Static Electricity

4 Sessions: 1 session per each activity (approximately 1 to 1 $\frac{1}{2}$ hours per session)

Connections and Suggestions

Science—Students will explore the properties of static electricity—creating and using static charges.

Technology—Students will use computers or tablets to record and report on the results of these static-electricity investigations. They can record results on charts they create. They will do a final journal entry and respond to testable questions posed in the introduction to the unit.

Engineering—The engineering in these activities involves design features that facilitate the creation of static charges. Students can observe the effects of these static charges.

Math—Most of the math in this unit involves timing the length that a static charge is held by various materials and determining the amount of material that a charge attracts.

Materials

- aluminum foil
- balloons of various shapes and sizes
- black pepper
- cinnamon
- fishing line, thin string, or thread
- grass seeds
- large sheets of paper, such as colored construction paper
- oregano
- parsley
- ruler
- scissors
- small bits of dried leaves and grass
- small pieces of cotton
- stopwatch/watch/clock
- table salt
- white facial tissue/bits of tissue paper
- white paper

Unit 3 Vocabulary

attract—to draw toward an object

conductor—a material that allows electrons or an electrical current to flow easily (electrons move freely in an electrical current)

current—the flow of an electric charge carried along by moving electrons in a conductor, such as a wire from a source of electricity (such as a battery) to a use for electricity (such as lighting a bulb)

discharge—the release of static electricity through a gas, liquid, or solid

electromagnetism—one of the four fundamental forces holding the universe together

electron—a particle circling an atom, carrying a negative charge

electroscope—an early scientific instrument used to detect the presence of an electric charge or to measure it

electrostatic discharge—the release of static electricity when two objects come into contact (such as when you touch metal after shuffling your feet on carpet)

inflate—to fill with air or gas

neutron—a particle in the nucleus of an atom that has no charge

particles—bits of matter or parts of atoms—includes particles with positive charges (protons) or negative charges (electrons)

proton—a particle with a positive charge in the nucleus of an atom

repel—to thrust or push away from an object

static electricity—a build up of electric charges on the surface of a material—the charge remains until it can move away either by electric current or electrical discharge

Discussion Prompt:

We've all felt that painful, frustrating *ZAP* when we've walked across a carpet and reached for a metal door handle. Or we've pulled off our hat only to discover our hair is standing straight up from our head! Static electricity can often be annoying (if not painful), but there are ways to help eliminate it. Increasing the humidity in your home helps, as dry air increases the frequency of shocks. In the same way, spritzing water on your hair helps reduce the static electricity. Dryer sheets thrown in the dryer coat clothes with a conductive substance that keeps them from having "static cling." There are even anti-static hand lotions! What else have you found to help reduce static electricity?

Static Electricity

There are no wires nor continuous flow of electricity in static electricity. Instead, static electricity is created by rubbing certain materials against each other. For example, materials such as rubber, plastic, or glass rubbed against hair, silk, wool, some other types of cloth, and similar materials can create static electricity. Because these materials do not conduct electricity easily, the rubbing tends to build up and maintain a static charge for a short time.

All physical objects are made up of atoms. Within each tiny atom are three smaller kinds of particles: protons, neutrons, and electrons. Protons are positively charged. Neutrons are neutral (they have no charge). Electrons are negatively charged.

Opposite charges attract. Like charges repel. Most of the time, positive and negative charges carried by protons and electrons are balanced within an object. Static electricity occurs when the charges are not in balance. Rubbing certain objects together transfers electrons from one object to another. For example, rubbing a balloon on your clothes transfers a surplus of electrons to the balloon. A wall—which would be more positively charged than the balloon in comparison—would then attract the balloon, causing it to stick to the wall. The same thing happens when you rub your shoes against a rug. This creates a static charge when you touch a cat or dog. Your pet may have some raised hair for a while.

