Community in the Classroom Presentation Plan

Lesson Name Zap, Crackle & Pop: Static Electricity Everywhere

Presenter(s) Bruce Jackson

Grade Level 4th **Standards Connection(s)** Physical Science: Electricity/magnetism: behavior of electrically charge objects (repel, attract)

Abstract:

What's going to be fun and interesting about your visit! Electricity is everywhere—in your brain & hair, the paper on your desk, mountains, trees, clouds & lakes. We don't notice it usually because it's invisible and "static:" not moving. It usually doesn't move because it's 'hugging' its friend. Tiny atoms are made up of negative (-) and positive (+) particles: protons & electrons. They are usually exactly balanced: for every 100 protons there are 100 electrons hugging them. But you can rub off some electrons so there are places that have too many and other places with too few. We call this an electric charge. Extra electrons are always trying to get back to their protons, which in turn are always hungry for a hug from free electrons. We call this attraction. But electrons never like other electrons; protons don't like other protons, and they're always trying to push each other away. We call this repulsion or repelling. Materials that let electrons move about and easily get back to their protons are called conductors. Most metals are very good conductors; paper, glass and plastic are not. A Van De Graff generator makes big electrical charges. Students can make similar charges with wool and plastic and see how static electricity behaves.

Vocabulary/Definitions:

3 – 6 important (new) words:

- ***Static:*** not moving, staying still
- ***Electrons & protons:*** negative (–) and positively (+) charged particles in the atom
- ***Attract & repel:*** attract = pulling towards each other; repel = pushing each other apart
- ***Negative charge:*** too many electrons (–) on something;
- ***Positive charge:*** not enough (–) electrons or too many (+) protons.
- ***Conduct:*** let electrons flow easily

Materials:

What you'll bring with you: Van De Graff generator & demonstration materials, extension cord & plastic crate; 8 sets: plastic & aluminum plates, wool cloths, & static electricity materials in storage bags. Work sheets (unless run off by teacher.)

What students should have ready: Pencils, run off work sheets, scrap paper.

Classroom Set-up:

Student grouping, Power/Water, A/V, Light/Dark, set-up/clean-up time needed: Curtains pulled. OH projector ready. Grounded power outlet within 25 feet. Students in groups of 3-4, 8 groups maximum.

Classroom Visit

1. Personal Introduction: 5 Minutes

Who are you? What do you want to share with students and why? How will you connect this with students' interests? I'm "Dr. J." I've had several careers—in Washington and embassies overseas, in the phone company with computers, and in schools with students of all ages. Science has always been a hobby—I've tinkered with electronic gadgets, installed electrical wiring in my parents' house, and fixed electrical problems in car motors.

At your age I was living in Arizona where every summer we had exciting thunderstorms. How many of you have been in thunderstorms? I learned to count the seconds after each lightning flash: one-a-thousand, two-a-thousand… If thunder came within 5 seconds, I knew the lightning was less than a mile away (and my mother

would call me to get inside!) Does anyone know why this works? Has anyone been close enough to a lightning strike to hear the thunder instantly as a loud crash?

Topic Introduction: 5 Minutes

Big Idea(s), vocabulary, assessing prior knowledge. What questions will you ask to learn from students?
Key words on board: Who knows what they mean? Who has ever felt a spark when they climbed out of a car? Rubbed their shoes on a carpet and then touched someone else? Had trouble with kitchen wrap or scotch tape sticking to itself? Gotten a spark from petting a cat or removing a sweater? If so, you've experienced electricity. There are more dangerous ways to feel it—300 people are injured every year by lighting; about 60 are killed. Others are killed by touching the 3rd rail of BART or the power lines that bring power to your house. But there are many safe things you can do with electricity. Our goal today is to do some of them and pay close attention to what's happening. With your careful observation and my help, you should be able to explain what's happening in each activity and why things act so strangely!

