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Electrical Energy and Atomic Structure Lesson Plan

Age(s) / Grade Level(s): Upper Elementary (3rd-5th grades)

Subject(s): Science

Length of time: 45-60 minutes

Curriculum Standards:

- **TEKS 112.5, 112.6, and 112.75**

(1) Scientific and engineering practices. The student asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;
(C) demonstrate safe practices and the use of safety equipment during classroom and field investigations as outlined in Texas Education Agency-approved safety standards;
(E) collect observations and measurements as evidence.

(3) Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models;
(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and
(C) listen actively to others' explanations to identify relevant evidence and engage respectfully in scientific discussion.

TEKS 112.5

(6) Matter and energy. The student knows that matter has measurable physical properties that determine how matter is identified, classified, changed, and used. The student is expected to:

measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float in water.

TEKS 115.6

(7) Force, motion, and energy. The student knows the nature of forces and the patterns of their interactions. The student is expected to plan and conduct descriptive investigations to explore the patterns of forces such as gravity, friction, or magnetism in contact or at a distance on an object.

(8) Force, motion, and energy. The student knows that energy is everywhere and can be observed in cycles, patterns, and systems. The student is expected to:

(C) demonstrate and describe how electrical energy travels in a closed path that can produce light and thermal energy.

TEKS 112.7

(6) Matter and energy. The student knows that matter has measurable physical properties that determine how matter is identified, classified, changed, and used. The student is expected to:

(A) Compare and contrast matter based on measurable, testable, or observable physical properties, including mass, magnetism, relative density (sinking and floating using water as a reference point), physical state (solid, liquid, gas), volume, solubility in water, and the ability to conduct or insulate thermal energy and electric energy.

(D) illustrate how matter is made up of particles that are too small to be seen such as air in a balloon.

Objective(s):

- Students will identify forms of energy.
- Students will apply knowledge of electrical energy to ask questions, make predictions, and formulate explanations related to a scientific investigation.
- Students will identify the parts of an atom and create a model to illustrate the structure of an atom with a negative charge.

Materials Needed:

- Balloons (1 per student)
- Tissue paper squares (approximately 2 inches by 2 inches)
- Paper plate (2 per student)
- 1 tbsp. of salt (per student)
- 1 tbsp. of pepper (per student)
- Round stickers labeled with plus sign in print/braille (4 per student)
- Round stickers labeled with minus sign in print/braille (5 per student)
- Round stickers left blank (at least 4 per student)

Lesson/Activity Sequence:

1. Engage students by asking, “would you rather be an animal (like a platypus or be) who can sense electric charges to find food or be an animal (like an electric eel or stargazer fish) that uses

electrical charges to catch its prey?" Allow time for students to think about their choice and then ask for each student to share their answers with the group.

2. Ask students to recall the different forms of energy (thermal, mechanical, electrical, chemical, light, and sound). Have them give examples of the different forms of energy.

3. Tell students, "Today, we will be focusing on electrical energy." Ask students to share what they already know about electrical energy. Let them know they will be following procedures to investigate electrical energy. They will make predictions, ask questions, and draw conclusions during the investigations. They will also create a model of an atom to show what is happening when electrical energy occurs.

4. Have students gather materials for the first investigation. They will need the balloon and tissue paper squares. Tell them to follow the below procedure:
    a. Place the tissue paper squares on the table.
    b. Blow up the balloon and tie it.
    c. Rub the balloon on your pants or shirt.
    d. Hold the balloon approximately two inches above the tissue paper squares.
    e. Notice what happens to the tissue paper squares and record your observations.

5. Ask students what they think happened and why it happened.

6. Introduce the vocabulary words atom, nucleus, protons, neutrons, electrons. Explain that an atom is made of smaller particles called protons, neutrons, and electrons. Explain that protons have a positive charge, electrons have a negative charge, and neutrons do not have any charge. Most atoms have an equal number of electrons and protons, giving a "neutral" or no charge. When there is an imbalance of electrons or protons, it causes the atoms to have either a positive or negative charge. Opposite charges attract each other. When the electrons transfer from one atom to another, this is electricity.

7. Ask them to discuss the investigation with the new vocabulary. When you rub the balloon on your clothes, it is causing a buildup of electrons on the balloon, so what type of charge did the balloon have if there were more electrons than protons? What about the tissue paper?

8. "Now, we are going to conduct another investigation." Have them gather the needed materials. They will need one of the paper plates, the salt, pepper, and the balloon from the first investigation.

9. Have them follow the below procedure:
    a. Fold the paper plate in half.
    b. Measure 1 Tbsp of salt onto one side of the plate and 1 Tbsp of pepper on the other side.
    c. Make predictions about what will happen if you "charge" the balloon and hold it over the salt or pepper.
    d. "Charge" the balloon by rubbing on your pants or shirt.
    e. Hold the "charged" balloon over the plate.
    f. Observe what is happening and record your observations.

10. Have students discuss what they think is happening using the new vocabulary. Ask what caused the pepper/salt to “stick” to the balloon? Why do they think the pepper was more attracted to the balloon than the salt (pepper is lighter than salt).

11. Review both investigations with the students. Have them record conclusions about both investigations using the new vocabulary.

12. “We are now going to make a model of an atom that has a negative charge.” Ask students to review the parts of an atom, including protons, neutrons, and electrons. Ask them to identify which has a positive charge and which has a negative charge. “If we want to create a model of a negatively charged atom, what is important to show on our model?” (There should be more electrons than protons.)

13. Students will use the second paper plate and round stickers to create their model. They will follow the below procedure:
    a. Create a nucleus by placing protons (stickers with the plus signs) and the neutrons (blank stickers) in the center circle of the plate (it is okay if the stickers overlap.).
    b. Place the electrons (stickers with the minus signs) on the outer edge of the plate.
14. Have students share in small groups or to the whole class their finished model, giving them another opportunity to use the new vocabulary in a different context.

How will I assess student progress?

- Review student observations and conclusions.
- Assess the accuracy of the atomic model, making sure that the number of electrons is more than the protons and that the positioning of electrons is around the outside of the model and the protons and neutrons are in the center for the nucleus.

Differentiation:

- This lesson could be completed as three separate lessons. Each investigation can be done as a mini-lesson, and creating the atomic model can also be an individual activity.
- If students are allergic to latex, use a replacement for the balloon. You can blow up a plastic glove or use a plastic spoon. Both of these suggestions may require additional time to “charge” by rubbing on clothes.
- Some students may need support blowing up or tying the balloon, folding the paper plate, or measuring out the salt and pepper. Presume competence and add supports as needed.
- Depending on the type of paper plate used, you may need to create a tactile or bold-line circle in the center of the plate (approximately 2-3 inches in diameter) to support the student in placing the stickers for the nucleus of the model.
- Students will need to use their identified learning medium to record their observations and conclusions. For some students, this will include braille or large print on paper, while others may use a device, such as a laptop or tablet.