Use a computer or tablet to search for information on the Internet to help you as you complete the activities in this unit. Helpful search items include:

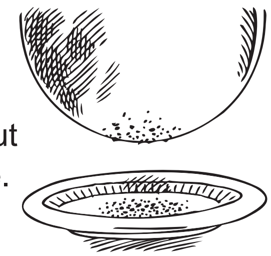
electric charge	neutrons	protons
electric current	electrons	static discharge

Pepper Picker-Upper

Directions: Work in teams of two as you perform this first activity. Gather these materials as directed by your teacher.

Team Materials

- balloons of various shapes and sizes
- black pepper
- ruler
- white paper (or paper plate)



1. Spread about three pinches of pepper on a piece of white paper or paper plate. Inflate a small balloon, such as one used for water balloons. Tie it off and rub the balloon ***one way only*** through your hair 10 times. (Do not rub back-and-forth for the first two tests.) Hold the balloon about 12 inches (30 cm) above the pepper. Use a ruler to measure the distance.

   Did you attract any pepper to the balloon? ____________

   Clean the balloon, rub it again the same way, and lower the balloon to 6 inches, then 3 inches. What results did you get? Record how much pepper your balloon picked up: ALL, MOST, SOME, or NONE.

RESULTS AT 12 INCHES	RESULTS AT 6 INCHES	RESULTS AT 3 INCHES

2. Do the experiment again, but rub the balloon 20 times this time—***one way only***. Hold the balloon 12 inches above the table with the pepper. (Use a ruler to measure the distances.) Record how much pepper your balloon picked up. Test again at 6 and 3 inches.

RESULTS AT 12 INCHES	RESULTS AT 6 INCHES	RESULTS AT 3 INCHES

3. Try the experiment this time by rubbing the balloon ***back and forth*** across your hair. Hold the balloon 12 inches above the table that has the pepper. Record how much pepper your balloon picked up. Clean the balloon, rub it again, and lower it to 6 inches, then 3 inches. What results did you get? Record how much pepper your balloon picked up.

RESULTS AT 12 INCHES	RESULTS AT 6 INCHES	RESULTS AT 3 INCHES

4. Why do you think you didn't pick up as much pepper when you rubbed your hair back and forth? What did you do that was different?

____

____

____

____

PEPPER PICKER-UPPER

5. Replace the pepper and inflate a **long balloon**. Do the experiment again. Be sure to rub the length of the balloon against your hair. Rub 10 times in ***one direction only***. Record the results below. Test again at 6 inches and 3 inches.

RESULTS AT 12 INCHES	RESULTS AT 6 INCHES	RESULTS AT 3 INCHES

6. Now rub 20 times—***one way only***. Record your results for 20 rubbings.

RESULTS AT 12 INCHES	RESULTS AT 6 INCHES	RESULTS AT 3 INCHES

7. Replace the pepper and inflate a **large, round balloon**. Rub the balloon against your hair 10 times—***one way only***. Record the results below.

RESULTS AT 12 INCHES	RESULTS AT 6 INCHES	RESULTS AT 3 INCHES

8. Rub the large, round balloon 20 times against your hair—***one way only***. Record the results.

RESULTS AT 12 INCHES	RESULTS AT 6 INCHES	RESULTS AT 3 INCHES

9. Which balloon carried the best static charge and thus picked up the most pepper?

____

10. What advantage did the long balloon have over the small balloons? Why was it able to pick up a lot of pepper?

____

____

11. Did the round balloon work as well as the long one or the small one? ____________

12. What advantage does the size of the round balloon give it in picking up the pepper?

____

____

13. What did the static electricity produce by rubbing your hair or your partner's hair?

____

____

NAME ______________________________

Pepper Picker-Upper

Journal Entry

1. The static electricity produced by rubbing hair is the force that picked up the pepper flakes. Where and when have you seen static electricity at home or at school?

   ____

   ____

   ____

2. What other items besides pepper could you pick up by rubbing a balloon?

   ____

   ____

   ____

3. Why do you think a balloon worked but a paperback book would probably not work?

   ____

   ____

   ____

4. What other materials besides a balloon might hold a static charge? Why?

   ____

   ____

   ____

5. What other materials or things might produce a static charge when rubbed by a balloon?

   ____

   ____

   ____

Design Process Review—Pepper Picker-Upper

Share your journal entries and experiences with your class during a discussion moderated by your teacher.

