What Is Static Electricity?

During this investigation, you will use a balloon and some other common objects to explore and observe what static electricity is and how it behaves. Choose a number of small items to test and then rub a balloon with a piece of wool to prepare it for your investigation. Write your "testable question" at the top of your page and make some predictions about the materials you selected: What do you think will happen when they come in contact with the balloon? Will they stick (be attracted to) or do something else (be repelled)? Make sure to record your predictions before starting your observations.

Now, conduct your tests observing the materials you selected to see which ones stick to the balloon. As you test the materials, think about why this is happening. What is causing the objects to stick or not stick to your balloon? Record your results on your sheets and try to make some conclusions based on what you observed.

What Is Static Electricity?

Grade Level: 3–5

Time Required for the Task
Two 45-minute sessions

Big Ideas and Unifying Concepts
- Cause and effect

Physical Science Concept
- Transfer and transformation of energy
- Motion and forces

Inquiry Process Skills
- Ask a question about objects, organisms, and events
- Communicate investigations and explanations
- Employ simple equipment and tools to gather data.
- Make observations
- Plan and conduct a simple investigation.
- Use data to construct a reasonable explanation

Mathematics Concepts
- Data collection, organization and analysis
- Diagrams
- Measurement

Suggested Materials
Start with balloons, pieces of wool and items to test such as small pieces of tinfoil, paper, string, cotton, fabric, plastic, salt, puffed rice, flour, paper clips and packing peanuts. Then, you can let students select other items in the classroom to test. (A little water is handy to decharge objects.)

Context
This is one of several investigations with which I begin a unit on electricity. We first look at static electricity, something students know a little about from prior knowledge and experience (they know they get a shock when walking on carpet and then touching something or that clothes out of the dryer stick to each other) but are not sure exactly what is happening or why. This is a good introductory, guided investigation that focuses students on the idea that the balloon "attracts" the objects and that the wool rubbed on the balloon gives it this attraction. This information will help them through later investigations on current electricity and magnetism. It also provides the opportunity for students to practice writing hypotheses or testable questions, making predictions, recording data/observations, conducting tests and drawing conclusions.

Instructional Stages

Engagement: Students access prior knowledge and engage with phenomena.

Exploration: Students explore ideas and phenomena using inquiry to clarify their understanding of concepts.

Explanation: Students construct explanations of concepts and phenomena.

What the Task Accomplishes

This investigation will help students begin to have some ideas about what static electricity is and how it behaves. They will practice making predictions based on what they already know and then test to see if their predictions were correct. They will have the opportunity to communicate and compare with others what their conclusions are, and this will allow the teacher to assess their understanding of the concept of static electricity as well as their science process skills. It is also possible that students will extend their thinking to make observations about the characteristics of the materials tested and/or characteristics of the wool or other objects that might be rubbed against the balloon. They might also notice that two charged balloons repel each other due to like charges.

How the Student Will Investigate

Students will first examine the materials they have chosen and think about which ones might and might not stick to the balloon. They will then write their question, record their objects to be tested and make their predictions. Once they have recorded these predictions, they will rub their balloon with the piece of wool and then test each of the materials to see what happens. In drawing their conclusions, they should consider how the materials behaved when they came in contact with the balloon and then consider why. Students testing similar materials might want to check their findings with those of their classmates, to verify their data (as a scientist would do).

Interdisciplinary Links and Extensions

Science: Other possible investigations might be comparing other materials (fabrics) by rubbing them on the balloon to see if they "charge" the balloon as strongly as the wool does. This could be set up as a "fair test," where the control would be to test the same objects on similarly-sized balloons rubbed with different fabrics. Students could try other materials besides the ones included in this investigation to see what happens, or use a comb instead of a balloon. Some interesting ideas might include the following: two (negatively) charged balloons will repel each other; the energy field of a well-charged resin rod or comb held close, but not touching, a very slow stream of water (running out of a tap) pushes the stream of water (water does not have a charge but is a balance of positive and negative) or bends it (negative comb repels negative charges in water and attracts positive charges in water); some, but not other, materials can de-charge the balloon. These can also be great science-fair demonstrations.