2. Learning Experience(s): 35 Minutes

Demonstrations, hands-on activities, images, games, discussion, writing, measuring… What will you do, what will kids do? Describe in order, including instructions to kids.

- *Distribution of work sheets for recording data; set up of aluminum pans. Instructions to students: Names & dates on worksheets: find section on flying pans.*

A. Initial demo: Van de graff generator and flying pans. All student silent and watching carefully. Generator turned on, pans fly, one at a time. Students sketch results and write about what happened. Volunteers to explain results. How to test explanations (hypotheses)? Is it really electricity? Turn on again and use fluorescent light bulb. Yes, It seems to be electricity. Diagram on board or OH like students' diagram: put in – and + signs. Write rule for students to copy: like charges repel; opposite charges attract. How does this explain pans? Now you're ready for you own experiments. If everything goes well, we'll have volunteers for a final demo with the machine!

- *Distribution of Static Electricity bags. Instructions to students: Care with materials, classroom rules. Following directions on worksheets. Checking materials list at beginning and end of projects.*

B. Attraction experiments: Magic Wands, Dancing Bits, Active Plates. Students work in pairs trading materials in their groups until all have done the first set and recorded their results. Group sharing, then short class discussion as group spokespersons record out with explanations. Prize for groups with all completed and data recorded.

C. Repulsion experiments: Plastic strips that stand perpendicular to the plate (magic snakes!). Aluminum disc on Styrofoam plates with foil scraps. Lifting charged plates from desks. Hanging yarn. More prizes.

D. Prediction challenge: Volunteers: one with yarn and plastic rag; one with plastic strip and wool rag. What will happen if each rubs their hanging substance with their rag. Same or different results? Perform the demo. Congratulate those who got it right. Now what will happen when we bring the hanging strips together? Why? Try it and get an explanation for the result.

E. Final Van de Graaf demo: Student on plastic crate, hair flying. Students record. First with a good explanation gets to try it also. Finish with wig and pompoms.

3. Wrap-up: Sharing Experiences and Building Connections 10 Minutes

Putting the pieces together – how will students share learning, interpret experience, build vocabulary? Erase or cover vocabulary words on board. Ask students in groups to quiz each other in groups on vocabulary; then do quick whole-group check for understanding. Ask students for ideas about how to find out more information (Internet, library, encyclopedias, Exploratorium, etc.). Put up "Lightning rods" and "Saint Elmo's fire" on board and have students copy these on worksheets while giving brief description. Ask for ideas about what might be happening & suggest they find out & report to the class.

4. Close: 5 Minutes

How can kids learn more? Clean-up. All static electricity materials back in plastic bags; all worksheets to teacher. All demo materials packed up. *Thanks and good-bye!*

TOTAL 50 – 60 Minutes

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Follow-up – After Presentation

Suggest students write a letter explaining "How we learned about _____?"
List or attach examples of activities, websites, connections for additional learning.
Attach worksheets, hand-outs, visuals used in classroom presentation.

- Students could look in their science books to see how the static electricity activities fit in.
- Student could write letters to "Dr J" about what they learned about static electricity.
- I will leave some Exploratorium handouts about things students could try at home and report back on.
- I will leave some sheets of suggestions the teacher could try in the classroom on a really dry day.
- I will leave a list of websites for further exploration.
- Here's a short list of things for Googling: Lightning, ball lightning, St. Elmo's fire, foo fighters, plus all the new terms from the activities so far.
- Students could read (or have the teacher read aloud) the book *Ben & Me* by Robert Lawson.
- Advanced readers could read *The Kite that Won the Revolution* by Isaac Asimov.

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Zap, Crackle & Pop!