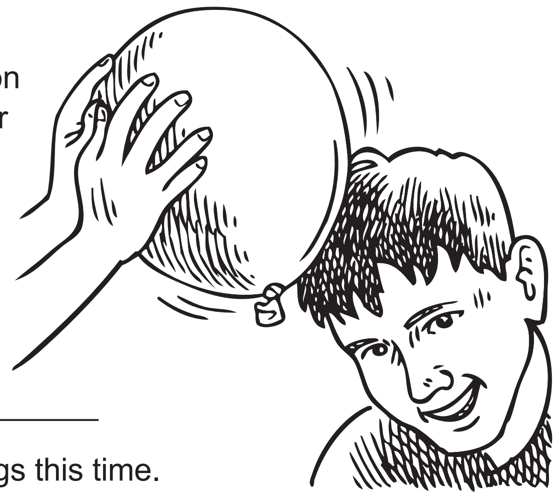
NAME ______________________________

BALLOONS ON THE WALL

TEAM MATERIALS

- balloons of different shapes and sizes
- computer for data entry
- stopwatch, watch, or clock

Directions:



1. Blow up and tie one **long balloon**. Rub the balloon **one way only** over your hair. Rub it over your hair front-to-back and then rub it again front-to-back. Repeat this for about 10 rubbings.

2. Place the balloon on a wall in the classroom. Time how long the balloon remains on the wall before falling.

   How many seconds before it fell? ___________________

3. Rub the balloon on your hair again. Use 20 rubbings this time. Place the balloon on a wall in the classroom. Time how long the balloon remains on the wall before falling.

   How many seconds before it fell? ___________________

   Was this longer than your first effort? ____

4. Rub the balloon against your shirt, jeans, or another article of clothing. Rub in **one direction only**. Rub 10 times and place the balloon on the wall again.

   Time how long the balloon remains on the wall before the balloon falls.

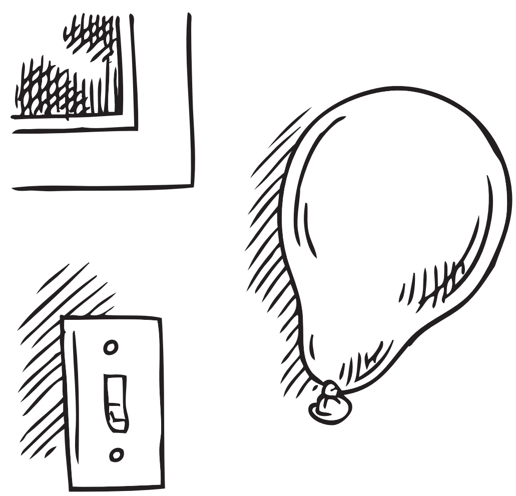
   How many seconds before it fell?

   ____

   Rub the balloon 20 times on your clothes and place it on the wall. Time how long it stayed on the wall.

   How many seconds before it fell?

   ____



Name ______________________________

Balloons on the Wall

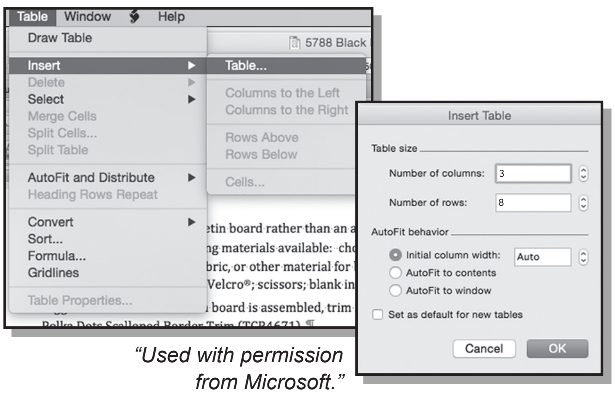
Trials

Directions: Complete the trials listed below with the long balloon and record the times in seconds and minutes for each experiment.