Mathematics — Estimating and Predicting: Students can time how long each object sticks to (is attracted to) the balloon. Which ones hold their attractions the longest? Propose an explanation for why an object will stick to the balloon for the longest amount of time. Students can also count how many objects will stick to the balloon at one time. What is the most of an item they can make stick?

History of Science: Research who discovered static electricity and how it affected scientific thought. Share what was learned with the class.

Teaching Tips and Guiding Questions

Try to teach about static electricity during a time of year when the weather is dry so that static can be generated. Electrons need dry air in which to build up and jump. (That is why there is more static cling in dryer clothes on a dry day than a humid day.) Combing hair and pulling off sweaters can also produce a spark and snap! The balloon picks up electrons (negative charges) when rubbed and becomes negatively charged. The negative charge on the balloon attracts the positive charges on objects, which are neutral (having both negative and positive charges on them).

Once the students are busily testing their predictions, some guiding questions to ask might be:

- How does rubbing charge the balloon? Does more, or faster rubbing make more charge? Can you make a super attractor?
- Can you make the objects dance?
- Are the objects easy to pull off the balloon once they are on there? Which materials stick well to the balloon? Which materials do not? Can you see a pattern as to why?
- What happens if you hold the balloon farther away from the object?
- Compare the materials that work and do not work. How are they different? How are they alike?
- Why do you think these objects stick?
- How is the charged balloon like a magnet?

Concepts to be Assessed

(Unifying concepts/big ideas and science concepts to be assessed using the Exemplars Science Rubric under the criterion: Science Concepts and Related Content).

Physical Science — Transfer and Transformation of Energy: Students understand that all bodies are capable of producing electrical charges; that conductors allow electrons to move, but insulators do not allow electrons to move easily; and that static electricity is the result of build up or deficiency of electrons. Students observe that like charges repel and unlike charges attract (cause and effect) and that there are positive and negative charges.

Physical Science — Motion and Forces: Students observe that material that has been electrically charged pulls on all other materials and may either push or pull other charged materials.

Mathematics: Students make precise measurements and diagrams. Students collect, organize and analyze data appropriately.

Possible Solutions

There are a variety of solutions to the testable question/hypothesis used. Many different objects will stick to the balloon after it has been "charged" by the wool. Most metal-like objects will not stick, however, and it is hoped that the students will discover this while testing and begin to wonder why. Conclusions that the students draw should include their ideas about what static electricity is. It is not necessary for them to have a textbook definition of what it is, but some key words and ideas like attraction and charge should be a part of their explanation. They might also speak of "jumping" electrons.

Task-Specific Assessment Notes

Novice

This student did not complete the investigation according to the directions given. There is no testable question stated to be investigated and only one prediction and test were completed. Without relevant data, this student was unable to make an informed conclusion. The student did use the word "repel" as it related to what was investigated, but there is no connection to static electricity or the question originally posed. This student does not yet demonstrate understanding of the inquiry or data-gathering processes.

Apprentice

This student framed the testable question (using an attempt at "if ... then ...") and investigated a number of objects. The predictions given were based on some understanding of the concept. This student also has some understanding of the inquiry process and uses the relevant skills but is unable to make an informed conclusion based on the results recorded. The conclusion given relates more to a comparison made about conductors of static electricity ("hair is better than wool") than to what they observed during this particular investigation (testing tinfoil, cotton, etc.). However, this comparison is somewhat valid and interesting and could be further explored to help the student make some connections.

