



Elementary Science Activity: EMANCIPATING ELECTRONS - Part One
By Shahram Shirani and Jill Royall, UBC Partnership Program

What's Needed:

- bag of balloons(*ask about latex allergies)
- one round tray



- handful of marbles of three different colours
- tablespoon of salt

What To Do:

1. Inflate balloons and tell the children to rub the balloons against their hair and stick them on the wall. Ask the children why the balloons stick. Record all answers on the blackboard.
2. Assign each coloured marble to be either an electron, a proton or a neutron. Describe their charges.
3. Arrange marbles on the round tray to resemble the particles that make up an atom (use a pinch of salt under each marble to stop them from rolling around).
4. Ask the children to repeat the charges of each molecule, and help them identify the overall charge on the atom.
5. Discuss what happens when electrons are taken away from the atom. (The nucleus attracts electrons.)
6. If possible, use 'role-playing'. Assign one student to be an electron, another a proton, etc. Have the group behave as an atom - you can even change their charge distribution for fun.
7. Finally, have them relate the atomic model to the balloon experiment. Indicate which aspects of the blackboard answers were on the right path.



What's Happening:

The balloon experiment demonstrates the concept of static electricity. Atoms are made of protons, neutrons and electrons, which you demonstrated using the tray & marble model. Usually an atom has as many protons as it has electrons so that its charge is balanced. When the student rubs the balloon against his/her hair, electrons from the hair are added to atoms on the balloon's surface. When the balloon is touched to the wall, the extra electrons on the rubber push away the electrons in that region of the wall and are attracted to the protons left behind. This creates enough attraction between the wall and the balloon to overcome gravity.

Future Fun:

1. Pop can racers: instead,of attaching the charged balloons to the wall, have the students hold the balloon an inch from a pop can lying on its side on the floor. By moving the balloon one can cause the can to roll. Have the students explain what is happening. Can they think of reasons why humans would harness and magnify this power?
2. If the room has a sink, have students run a comb through their hair several times. Turn on the faucet so that a very thin stream of water is flowing out. Hold the flat side of the comb close to, but not touching, the water. Have the students describe what happens to the water, at the level of the atom. If this does not work, what might be happening?



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This experiment can be conducted in one longer classroom session or over two sessions. The follow-up is ideal for a visit one week later.

What's Needed:

- one flashlight (with two C batteries)
- 30 cm of copper wire
- electrical tape
- metal spoon, piece of wood

What To Do:

1. Take apart the flashlight. Attach the copper wire from the bulb to the batteries using electrical tape.
2. Open the circuit so that two 'leads' are 4 cm apart (see Figure). Place the apparatus near the teacher's desk and set a record-keeping book beside it.
3. Demonstrate that the bulb lights up when a metal spoon is placed across the leads. Repeat using a piece of wood.
4. Tell the children to collect various objects from the classroom and have them place the objects so that they connect the two leads.
5. Talk about **insulators** and **conductors** and relate the concepts to the marble / tray model of the atom.
6. Set up a table for results in the record book using the following headings:

- | | |
|---|--|
| <ul style="list-style-type: none">• name of investigator• name of object | <ul style="list-style-type: none">• description of object (ask students for useful descriptions:
what it is made of? colour? weight?)• yes/no if bulb lights up |
|---|--|

Follow Up:

1. Visit the class one week later, and examine the table of data they produced.
2. Ask the children to describe the characteristics of an insulator and a conductor, and give examples from the objects they tested.

What's Happening:

Electrical energy is generated in the battery by a chemical reaction. When a wire is attached from the negative end of the battery to the positive end, electrons flow through the wire. The flow is called an electric 'current'. Some materials allow the flow of electric current through them (conductors) and others do not (insulators). A substance is a good conductor if it has electrons which are able to travel.

- When a **conductor** is placed across the open leads, the circuit is 'closed' (continuous) and electrons flow from the copper wire, through the object, and into the wire in the bulb (filament), which generates energy in the form of light. The students will find that metals are good conductors and most other materials are good insulators.
- When using a good **insulator** between the leads, electrons cannot travel from the negative to the positive terminal of the battery, and a current does not flow through the circuit. In order to light the bulb, a current must follow between the leads.

More Experiments:

1. For intermediate students: have them make their own insulator/conductor tester.
2. The graduate student could try some of the students' "insulators" with a higher voltage battery to see how well they insulate. A discussion of voltage could follow.