Charting Results—Technology Procedure

Use a computer to make a table like the one below.

1. Open **Word** or **Google Docs**.
2. Click on the **Table** and insert a table. You will need to fill in how many rows and columns you need.



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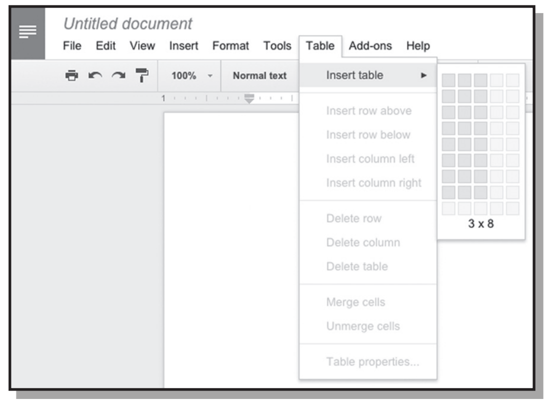

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3. The table should have 3 columns and 8 rows.
4. Your empty table will appear on your page.
5. You can make adjustments by going back to **Table** on the menu bar. You can make the size of the cells different, and you can add or delete rows and columns.
6. Label the table and fill it in with the results of testing your balloon. Add any notes and observations that you made while testing.

Long Balloon		
Material Rubbed	**# Times Rubbed**	**Time on the Wall (min./sec.)**
1. hair	20	
2. jeans/pants	20	
3. shirt	20	
4. friend's hair	20	
5. down one arm	20	
6. shoe	20	

Which material was best for creating a static charge? Why? ______________________________

____

Test some other materials from the classroom, your desks, your backpacks, and the closet. Create a table like the one above listing the materials and whether they had **no attraction**, **some attraction**, or **strong attraction**.

NAME ______________________________

Balloons on the Wall

Testing Other Balloons

Try a different balloon shape or size. Record your results below.

BALLOON SHAPE: ______________________________

Material Rubbed	# Times Rubbed	Time on the Wall (min./sec.)
1. hair	20	
2. jeans/pants	20	
3. shirt	20	
4. friend's hair	20	
5. down one arm	20	
6. shoe	20	

Try your favorite balloon shape. Describe your balloon and record your results in the table.

BALLOON SHAPE: ______________________________

Material Rubbed	# Times Rubbed	Time on the Wall (min./sec.)
1. hair	20	
2. jeans/pants	20	
3. shirt	20	
4. friend's hair	20	
5. down one arm	20	
6. shoe	20	

Balloons on the Wall

Journal Entry

1. Which type of hair worked best? Did it make a difference if it was short hair, long hair, curly hair, fine hair, or thick hair? Did it help if there was some type of product (hairspray or gel) in the hair?

   ____

   ____

   ____

2. How did the shape of the balloon affect its ability to stick to the wall? Did the balloon need a large surface area in order to stick to the wall?

   ____

   ____

   ____

3. What did you learn that you didn't know before this experiment?

   ____

   ____

   ____

4. How could you use at home what you learned from this activity?

   ____

   ____

   ____

5. Where have you seen static electricity working at home or school?

   ____

   ____

   ____

Design Process Review—Balloons on the Wall

Share your journal entries and experiences with your class during a discussion moderated by your teacher.

NAME ______________________________

Static Pick-Ups

Directions: Work in teams of two as you perform this activity. Gather these materials as directed by your teacher.

Team Materials

- balloons of different shapes and sizes
- cinnamon
- clock or stopwatch
- grass seeds
- large sheets of paper, such as colored construction paper
- oregano
- parsley
- pepper
- small bits of dried leaves and grass
- small pieces of cotton
- table salt

Unpeppering the Salt

1. Blow up a balloon of any size or shape. Choose one that you found worked well in previous experiments for producing and holding a static charge.
2. Spread some salt onto a piece of paper.
3. Rub the balloon along your hair ***one way only*** 10 times.
4. Hold the balloon a few inches above the salt. Describe the results. How much salt, if any, did the balloon attract? Could you hear it being picked up by the balloon?

