

THE TRIBOELECTRIC SCALE

Understanding Energy Transfer and the Triboelectric Scale

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Tennessee 4-H Youth Development

The Triboelectric Scale

Understanding Energy Transfer and the Triboelectric Scale

Skill Level

Intermediate

Learner Outcomes

The learner will be able to:

- Explain how static electricity builds up
- Determine the flow of energy in a system
- Be intrigued by lightning strikes and how they are formed

Educational Standard(s) Supported

8.PS2.1: Design and conduct investigations depicting the relationship between magnetism and electricity in electromagnets, generators, and electrical motors, emphasizing the factors that increase or diminish the electric current and the magnetic field strength.

Success Indicator

Learners will be successful if they:

- List at least 3 items on the Triboelectric Scale
- Explain how thunderstorms produce lightning

Time Needed

55 Minutes

Materials List

3-5 latex balloons
Student handout
Van de Graff generator (if you do not have access to one, use included video link)
Triboelectric scale cards (cut apart and laminated)

Introduction to Content

This lesson focuses on energy transfer, through static electricity and the Triboelectric scale. Students are introduced to how static electricity is transferred between objects, and where those objects fall on the Triboelectric scale. Students also learn the basics of a Van de Graff generator and how energy is transferred from it.

Introduction to Methodology

This lesson begins with a basic static demonstration by using a balloon and then assessing the students' prior knowledge of static electricity. Students then work as a class to establish a Triboelectric scale using common objects and learn how a Van de Graff generator works. The lesson concludes with a 3-2-1 assessment, and application of what they have learned to lightning strikes.

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Terms and Concepts Introduction

Triboelectric Scale -- a sequence of substances arranged so that any one of them is positively electrified by rubbing it with any other substance farther down the list.

Van de Graff Generator -- an electrostatic generator which uses a moving belt to accumulate electric charge on a hollow metal globe on the top of an insulated column, creating very high electric potentials. It produces very high voltage direct current (DC) electricity at low current levels.

Setting the Stage and Opening Questions

Ask for 2 or 3 volunteers who have short hair and are not allergic to latex. Have the students stand at the front of the room and rub a balloon on their hair until it sticks. Say to the class, **“Today, we will be learning about different forms of electricity. By the end of today’s class, you should be able to amaze your family with your ability to shock them... literally! You’ll also be able to determine how energy flows in a system, and explain how lightning forms. For a quick activity before we get started, if you can fully explain why the balloon stuck to your classmates hair, I want you to hold up 4 fingers, if you have a pretty good idea of why it stick hold up 2, and if you have no clue hold up a fist.”** Use this to assess the students prior knowledge. Ask for volunteers to share their explanations as to why it stuck, and then say, **“By the end of today’s class, everyone will be holding up 4 fingers.”**

Experience

Say to the students, **“What you just saw with the balloons and your classmates was a demonstration of Static Electricity. Static electricity is one of many forms of energy that we encounter on a daily basis. Today, we are going to be learning about how that energy flows and interacts with us, other objects, and itself. To begin, we are going to learn about the Triboelectric Scale. This is a list of objects that transfers energy in the form of protons to other objects to make them positively charged.”**

Display the blank scale on the board(see supplemental information), or draw one. Pick one item from the Triboelectric cards and place it in the correct place on the scale, as student volunteers to come up one at a time and place an item where they think it goes on the scale, explain to students that items that are farther apart on the scale will generate larger charges, and therefore produce more static electricity. Continue until all items have been placed on the scale in the correct order.

Say, **“This list does not include all items that will transfer energy between each other, but we can now see how the items fall on the spectrum. As we said earlier, objects that are farther apart on the scale will generate larger charges between them, creating a bigger shock.”**

Tips for Engagement

AS students are working through the Triboelectric Scale activity, you may need to give them guidance as they work. Offer suggestions for where certain items will go.

If the class has not discussed electricity previously, you can also place more than one item on the scale to start the activity.

Share

Show the Van de Graff generator and explain how it works (see definition). Ask students, “**When the charge builds up in the generator, where will it go when it’s discharged?**” (into what touched the generator)

“**Is the charge on the generator positive or negative?**” (Negative)

Process

If you have a generator, plug it in. Ask students to explain how the globe of the generator is being charged, and ask for an explanation. Ask students to touch the generator, and form a chain to see how far the charge can be carried.

If you do not have a generator, show this clip:

<https://www.youtube.com/watch?v=rNEY3Yv9kC8> and ask students to share what they learned from the clip.

Generalize

Ask students to flip to the back of their handout, and fill in the 3-2-1 portion. This should highlight 3 new things they learned from today, 2 examples of electricity transfer from items on the Triboelectric Scale, and 1 question they still have.

Apply

Conclude the lesson by saying, “**Another example of energy transfer we see often is lightning. Lightning is just like the sparks we saw off the generator, but on a much larger scale.**”

Show this clip: <https://www.youtube.com/watch?v=6NZ7BollRo4>

Life Skill(s) from TIPP for 4-H

8th Grade

Support the efforts of others to learn. (Head thinking)

Communicate accurate information on a given topic to someone else. (Head thinking)

Specify goals and constraints (limits) for a given problem. (Head thinking)

Plan a strategy for a given problem or situation; set a goal and determine ways to reach it. (Head thinking)

Control impulses and irrational behavior, particularly when in conflict or disagreement by giving examples of how you have done so in the past. (Heart relating)

Speak up for your rights. (Heart relating)

Have positive experience with those who are different from oneself. (Heart relating)

Plan, organize, and present a speech. (Heart relating)

Communicate effectively. (Hands working)

Understand social, organizational, and technological systems related to careers. (Hands working)

Demonstrate perseverance. (Hands working)

Evaluate career opportunities. (Hands working)

Supplemental Information

Educational Standards Met

8.PS2.1: Design and conduct investigations depicting the relationship between magnetism and electricity in electromagnets, generators, and electrical motors, emphasizing the factors that increase or diminish the electric current and the magnetic field strength.

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