GET TO KNOW BEN FRANKLIN

STEM

Grades: 4-6

Objectives: Benjamin Franklin was fascinated by electricity. Host a classroom "Electricity Party" that gives students to the opportunity to:

- Learn to make observations about electricity.
- Modify an experimental design to help answer questions.
- Draw models and construct explanations about processes and
- phenomena that cannot be easily seen.

Sources: PBS/WETA

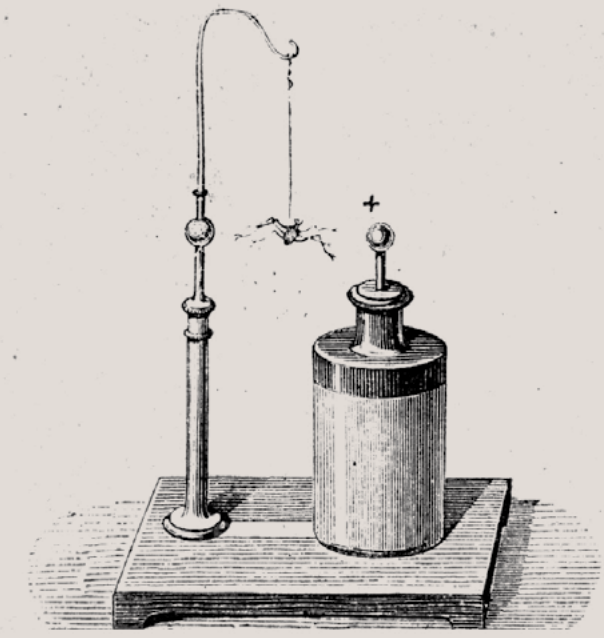
WETA PBS

HOST AN ELECTRICITY PARTY!

OVERVIEW

"I never was before engaged in any study that so totally engrossed my attention and my time."

- Benjamin Franklin



Benjamin Franklin was fascinated by electricity, and enjoyed sharing his discoveries with friends and colleagues. In this activity, you will host a party, as Franklin did, where you will make some observations about static electricity and figure out how to impress your friends and family with different experimental designs. Franklin would do tricks with electricity, such as making bells ring or fake spiders jump. It was from these experiments and observations that he was able to further his understanding of electricity and lightning. This activity invites participants to tinker with static electricity.

TIMING
2 HOURS

OBJECTIVES
Learners of all ages will...

- Learn to make observations about electricity.
- Modify an experimental design to help answer questions.
- Draw models and construct explanations about processes and phenomena that cannot be easily seen.

This activity is ideal for community events and classrooms (children 7+). You will need time to collect and organize all the materials in advance of the event, especially if you are working with younger audiences. Ensure that you have a set of the materials for each group of 3-4 participants. We recommend having at least one adult in each group of young learners, if possible. For younger learners, you might need to provide more support for the more open ended explorations.

In the classroom, this activity is appropriate for grades 2 and up, and could be used at the beginning of a unit about electricity. Make sure you leave enough time to gather and organize the materials for your students. This activity is a great launching point for learners of all ages to explore static electricity and how it behaves. Your group will likely generate a lot of questions, but this will lead to more learning and exploration!

MATERIALS

- Pencil
- Blank paper
- Model template provided in toolkit
- 1 ft of PVC pipe (vinyl pipe you can get at a hardware store). You could also look for other items made of vinyl in your home, such as window blinds and old records. Alternatively, or additionally, you could use a balloon, but the PVC pipe will be reusable for future experiments.
- 1 piece of wool clothing (could be a sock, hat, glove, scarf, or you could **buy a piece of wool cloth**). Alternatively, you could use your hair, but only if you are comfortable rubbing the PVC or the balloon on your head.
- 1 clear glass jar, or cup between 8- 12 oz
- 1 large paperclip
- 1 piece of cardboard, wide enough to cover the mouth of the jar
- Tape
- Scissors
- A sheet of aluminum foil at least 6x6 inches
- Additional items for more experimentation:
  - 3-4 inch pieces of thin twine or rope
  - Plastic wrap
  - Tiny pieces of Styrofoam
  - Other rods or pipes made out of metal or glass
  - Salt or pepper
- Access to PBS LearningMedia videos about static electricity:
  - **Testing for Static Electricity:** https://www.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zele/testing-for-static-electricity/
  - **Static Electricity: Snap, Crackle, Jump** https://pbslearningmedia.org/resource/phy03.sci.phys.mfe.zsnap/static-electricity-snap-crackle-jump/
  - **Static Electricity: DIY Science Time** https://pbslearningmedia.org/resource/b27c3297-ecc7-4254-bdeb-8e0cf208c8fc/static-electricity-diy-science-time/

PROCEDURE

PART 1: SETTING UP THE EXPERIMENT (10 MIN)

1. Cut out a cardboard lid for the jar or cup (this could be done in advance).

2. Cut out two strips of aluminum foil measuring ¼ inch x 3 inches.

3. Straighten outside of the paperclip and poke the end through the middle of the cardboard lid. Then, tape this side of the paperclip to secure it to the cardboard.

4. Shape the other end of the paperclip into a "J" and use the end to poke holes through the two strips of aluminum foil. When you hold the cardboard with the "J" of the paperclip down, the foil strips should hang next to each other.

5. Place the lid on the jar with the aluminum foil strips hanging down. The foil strips should not touch the bottom of the jar. If they do, you can trim them with the scissors or adjust the position of the paperclip.

Experimental setup showing how the cardboard, paperclip, and aluminum foil strips should be arranged and placed on the jar.

