Jupiter's Jolts

Overview: Jupiter not only has the biggest lightning bolts we've ever detected, it also shocks its moons with a charge of 3 million amps every time they pass through certain hotspots. Some of these bolts are cause by the friction of fast-moving clouds. Today you get to make your own sparks and simulate Jupiter's turbulent storms.

What to Learn: Electrons are too small for us to see with our eyes, but there are other ways to detect something's going on. The proton has a positive charge, and the electron has a negative charge. Like charges repel and opposite charges attract.

Materials

- Foam plate
- Foam cup
- Wool cloth or sweater
- Plastic baggie
- Aluminum pie pan
- Aluminum foil
- Film canister or M&M container
- Nail (needs to be a little longer than the film canister)
- Hot glue gun or tape
- Water

Experiment

1. Lay the aluminum pie pan in front of you, right-side up.
2. Glue the foam cup to the middle of the inside of the pan.
3. Lay the plate on the table, upside down. Place the pie pan (don't glue it!) on top of the plate, back-to-back. Set aside.
4. Insert the nail through the middle of the film canister lid. Wrap the bottom of the film canister with aluminum foil. Tape the foil into place.
5. Fill the canister nearly full of water.
6. Snap on the lid, making sure that the nail touches the water.
7. Rub the foam plate with the wool for at least a minute to really charge it up. Place the plate upside down carefully on the table.
8. Put the pie pan back on top of the foam plate. The plate has taken on the charge from the foam plate.
9. Touch the pie pan with a finger… did you feel anything?
10. Use the cup as a handle and lift the pie pan up.
11. Touch the pan with your finger, and you should feel and see a spark (turn down the lights to make the room dark).
12. Charge the foam plate again and set the pie pan back on top to charge it up. (Make sure you're lifting the pie pan only by the foam cup, or you'll discharge it accidentally.)
13. Hold the film canister by the aluminum foil and touch the charged pie pan to the nail.
14. Rub the foam plate with the wool again to charge it up. Set the pie pan on the foam plate to charge the pan. Now lift the pie pan and touch the pan to the nail. Do this a couple of times to really get a good charge in the film canister.
15. Discharge the film canister by touching the foil with one finger and the nail with the other. Did you see a spark?

16. The wool gives the plate a negative charge. You can use a plastic bag instead of the wool to give the foam plate a positive charge.
17. Complete the data table..

Jupiter's Jolts Data Table

For the first column, describe which object you are charging and how. For example, is it the foam plate with wool, or is it the jar with the plate? For the second column, if you're charging the plate with wool, then time yourself to see how long you rubbed it for and write this down. If you're charging the jar, then write in how many times you touched the plate to the jar and record it.

Item/Object	**How long did you charge it for?** *(measure in seconds or number of times)*	**Did it spark?**

Reading

If you rub a balloon on your head, the balloon becomes filled up with extra electrons, and now has a negative charge. Try the following experiment to create a temporary charge on a wall: Bring the balloon close to the wall until it sticks.

Opposite charges attract right? So, is the entire wall now an opposite charge from the balloon? No. In fact, the wall is not charged at all. It is neutral. So why did the balloon stick to it?

The balloon is negatively charged. It created a temporary positive charge when it got close to the wall. As the balloon gets closer to the wall, it repels the electrons in the wall. The negatively charged electrons in the wall are repelled from the negatively charged electrons in the balloon.

Since the electrons are repelled, what is left behind? Positive charges. The section of wall that has had its electrons repelled is now left positively charged. The negatively charged balloon will now "stick" to the positively charged wall. The wall is temporarily charged because once you move the balloon away, the electrons will go back to where they were and there will no longer be a charge on that part of the wall.

This is why plastic wrap, Styrofoam packing popcorn, and socks right out of the dryer stick to things. All those things have charges and can create temporary charges on things they get close to.

If you rub a balloon all over your hair, the *Triboelectric Effect* causes the electrons to move from your head to the balloon. But why don't the electrons go from the balloon to your head? The direction of electron transfer has to do with the properties of the material itself. And the balloon-hair combination isn't the only game in town.

Electrons move differently depending on the materials that are rubbed together. A balloon takes on a negative charge when rubbed on hair. Today, the kids are going to find when a foam plate is rubbed with wool, the plate takes on electrons and creates a negative charge on the plate. To give the plate a positive charge, kids can rub it with a plastic bag.

The *Triboelectric Series* is a list that ranks different materials according to how they lose or gain electrons. A rubber rod rubbed with wool produces a negative charge on the rod, however an acrylic rod rubbed with silk creates a positive charge on the rod. A foam plate often has a positive charge when you slide one off the stack, but if you rub it with wool it will build up a negative charge.

Near the top of the list are materials that take on a positive charge, such as air, human skin, glass, rabbit fur, human hair, wool, silk, and aluminum. Near the bottom of the list are materials that take on a negative charge, such as amber, rubber balloons, copper, brass, gold, cellophane tape, Teflon, and silicone rubber. Scientists developed this list by doing a series of experiments, very similar to the ones we're about to do.

Exercises

1. What happens if you hold the nail and charge the aluminum foil?
2. Can you see electrons? Why or why not?

Answers to Exercises: Jupiter's Jolts

1. What happens if you hold the nail and charge the aluminum foil? (It also works to charge up the film canister.)

2. Can you see electrons? Why or why not? (No – they are too small!)