   ____

5. Wipe the salt off the balloon so it falls back onto the paper. Try the experiment again using a different material on which to rub the balloon, such as a friend's longer hair, the length of a pair of jeans, or a wider piece of material. What were the results this time with 10 rubbings?

   ____

   ____

6. Do the same experiment with 20 rubbings. What happened to the salt?

   ____

   ____

7. Stir some black pepper in with the salt on the paper. Rub the balloon 20 times again. Could you "unpepper" the salt by lifting the pepper from the salt? Describe what happened.

   ____

   ____

   ____

N A M E ____________________

Static Pick-Ups

Unpeppering the Salt *(cont.)*

8. Stir in some other herbs and spices—such as oregano, cinnamon, or parsley—into your salt-and-pepper mixture. Rub your balloon 20 times on your favorite hair or material. What were you able to pick up?

____

____

9. Tear one tissue into small pieces that are each about an inch long. Place a layer of tissue next to the inch-long pieces. Rub your balloon on your hair or your favorite material for creating a static charge. Do 20 rubbings—one way only. What pieces did it pick up? Describe your results.

____

____

10. Put a charge on your balloon with another 20 rubbings. Try picking up the seeds, grass, leaves, and other smaller particles listed on the previous page in the materials section. How close do you have to be to attract some of the heavier pieces?

____

Try chalk dust, lint, and any other light pieces you can find. Describe your results.

____

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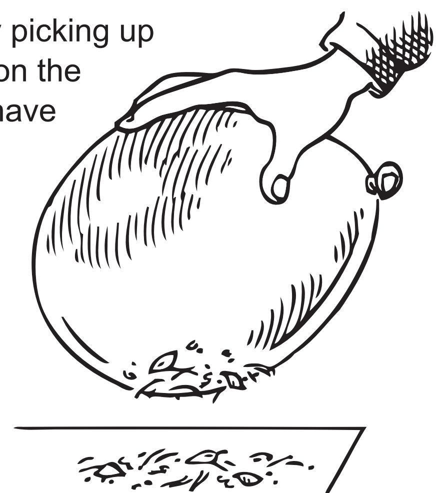

11. Which materials were the easiest to pick up with the balloon?

____

____

12. Were you unable to pick up some of the materials? Were they too heavy?

____

____

13. How long did it take for the seeds, grass, leaves, and other material to fall off the balloon?

____

____

NAME ______________________________

Static Pick-Ups

Journal Entry

1. What was the easiest material to pick up? What type of rubbing provided the best static charge?

2. How could you make a game out of these static-electricity experiences?

3. How could you help someone take lint off a piece of clothing with a balloon?

4. Which activity did you enjoy the most in these static-electricity tests? Why?

5. What did you learn from these static-electricity experiences?

Design Process Review—Static Pick-Ups

Share your journal entries and experiences with your class during a discussion moderated by your teacher.

It's Electrifying!

Challenge Activity—Attracted or Repulsed?

You have been working with static electricity for three periods now and experiencing it since your parents first combed your hair as a very young child. (Young children often have light, thin, hair that provides an excellent static charge on a comb.) You may design and develop your own experiment based on your previous experiences or use one of the choices below as a starting point. Use the Design Process Worksheet on page 5 to help you.

Choices to Consider

1. Plan and conduct an experiment to determine which student's hair or article of clothing creates the best static charge.
2. Make static streamers. Cut thin strips of notebook or plain white paper about 3 inches long. Place a static charge on a balloon or comb. Hold the charged item next to the long, thin strips. Can you see a static reaction? Try using tissue paper or thin strips of aluminum foil cut in the same way.
3. Become an Electric Student. Decorate your clothes, hair, face, arms, or legs with static-producing material or several balloons. The other team member will try to create the best charge or the most dramatic static response for hair or other materials.

or

Take the Challenge! Attracted or Repulsed?

(This activity requires participation from multiple class members.)