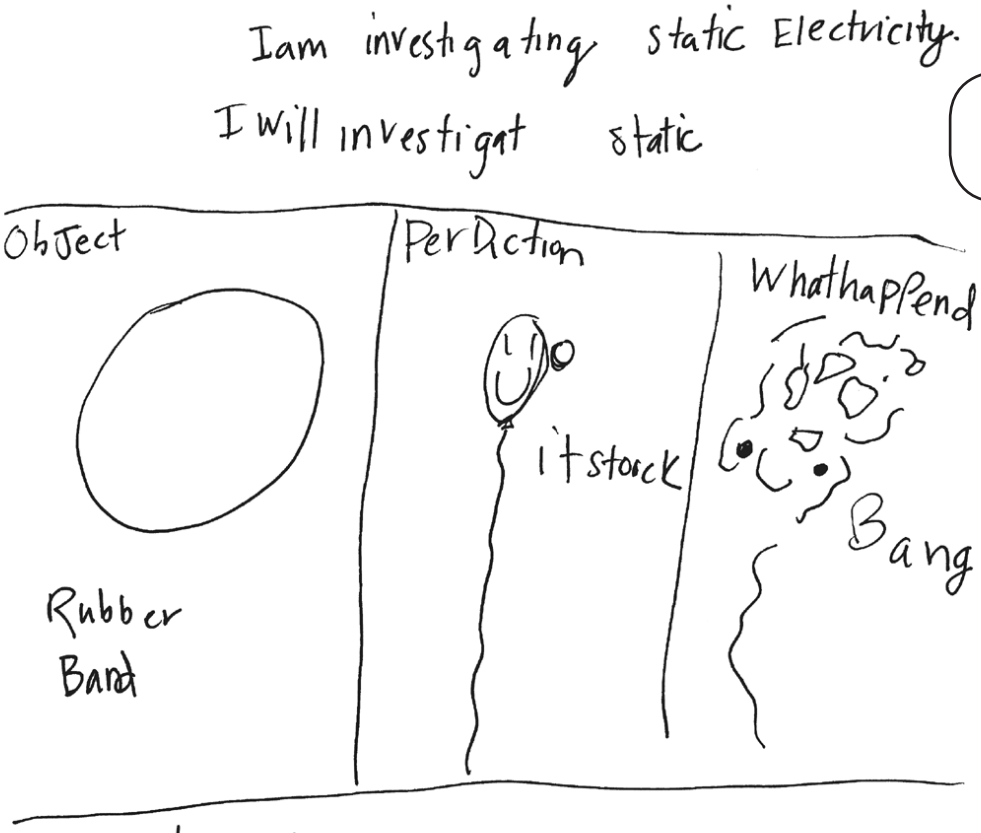
Practitioner

This student framed the testable question (using an attempt at "if ... then ...") and investigated a number of objects. There is a good basic understanding of the physical science concepts. An interesting comparison of static electricity to magnetism and correct use of the term "attracted" are included. The graphic representation is well labeled and demonstrates scientific reasoning and thinking skills in that the student extended the investigation from wool to hair and collected appropriate data.

Expert

This student's investigation was clear and well conducted to answer the question posed. All parts were included and results recorded accurately, evidence of the scientific method applied well. The conclusion includes some of the important ideas about static electricity. Again, a comparison was made to magnetism. This student also made an important, more specific observation about the objects only sticking to the part of the balloon that was charged. The graphic representation is very clear; all columns are labeled.

Novice



There is no testable question.

There is only one object tested. There is not enough relevant data to draw conclusions.

Apparently, the balloon broke — meaning the inquiry was not complete.

Inappropriate use of the science term *repel*.

Apprentice

Question: If I rub a balloon with wool what will stick to it.

OBJect	Perdiction	what happened
Tinfoil	It would work	It didn't stick to the balloon.
rubber band	it would work	It didn't stick to the balloon.
Cottin	it wouldn't work	It worked The cottin stuck to The Balloon.
String	it would work	I worked.
Stars	it would n't work	iT Didn't work
plactic	it would work	I t worked.

Conclusions: I learned That hair is better Than wool because The hair made The balloon more static electricity because there is more hair

The student framed a testable question using "if."

There is evidence of relevant data collected, and some understanding of the concept being explored.

The conclusion is not linked to the data collected. "Hair" is compared to wool although no data mentions "hair."

Practitioner

☆ If I rub a ballon to my hair what will stick to it?

