

**ITQ ARTS and SCIENCE INTEGRATION
GRADE 4
DANCE AND PHYSICAL SCIENCE**

**Electricity: Charge and Flow
Lesson 1**

CONTENT STANDARDS

Dance

1.3 Demonstrate increased range and use of space, time, and force/energy concepts (e.g., pulse/accent, melt/collapse, weak/strong).

Physical Science

PS1e Students know that electrically charged objects attract or repel each other.

PS1g Students know electrical energy can be converted to heat, light, and motion.

ESSENTIAL QUESTIONS (*Questions that students might ask about the topic*)

- How can I show static electricity and the flow of electricity through movement?
- How does dance help me to understand the differences and similarities between static and current electricity?

OBJECTIVES & STUDENT OUTCOMES

- Students will make movement choices as they explore electrical charge and the role electrons play in static electricity.
- Student will make movement choices to explore the flow of electricity through a D-cell.

ASSESSMENT (*Various strategies to evaluate effectiveness of instruction and student learning*)

- **Feedback for Teacher**
 - Student response to inquiry
 - Student performance
- **Feedback for Student**
 - Teacher feedback
 - Peer feedback
 - Videotape feedback

WORDS TO KNOW

Dance

- **axial movement:** movement around the axis of the body in personal space (does not travel; bend, stretch, twist, reach).
- **locomotor movement:** Traveling steps done in general space that move the body from point A to point B (leaping, jumping, walking, etc.).
- **pathway:** The line which the body or body part moves through space, It can vary in width, length, curvature and direction. flow of electric energy (electricity).

Science

- **Current:** the flow of electricity through a conductor.
- **D-cell:** source of electric energy (sometimes called a battery).
- **electrically neutral:** equal positive and negative charge.
- **electron:** is a tiny particle that is part of an atom. Electrons are responsible for charges on an object.
- **positive charge:** occurs when an object loses electrons.

- **negative charge:** occurs when an object has extra electrons.

MATERIALS

- Two 8"x10" pieces of paper, one marked with a "+" and one marked with a "-" symbol
- Optional: One piece of yarn, ribbon or fabric 20' long
- Music (*Music for Creative Dance* by Eric Chappelle)
- CD Player
- Video Camera and monitor
- Science Notebooks (one per student)

RESOURCES

- *FOSS Physical Science*, Gr. 4, Investigation 2, Parts 1 and 2
- *Music for Creative Dance* by Eric Chappelle

PREPARATION

- Review dance vocabulary: space (levels, direction, pathways, personal and general, shape and size); locomotor (jumping, walking, skipping) and axial movement (spinning, bending, twisting); energy (vibrating, shaking); and time (tempo, speed).
- Prepare two signs: one with a plus (+) and one with a negative (-) symbol.
- One long piece of yarn 20' long (optional)
- Video Camera
- CD Player, music and camcorder
- Ample space in which to move freely

WARM UP (*Engage students, access prior learning, review, hook or activity to focus the student for learning*)

(10 minutes)

- Post vocabulary words or chart as they are presented.
- Explore
 - Begin with five students as **electrons** (representing **negative charge**) and five students in the nucleus. The equal number of students in the nucleus and **electrons** represent a neutral charge.
 - Movement:
 - Students as the nucleus:
 - Gesture: Place right arm across chest and place left elbow on right hand.
 - **Axial Movement:** Teach a ball-change step using a Latin rhythm with beats one-and-two, three-and-four. Shake the body and change arm position from right to left every two beats.
 - Students should use bound energy in personal space, vibrating and turning.
 - Option: Place a border around the nucleus (using the yarn) to keep students bound in one place.
 - Students as the **electrons**:
 - Gesture: Arms bent, elbows raised, knuckles touching at chest.
 - **Locomotor Movement:** Step forward with the right foot into a lunge, medium level, and bounce pulsing arms.
 - Assign a designated area near and around the nucleus where students will move with free energy in general space: vibrating, spinning, jumping and turning.
 - Students as **electrons** do not orbit but will move toward and away from the nucleus and remain in a contained, eight-foot area. Encourage students to use multiple pathways, directions, and space: levels, size and tempo.
 - The remainder of the students will be observers.
 - Play music and move for 15 seconds.
 - Add two more students to the **electrons**. Move for another ten seconds.
- Ask:
 - *What did you observe about the nucleus and **electrons**? [They move differently. The*

- electrons** are lively, free, move from point A to point B using **locomotor movement**, the nucleus stays in one place (**axial movement** in personal space), vibrates, turns.]
- *What did you notice about the number of people in the nucleus and the number of people as **electrons** at the start of the exercise?* [There was an equal number in both nucleus and **electrons**.]
 - *Say: When there are equal numbers we say this is an **electrically neutral** charge.*
 - *Ask: What did you observe at the end of the dance?* [There were more numbers of **electrons** than numbers in the nucleus.]
 - *Say: When more **electrons** were added, this created a **negative charge**. When there are unequal numbers (more numbers of **electrons** than those in the nucleus), we say this is an **electrically negative** charge.*