Each student should use their own balloon. Tie a piece of fishing line about 6 inches long on the knotted end of the balloon. Place a good static charge on the balloon. Rub it on your hair—***one way only***—10 to 20 times.

While holding your balloon by the fishing line, check each student to see if it is pushed away—repulsed—by the other person's balloon or attracted to it. (You can also see if the other person's hair or clothes are attracted to or repulsed by the balloon.) You may need to "recharge" your balloon throughout the activity.

Record your results on the next page.

IT'S ELECTRIFYING!

CHALLENGE ACTIVITY—CHARTING RESULTS

Use a computer to make a table like the one below.

1. Open **Word** or **Google Docs**.
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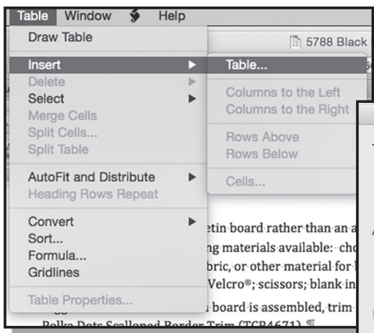

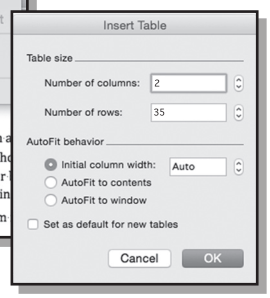

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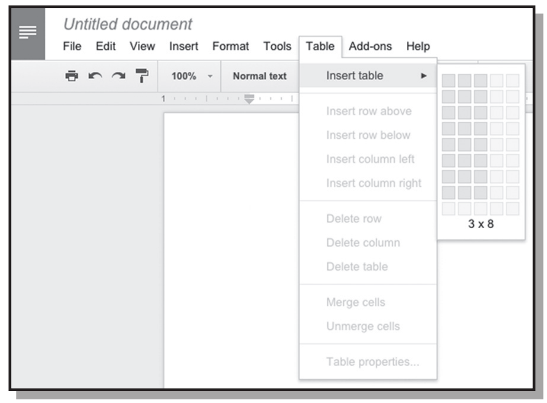

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3. The table should have 2 columns and as many rows as there are students in your class.
4. Your empty table will appear on your page.
5. You can make adjustments by going back to **Table** on the menu bar. You can make the size of the cells different, and you can add or delete rows and columns.
6. Label the table and fill it in with the results of testing your balloon. Add any notes and observations that you made while testing.

NAME	ATTRACTED (YES/NO)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	

NAME ____________________

It's Electrifying!

Challenge Activity—Engineering Process

Use the lines below to describe each step of your process during this challenge activity.

1. **Learning Objective** (What do you wish to discover?)

2. **Procedure** (What you plan to do, build, make, or produce in the experiment? Be specific.)

3. **Materials Needed** (Choose available materials from the classroom.)

4. **Problems** (What difficulties did you encounter?)

5. **Results** (What happened?)

6. **What did you learn?**

NAME ______________________________

It's Electrifying!

Challenge Activity—Journal Entry

Use a computer, tablet, or other device to answer each paragraph subject below. Be sure to use paragraph format and complete sentences.

Paragraph 1

Which experiment in the unit impressed you the most? Why? What was new to you in some way?

Paragraph 2

What did you learn about static electricity—either during today's activity or the entire unit?

Paragraph 3

What use do you think you could find for static electricity? Explain your answer. Be creative!

Paragraph 4

What is the difference between static electricity and current electricity flowing into your home or school? Which is more useful? Which is more interesting?

Paragraph 5

Which experiment with static electricity would you like to do again? Why?

Paragraph 6

Respond to these questions by referring back to the activities you completed in this unit.

1. *How does static electricity occur in everyday life?*
2. *How can static electricity be created or used in the classroom?*
3. *What materials are very effective in creating static charges?*
4. *When have you encountered static charges?*
5. *Why can't you plug into a source of static electricity?*

Design Process Review—Static Electricity

Share your journal entries, experiences, observations, and questions with your classmates in the class discussion your teacher leads to culminate the unit.