Object	Predicition	What Happend
to stick a pice of tin foil to the ballon	I think it will work	it does work
to get a pice of string to stick to the ballon	I think it wont work	it didnt work
A pice of cotton to stick to the ballon	I think it will work	it works

My conclusion: By rubbing the ballon on my hair made it sort of like a magnet it atracked alot of things

When you rub the ballon you create it

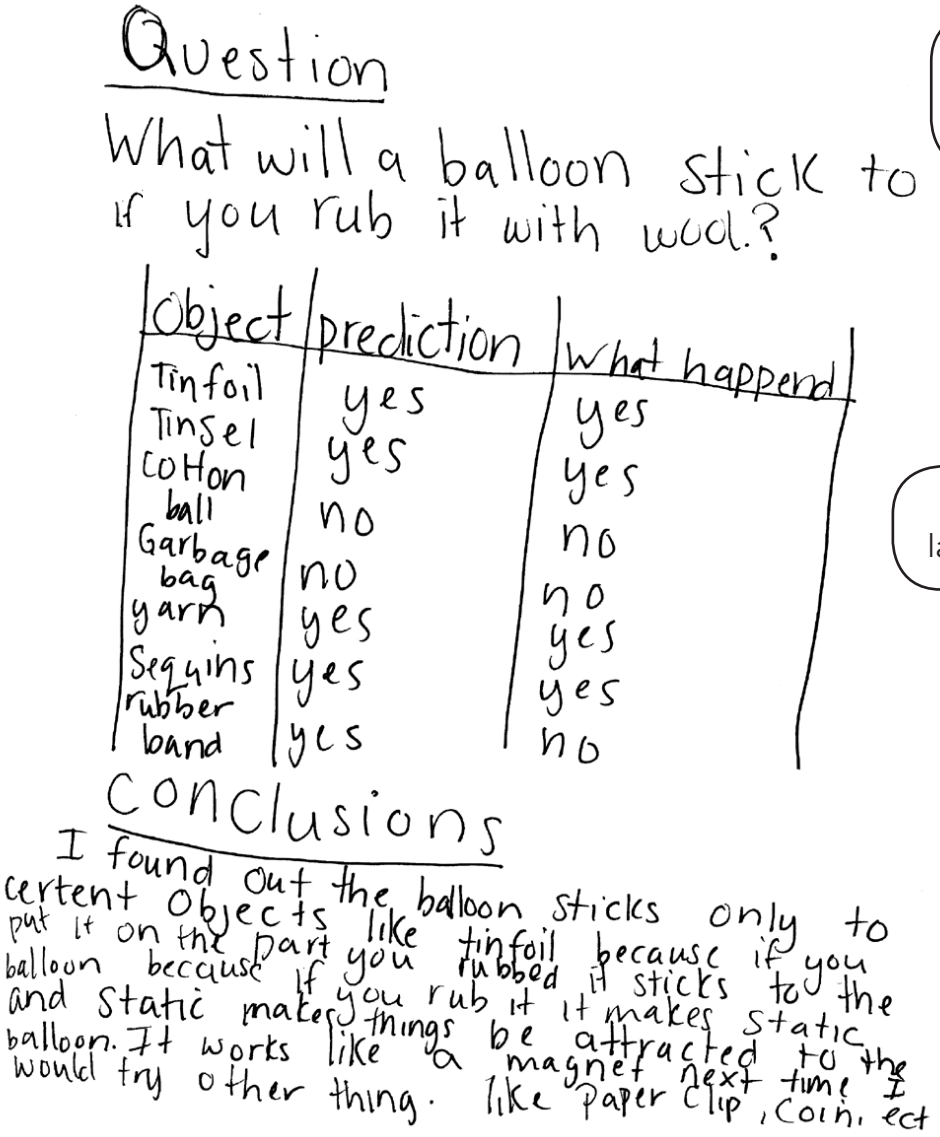
The student framed a testable question using "if."

There are clear labels on the representation.

There is appropriate use of science term *attracted*.

There is evidence of conceptual understanding linking magnets to static electricity.

Expert



Question

What will a balloon stick to if you rub it with wool?

Object	prediction	What happend
Tinfoil	yes	yes
Tinsel	yes	yes
COHon ball	no	no
Garbage bag	no	no
yarn	yes	yes
Seqwins	yes	yes
rubber band	yes	no

Conclusions

I found out the balloon sticks only to certent objects like tinfoil because if you put it on the part you rubbed it sticks to the balloon because if you rub it it makes static and static makes things be attracted to the balloon. It works like a magnet next time I would try other thing. like paper clip, coin, ect

The student framed a testable question using "if."