MODELING (Presentation of new material, demonstration of the process, direct instruction)

(20 minutes)

- Explore the transfer of **electrons** from one object to another that will create static electricity (causing objects to attract or repel).
- **Electric Charge** Dance (you will need a large, open space for this exercise)
 - Set-up:
 - Select two groups of six students to represent atoms of two balloons (three in the nucleus, three **electrons**). Identify one group as balloon atom #1 and the other group as balloon atom #2.
 - *Ask: Are these balloon atoms **electrically positive, negative or neutrally charged?** [Neutral charge]*
 - Arrange six students side by side, each holding one long piece of yarn. The yarn represents the wool fabric of the sweater and the six students will represent the **electrons** in a wool sweater.
 - *Say: The wool sweater is **neutrally charged**. Even though all we see are the negative **electrons**, know that there are nucleus' here as well. We do not add them because there would be too many people.*
 - Select 4 students to represent an object (e.g., plastic cup, a wall) who will freeze in a combined shape to represent that object.
 - *Ask: Is this object (plastic cup) **positive, negative or neutrally charged?** [Neutral charge]*
 - The rest of the class observes.
 - *Ask observers: What do you notice about all three of these objects?* [They all have a **neutral charge**.]
 - Perform and videotape (optional):
 - The two balloon atoms will perform movement for 15 seconds in personal and general space (see warm up).
 - Upon your cue, the students representing the wool sweater will weave around balloon #1's atom using the **locomotor** lunge step.
 - As the wool sweater circles around the first atom, it loses one of its **electrons** to balloon atom #1. That **electron** will now move with the other **electrons** in balloon #1.
 - The wool sweater continues to circle and weave around balloon atom #2 and loses another **electron** to that atom. That **electron** will now dance with balloon atom #2's other **electrons**. *Note: (The" wool sweater" should have four people remaining).
 - The wool sweater moves off to the side and drops to the floor.
 - Stop music.
 - *Ask: What did you observe?* [Each balloon atom picked up one **electron** from the wool or the wool lost one **electron** to each balloon atom].
 - *What is the charge of each balloon? How do you know?* [**Negative charge**, because each balloon atom gained one **electron** from the wool sweater].
 - *What happened to the wool sweater? What is its charge now?* [The wool sweater lost two **electrons**, one to each balloon atom and is now **positively charged**.]
 - *What do you think will happen when these two balloon atoms meet?* [They will repel]

because they have like charges.]

- Have balloon atoms #1 and #2 show repel through movement (refer to Gr. 4 Theatre Lesson #1).
 - Describe the movement for repel? [pushing, or moving away]
- Let's review.
 - Ask:
 - What is the charge of the plastic cup? [**neutral charge**]
 - What do you think will happen when a balloon atom meets the plastic cup? [They will attract because they have unlike charges.]
 - Have the plastic cup (4 students) move toward balloon atom #1 and perform attraction movement.
 - Describe the movement for "attraction"? [Pulling, moving toward.]
- Ask:
 - When electrons from the wool sweater were lost what kind of a charge was created? [**Positive charge**]
 - When the balloon atoms gained an **electron** what kind of charge was created? [**negative charge**]

GUIDED PRACTICE (Application of knowledge, problem solving, corrective feedback)

(15 minutes)

- Say: **Electrons** and the electric charge just demonstrated was random, meaning the flow of the electricity was not very organized. We call that static electricity. Electrons jumped from the wool to the balloon
 - Option: Talk about rubbing feet on a carpet and touching another person or a piece of metal.
- In order to make objects work like lamps, light bulbs, or motors, the flow of electricity must be organized into a **current**. This is called **current** electricity. **Electrons** must be organized into **pathways**. A battery (**D-cell**) contains stored electric energy. Electricity travels (or flows) from the **D-cell**. An insulated wire acts as a conductor to move along the **electric current** from the **D Cell**, out the negative pole to the positive pole and around and around it goes. The **electrons** cannot move randomly like in static electricity. It's like one big Conga line.
 - Place the positive (+) 8" x 10" sheet at one end of the space and the negative (-) 8" x 10" sheet at the other end of the space. The area between the two poles represents the **D-cell**.
 - Arrange the class in a long curved pathway, beginning at the negative pole and connected to the positive pole and running through the **D-cell**.
 - Students will stand at dancer's ready, holding their arms in the negative gesture.
 - Designate one student to initiate the push of electrons along the pathway, starting at the negative pole. This student will lunge to left gently bumping the student on his left. The 2nd student will repeat the movement until the electric **current** has traveled all the way back to the beginning
 - Teacher should constantly tell students during the exercise they are being pushed out the negative pole and pulled toward the positive pole.
 - Recommendation: Use a zigzag pathway to facilitate the movement inside the **D-cell**.
 - The student who initiates the bump will do so every eight beats.
 - Repeat the exercise moving faster and faster but cutting the number of beats by two (e.g., start every 6 beats, then 4 beats, then two beats). This will start the overlapping of the bumping to show how the **current** moves continuously.
 - Option: Videotape the exercise.
- Ask: How does electric **current** flow through a **D-cell**? [From the **D-Cell**, pushed out the negative pole and pulled to the positive pole, and back through the battery in a complete **pathway**].