Static Electricity Investigations

Name: _____ Date: _____

Partner: _____

Part I. Vocabulary: fill in the definitions:

static:_____

electrons: _____

protons: _____

attract: _____

repel: _____

negative charge: _____

positive charge: _____

conduct: _____

Part II. Van de Graaf Generator & and the flying pans

A. **Watch carefully and record what happened with the pie pans: in words ↓, and with a sketch. →**

_____

_____

_____

_____

B. After the class discussion, write down the first rule of static electricity***:*** _____

Part III. Explorations in attraction. Check off each box when completed.

❒ A. Materials check: Your group of 3-4 will be sharing materials. Take them from your bag and stack them neatly on your desk. Find the materials list in the bag. One person should use it to check off your materials: 2 clear plastic panes, 1 clear plastic rod, 1 thick styrofoam rod, 2 pieces of wool cloth (brown & purple), 2 pieces of soft foam plastic (blue on back), 4 styrofoam plates (2 labeled A & 2 labeled B), 2 lengths of yarn, a styrofoam egg carton lid, 1 plastic mailing tube (red ends) and 1 small plastic bottle containing aluminum foil scraps.

❒ B. **Magic wands**:

1. Take a scrap of paper, tear it up into bits this size:
2. Take turns rubbing the clear plastic or Styrofoam rod with wool, cotton, or soft plastic until you can get it to attract the scraps of paper when you hold it near them. Which soft materials worked best? _____What other things can you attract with your 'magic' wand (try hair, threads, etc.)

_____

3. Draw a sketch of your magic wand and paper scraps: →

❒ C. **Dancing bits:**

1. Place the rectangular plastic pane across two paperback books so there's space underneath. Put some bits of paper under it and rub the top with wool or soft plastic. Record what happened:

_____

_____

Was there anything other than attraction going on? _____ If so, explain:

_____

❒ D. **Active plates**. 1. Put plastic plate #1 flat on your desk and rub it with a wool cloth until it seems to stick to your desk. Sprinkle bits of paper, plastic and foil on it. Record what happened:

_____

2. While you have bits sticking to the plate, lift it slowly off your desk. Record what happened:

_____

3. Think up at least one possible explanation for what happened when you lifted the plate (it doesn't have to be scientific):_____

_____

STOP HERE AND MAKE SURE EVERYONE IN YOUR GROUP HAS COMPLETED ALL OF PART III

Part IV. Explorations in repulsion (& attraction). Check off each box when completed.

❒ E. **Plastic "snake"-charming**. 1. Take out the piece of plastic egg-carton lid with a thin strip of soft blue plastic taped to its center. Figure out a way to get it to stand up vertically with nothing holding it. Explain how you did it:

_____

2. Record what happens when it is standing up away from the plastic lid, and you bring your finger close to it:

_____

❒ F. **Metallic launching pad**. 1. Put aside the first plastic plate and get out plate #2. How is it different from #1? _____

2. Charge this plate with your wool cloth and this time drop bits of foil onto the aluminum patch. Record what happened and what it reminded you of: _____

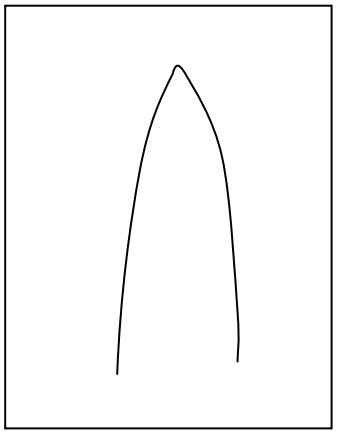
_____

3. What might explain what happened? (Hint: try to remember a special property of metals)

_____

_____

❒ G. **Repulsion and attraction**. 1. Rub a long piece of yarn with the foam plastic cloth and hold it from the middle so it hangs like the one in the sketch. Have your partner do the same with another piece of yarn. When one of you puts your hand between the hanging yarn ends, what happens?



_____

2. What happens when you bring your two pieces of yarn close to each other? _____

_____

3. In the sketch at right, draw **+** or **–** marks to show what charges the pieces of yarn must have. →

4. What is the rule of static electricity that this shows?

_____