explain their prediction.
5. **Observe**
   Charge the polyethylene strip by rubbing it with wool.
6. Hold the charged strip just above Petri dish but DO NOT touch the Petri dish with the strip.
7. Move the strip around above the dish to observe the effect on the paper circles.
8. **Explain**
   Ask the students to review their predictions and see if they match what they have observed. Invite students to consider the atomic structures of conductors and insulators. Help students to develop a model that explains their observations.

Disposal

Store the equipment for future use.

What happens?

The paper circles stand on edge when the charged strip is held nearby. However, if the strip is brought closer or if lighter confetti is used, then the paper circles may "jump" to the strip.

How does it work?

Rubbing transfers electrons from the wool onto the strip, resulting in a negatively charged strip. Placing the charged strip near the neutral paper causes (or induces) some of the electrons in the paper to shift temporarily away from the strip. This leaves one side of the paper circles with a temporary build-up of positive charge. The attraction of the positive charges to the negatively charged strip causes the paper circles to stand on edge. If there is sufficient humidity on the paper, the water acts like a partial conductor and electrons can move from one side of a paper circle to the other. If the paper is dry then electrons can only move within the various paper molecules. Attraction should occur in both cases.

Teaching Suggestions/Hints

1. Discuss why it is electrons (rather than positively charged particles) that move in solids. Relate this idea to the model of the atom.
2. Plastic Petri dishes do not work as well as glass because the plastic will become charged and will interfere with the interaction of the charged strip and the paper circles.
3. Do not touch the Petri dish with the strip as this will cause electrons to pass from the strip to the Petri dish.
4. Glass and plastic Petri dishes are excellent insulators and will not ground the strip (i.e., completely dissipate the charge) merely by touching. Since the polyethylene strip is also an insulator any charge on its surface will be spotty. If conditions are humid then the charge can leak off (especially at the edges) due to surface conduction and point discharge.

Next Steps

Repeat the demo using an acetate strip rubbed with silk in place of the polyethylene strip rubbed with wool. The acetate will become positively charged. To show that the charges on the acetate strip and the polyethylene strip are opposite, you could first demonstrate that the two charged strips are attracted to each other. Even though the acetate becomes positively charged, the paper circles will still be attracted toward the strip. Students may think the paper will be repelled from the positively charged acetate strip. Discuss why this is not the case.

Additional Resources

none