DEBRIEF AND EVALUATE (Identify problems encountered, ask and answer questions, discuss solutions and learning that took place. Did students meet expected outcomes?)

(5 minutes)

- View videotape and discuss modeling and guided practice questions as needed.
- Have students respond to the following exit questions in their science notebooks. Students may work independently, in pairs, or small groups
 - *Describe what happened in our balloon and wool sweater demonstration.* [The wool sweater lost **electrons**, the balloons each gained an **electron**. The wool sweater had a **positive charge**, the balloons had a **negative charge**. The balloons repelled each other but when placed next to the plastic cup, they were attracted to the cup because they had a charge opposite that of the cup].
 - *What is **current**?* [Flow of electric energy or electricity, moves in a complete pathway]
 - *What did you learn about the **D-cell** and electric **current**?* [A D-cell stores energy. and the flow of electrons (**current**) travels in a complete pathway. Electrons follow a path from the negative pole to the positive pole of a D-Cell. Electrons are pushed along a pathway (wire) from the negative pole to the positive pole.]
 - Draw a diagram of a **D-cell** and the complete **electric current**.
 - *Describe the dance words we used to portray the movement of **electrons** in both static and electrical **current**?* [Vibrate, spin, bounce, free, **locomotor movement** travels from point A to point B (leap, jump, walk), **axial movement, pathway**].

EXTENSION (*Expectations created by the teacher that encourages students to participate in further research, make connections and apply understanding and skills previously learned to personal experiences.*)

- Static Electricity Dance
 - *Say: Static electricity is an imbalance between **positive** and **negative charges** of an object. These charges can build up on the surface of an object until they find a way to be released or discharged. Finding balance is what the electrons are trying to do. Free electrons have potential energy.*
- Procedure:
 - Six - eight students dance as *free electrons in general space*. They *vibrate, spin* and move *freely; jumping, floating, bouncing* and may bump *gently* into another electron (use a hand bump or gentle bump of shoulders).
 - Two students walk through the electron field “picking up” **electrons** (have ½ of the electrons attach themselves to each student).
 - Two students hold a large sign with a “+” in different parts of the room. Have an additional student stand beside each person with sign with both hands clasped together, arms extended. (The hands will represent the object the electrons will transfer).
 - When the sign holder flips the sign up (or when the music stops) the **electrons** quickly move in a straight *pathway* by *leaping* to the positive charge.
 - Ask students “why are the **electrons** transferring to the positive object?” *attraction to opposite charge, trying to find balance in charges*
 - The electrons are now stuck (each electron will grab the hand or arm of the person representing the object) and can no longer move freely.
 - *Ask: Do the **electrons** still move once they transfer?* [yes, but they are temporarily bound and can only vibrate until they either drop off or are transferred again to another object or atom]
 - Have the watchers and **electrons** can say “ZAP” when the transfer takes place. This would represent the “spark” and discharge (the transfer from potential to kinetic energy)
 - Repeat the exercise with a new group of students.
 - Videotape
 - Option/Extension:
 - Repeat with a new groups of students but this time, add two students with posters with a “-” symbol and a student to stand beside each poster.
 - The gesture for the student standing next to the “-” poster will be arms extended in front of the body, hands flexed, palms facing out (as in pushing away).
 - As student electrons move freely around the room, flash either a positive or

negative poster. "Electrons and charges standing next to the posters act accordingly doing a repelling or attracting sequence for about 15 seconds. Encourage creative movement, changing relationship, level, dynamics, etc.

- **Discuss:**

- *Say: How can you describe what we demonstrated in this exercise?* [Free floating **electrons** with a negative charge seek an object with a positive charge because opposites attract. Electrons were repelled when coming in contact with a like charge]
- *Why is there a spark when static electricity is discharged?* [When electrons jump to a positively charged object it create heat. As the air gets hotter and hotter, more and more electrons jump over and you get a spark! Ouch!]
- Compare static and current electricity using Venn diagram.

The Flow of Electric Energy in a D-cell

