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Charge and Charge Models

Imagine that you could see electrons and protons moving around in the objects in the classroom. Watch these demonstrations and think about what is happening to the charges.

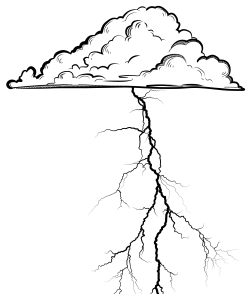


Figure 1

Preliminary Observations

Observe the following electrostatic demonstrations:

* Balloon charging demonstration
* Charged rod and can demonstration

After the demonstrations, you will experiment with electrostatics using sticky tape:

Part I  Prepare tape pieces

1. You will need 6 pieces of tape, each 15–20 cm long, with the last centimeter folded over to create a non-sticky handle.
   1. Place two of the tapes on a flat surface and label the handles “B” for base tape.
   2. Place two pieces of tape directly on top of these tapes, and label them “L” for lower tape.
   3. Place the last two pieces of tape directly in top of the L tapes, and label them “U” for upper tape.
2. Smooth the tapes down to the table with your fingers until there are few air bubbles.

Part II  Make observations

1. Pull one U tape rapidly off the other tapes. Bring the non-sticky side near to various objects. What do you observe?
2. Pull the second U tape rapidly off the other tapes. Bring the two U tapes together and observe.
3. Replace the two U tapes on top of the L-tapes and smooth them down.
4. Pull an L tape up off the B tape, bringing the U-tape with it. Does it behave like the U tape did?
5. Use your fingers on the non-sticky side of the U-tape to “neutralize” the tape by running your fingers down the tap from top to bottom. Do this several times until the combined U and L tapes no longer act like a U tape.
6. Quickly pull apart the U and L tapes. How do these tapes behave toward various objects and toward each other?
7. Replace the tapes on top of the B tape in the correct order. Repeat Steps 6–8 with both sets of U and L tapes. Observe what happens when you bring two L tapes toward each other.

After you are done making observations, your teacher will introduce the Charge Sensor as a measurement tool for static electrical charge. Your challenge is to develop a model to explain the events you observe.

Procedure

1. Discuss and decide what variables you will consider in the process of constructing a model of the properties of electrostatic charge.
   * Consider any knowledge you have gained from previous coursework.
   * Make sure that your experiments include collection of objective data as well as observations.
2. Develop a purpose and a procedure for your investigation.
   * Your purpose should ask a question or propose a model related to the nature and properties of electrostatic charge.
   * Include an explanation of the equipment you will use.
   * Decide how much data and what observations to take in order to have enough information to satisfy your purpose and stand up to questioning by your peers.
3. Carry out the investigation and record your data and observations. Make sure all group members have access to the data.

Analysis

Evaluate your data and develop a model based on this data to explain the phenomena you have observed. The model should address the following points:

* How many types of charge are there?
* Where are the charges located when you observe an electrostatic phenomenon?
* What effect does the type of material have on charge transfer or charged state?
* Can charges be removed or eliminated?

Extensions

1. Your teacher will set up an activity demonstrating charging by induction. Use your model to explain in a step-by-step fashion what is occurring.
2. Develop or find a unique electrostatics demonstration to share with the class. In addition to conducting the demonstration, apply your model to explain the results in detail.
3. Research and summarize in a short report a history of the observations that have led up to our understanding of charge and electrostatics.