

## SNC1D/1P The Characteristics of Electricity/Electrical Applications

### Teacher Demo/Student Activity: Bending Water

Topics	Timing
static electricity transfer of charge induction	preparation: 0 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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**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 rod is charged by rubbing with wool. The charged rod is then used to bend a stream of water flowing from a tap.

Different substances have different attractions for electrons. When two materials are rubbed together, electrons will leave the substance with the lower attractive force and enter the substance with the higher attractive force. This will result in each substance having a slight positive or negative charge. Water is made up of polar molecules, each containing a negatively charged oxygen end and a positively charged hydrogen end. When a charged rod of material is brought near a thin stream of water, the water will be attracted to the charged rod and the stream of water will bend towards the rod.

## Materials

polyethylene rod  
wool (sheep's fleece)  
source of running water

## Safety Considerations

- None

## Procedure

1. **Predict**  
Ask students to predict what will happen when the rubbed rod is placed beside a fine stream of running water.
2. **Explain**  
Ask students to explain their prediction.
3. **Observe**  
Charge a polyethylene rod by rubbing with wool.
4. Turn on the faucet so as to produce a fine, continuous stream of water.
5. Bring the polyethylene rod very close to the stream of water but **DO NOT** touch the water with the rod.
6. **Explain**  
Ask students to evaluate and revise, if necessary, their explanations based on what happened.

## What happens?

Placing the charged rod near the stream of water causes the stream to bend toward the rod.

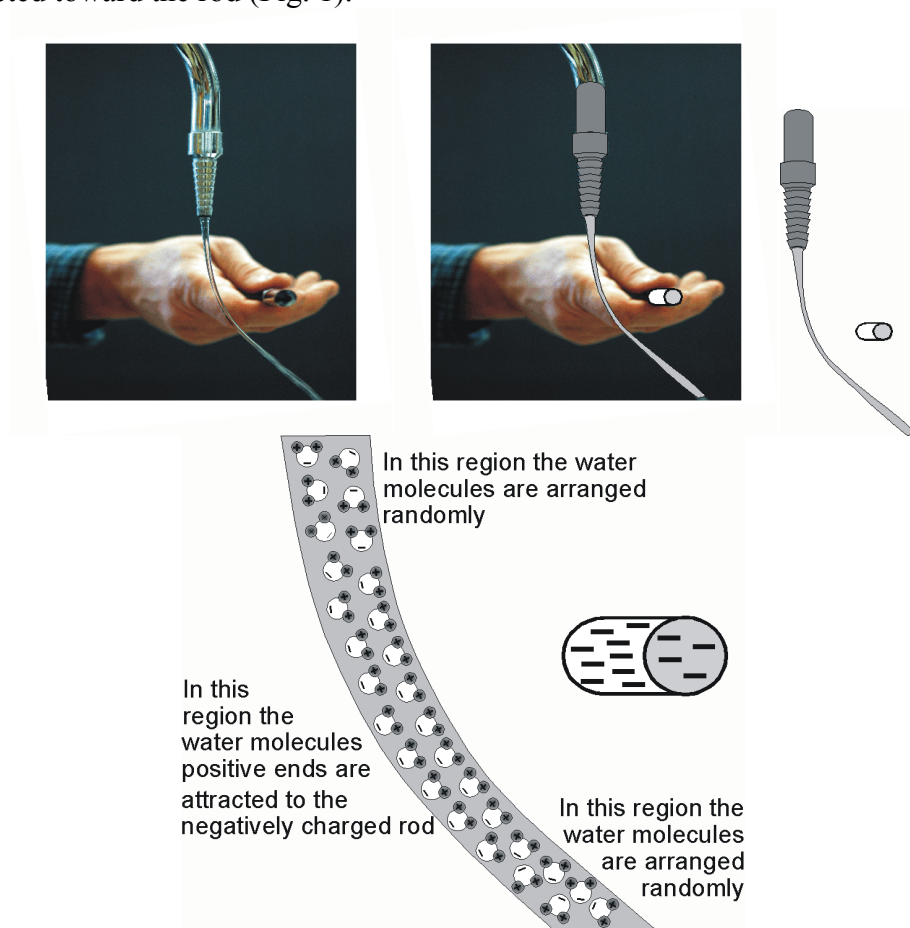
## How does it work?

A water molecule is electrically neutral because its atoms contain equal numbers of protons and electrons. The two hydrogen atoms in the molecule are linked to the central oxygen atom by covalent bonds. Each of these bonds consists of a pair of electrons that is shared between the

hydrogen atom and the oxygen atom. Oxygen is more electronegative than hydrogen. Oxygen therefore has a stronger attraction for the shared electron pair than does hydrogen. As a result, the shared electron pair that forms the oxygen–hydrogen bond is attracted toward oxygen. This buildup of negative charge makes the oxygen end of the water molecule slightly negatively charged, leaving the hydrogen end slightly positively charged. However, the water molecule remains electrically neutral overall.

Rubbing the polyethylene rod with wool transfers electrons from the wool to the rod, imparting a negative charge to the rod.

When the rod is placed close to a stream of water, the negative charges (electrons) in the polyethylene rod attract the partially positive hydrogen ends of nearby water molecules. This causes the water molecules to rotate so that their positive ends are closer to the rod than their negative ends. Therefore the attractive force (positive end of water molecule to negative rod) is stronger than the repulsive force (negative end of water molecule to negative rod) and the water stream is attracted toward the rod (Fig. 1).



**Fig.1** The theory behind the bending of a stream of water towards a charged rod

### Teaching Suggestions/Hints

Fur can be used instead of wool.

This demo can be done as a student activity. Different pairs of materials can be used (e.g., an acetate strip and silk fabric).

### **Next Steps**

Challenge students to predict what would happen if a positively charged rod were to be brought near the same stream of water. A positively charge can be produced by rubbing acetate with silk. Some students may predict that the stream should be repelled away from the positively charged rod. In fact, the water stream is attracted by the rod because the negative oxygen ends of the water molecules are attracted to the positively charged rod.

### **Additional Resources**

1. A video of this demonstration - [http://www.youtube.com/watch?v=0qbo0T\\_HYe8](http://www.youtube.com/watch?v=0qbo0T_HYe8)
2. Another video and explanation of this phenomenon - <http://www.youtube.com/watch?v=VhWQ-r1LYXY&feature=related>