The chart is clearly labeled and complete.

The conclusions are based on data collected: noting specific objects—tinfoil, etc.

The student makes observations about where sticking occurs.

The student correctly uses and understands the terms *static* and *attracted* as well as concepts like "magnet."

Standards-Based Science Rubric

	Scientific Tools and Technologies	Scientific Procedures and Reasoning Strategies	Scientific communication/Using Data	Scientific concepts and Related Content
Novice	• Did not use appropriate scientific tools or technologies (e.g., rulers, pH paper, hand lens, computer, reference materials, etc.) to gather data (via measuring and observing).	• No evidence of a strategy or procedure, or used a strategy that did not bring about successful completion of task/investigation. • No evidence of scientific reasoning used. • There were so many errors in the process of investigation that the task could not be completed.	• No explanation, or the explanation could not be understood, or was unrelated to the task/investigation. • Did not use, or inappropriately used scientific representations and notation (e.g. symbols, diagrams, graphs, tables, etc.). • No conclusion stated, or no data recorded.	• No use, or mostly inappropriate use, of scientific terminology. • No mention or inappropriate references to relevant scientific concepts, principles, or theories (big ideas). • No evidence of understanding observable characteristics and properties of objects, organisms, and/or materials used.
Apprentice	• Attempted to use appropriate tools and technologies (e.g., rulers, pH paper, hand lens, computer, reference materials, etc.) to gather data (via measuring and observing) but some information was inaccurate or incomplete.	• Used a strategy that was somewhat useful, leading to partial completion of the task/investigation. • Some evidence of scientific reasoning used. • Attempted but could not completely carry out testing a question, recording all data and stating conclusions.	• An incomplete explanation or explanation not clearly presented (e.g., out of sequence, missing step). • Attempted to use appropriate scientific representations and notations, but were incomplete (e.g., no labels on chart). • Conclusions not supported or were only partly supported by data.	• Used some relevant scientific terminology. • Minimal reference to relevant scientific concepts, principles, or theories (big ideas). • Some evidence of understanding observable characteristics and properties of objects, organisms, and/or materials used.

Standards-Based Science Rubric cont.

	Scientific Tools and Technologies	Scientific Procedures and Reasoning Strategies	Scientific communication/Using Data	Scientific concepts and Related Content
Practitioner	• Effectively used some appropriate tools and technologies (e.g., rulers, pH paper, hand lens, computer, reference materials, etc.) to gather and analyze data.	• Used a strategy that led to completion of the investigation/task. • Recorded all data. • Used effective scientific reasoning. • Framed or used testable questions, conducted experiment, and supported results.	• A clear explanation was presented. • Effectively used scientific representations and notations to organize and display information. • Appropriately used data to support conclusions.	• Appropriately used scientific terminology. • Provided evidence of understanding of relevant scientific concepts, principles or theories (big ideas). • Evidence of understanding observable characteristics and properties of objects, organisms, and/or materials used.
Expert	• Accurately and proficiently used all appropriate tools and technologies (e.g., rulers, pH paper, hand lens, computer, reference materials, etc.) to gather and analyze data.	• Used a sophisticated strategy and revised strategy where appropriate to complete the task. • Employed refined and complex reasoning and demonstrated understanding of cause and effect. • Applied scientific method accurately: (framed testable questions, designed experiment, gathered and recorded data, analyzed data, and verified results).	• Provided clear, effective explanation detailing how the task was carried out. The reader does not need to infer how and why decisions were made. • Precisely and appropriately used multiple scientific representations and notations to organize and display information. • Interpretation of data supported conclusions, and raised new questions or was applied to new contexts. • Disagreements with data resolved when appropriate.	• Precisely and appropriately used scientific terminology. • Provided evidence of in depth, sophisticated understanding of relevant scientific concepts, principles or theories (big ideas). • Revised prior misconceptions when appropriate. • Observable characteristics and properties of objects, organisms, and/or materials used went beyond the task/investigation to make other connections or extend thinking.