PART 2: ELECTRIFYING OBSERVATIONS! (20 MIN)

1. Before touching the materials, discuss as a group what you think would happen if we: 1) Rub the PVC pipe with the wool cloth, and then, 2) move the pipe close to the end of the paperclip poking out of the jar without touching the paperclip. After you talk, draw some of your ideas.

2. Now, we will test your ideas! Rub the PVC pipe (or balloon) with the wool cloth (or your hair) for at least 5 seconds. Some students might start talking about static electricity, or notice little snaps and shocks that come off the PVC pipe.

3. Make sure the whole group is watching the jar and place the PVC pipe near the end of the paperclip poking out of the jar, but don't touch it! What happened?! Record your observations on your paper.

4. Now move the PVC pipe away from the jar. What happened?! Discuss with your group members!

5. Now work in pairs and draw a model of what happened during the experiment. A template for modeling is provided in the toolkit. Think about what you can see and what you cannot see with your eyes. Show what you think was happening when the PVC pipe was rubbed against the wool, and what happened as the PVC pipe was moved toward and away from the jar. Write down any questions in the box at the bottom of the handout.

PART 3: CONTINUE EXPLORING AND ANSWERING QUESTIONS (40-60 MIN)

1. Now it's time for you to share ideas with the whole group or class (10 min). Ask participants:

- What did you include in your model?
- How can you explain what happened in the jar?
- How could you test your ideas?
- How would you change your model based on the ideas that have been shared?

Remind learners of all ages that in Benjamin Franklin's time, scientists didn't have perfect explanations for how electricity behaves, and many of the early experiments looked a lot like this one! As you work to figure out what is going on, you are following in the footsteps of these scientists, and exploring in this way will give you a better understanding of what is happening!

2. After all the groups have shared, ask the groups to experiment more with the materials provided. Some experiments could include:

- Touching the PVC pipe to the paperclip on the jar.
- Rubbing the PVC pipe for different amounts of time or on different materials.
- Touching the PVC pipe directly to a piece of aluminum foil.
- Placing other objects in the jar, such as a piece of rope, Styrofoam, or salt to see what happens.
- Touching the paperclip with your hand when the PVC pipe is close to the jar.
- Touching the paperclip with other household objects (remind young learners to be courteous and ask if they can use something if they are not in their own home).
- Rubbing other materials (metal, plastic, glass, etc.) and then touching the paperclip.
- Replacing the aluminum foil strips with smaller or larger strips, or with another material, such as paper.
- Test paper strips with and without shading one side with pencil.
- There are SO many possibilities!

Over time, you will start to figure out which conditions and materials used in the experiment will change the results and which ones do not. Remember to write down or make sketches of your experimental setups and observations. (20 min)

3. Come back together at the end of the class or event to discuss what materials were used by the different groups. Write ideas on the board to document what the group figured out. Then watch one or more of the PBS LearningMedia resources linked below that are appropriate for your audience or classroom to further everyone's understanding of the experiment(s). Ask students how the experiments in these videos are similar or different from the ones they conducted. (10-40 min)

- **Testing for Static Electricity:** https://www.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zele/testing-for-static-electricity/
- **Static Electricity: Snap, Crackle, Jump** https://www.pbslearningmedia.org/resource/phy03.sci.phys.mfe.zsnap/static-electricity-snap-crackle-jump/

- **Static Electricity: DIY Science Time** https://www.pbslearningmedia.org/resource/b27c3297-ecc7-4254-bdeb-8e0cf208c8fc/static-electricity-diy-science-time/

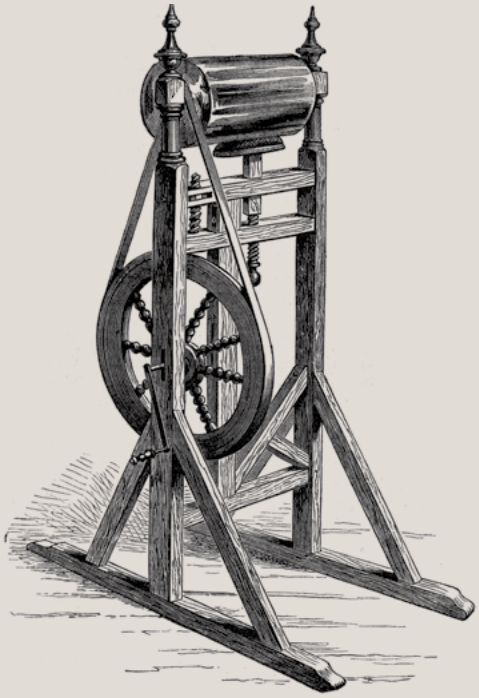
- **Additionally, here are some simulations works for teachers, community leaders, and adult learners to help visualize how this experiment and static electricity works:**

  - **SIMPOP Electroscope:** https://simpop.org/electroscope/electroscope.htm

  - **PhET Interactive Simulations, University of Colorado, Boulder:** https://phet.colorado.edu/en/simulations/balloons-and-static-electricity

  - **Balloon Charging Lab (simulation)** https://www.pbslearningmedia.org/resource/arct15-sci-balloonchargin glab/balloonchargin g-lab/

4. Finally, have everyone work in pairs to revise their models and apply what they have learned to explaining what happened in the experiment. Everyone still might have more questions, and that's OK! There is a lot more to learn about electricity and how it works!



Benjamin Franklin´s First Electrical Machine

Draw a model of what you think is happening during the experiment in the space below! Think about what you can see and what you cannot see at different points in the experiment. What changes?

Explain using words and diagrams what happened when...

The PVC pipe was rubbed with the wool...	The PVC pipe was moved near the paperclip in the jar....	The PVC pipe was moved away from the paperclip in the jar.

Questions I have...