Physical Sciences Trek

Grades: 3 - 5

Time: a pre-visit session of 30-45 minutes and a post visit session of 20-30 minutes (*Note: Time for either session can be adapted. For instance the pre-visit session can consist of a 10 minute preview of the exhibits.)*

Rationale and Context:
This trek is organized around the NGSS crosscutting concept cause and effect. This video provides an overview of the concept. To help maximize their ECHO experience, students will be introduced to ECHO exhibits that relate to physical sciences before their classroom visit. They will make predictions about how to produce desired results at several exhibits. At ECHO, students will test out their designs or hypotheses and explore exhibits more deeply with the help of additional challenge questions. After their visit, students will process their learning as a group and draw conclusions about energy, motion, forces and cause/effect relationships. Teachers may choose to continue to explore these concepts using additional resources provided.

Teacher Background Information:
The primary learning goal of ECHO's Awesome Forces exhibit gallery is to help visitors understand the physical laws that govern the natural phenomena we experience everyday on the Burlington Waterfront. Through hands-on interactive exhibits your students will delight in discovering the amazing processes that have shaped the Lake Champlain Basin and our Earth. Many of the exhibits in Engineer It also draw on physical science principles while encouraging visitors to use the Engineering Design Process to solve problems.

Learning/Behavioral Objective(s):
1. Students will engage with ECHO exhibits with a sense of purpose.
2. Students will hypothesize about how to create desired effects with the exhibits.
3. Students will connect the phenomena they observe with physical science concepts.
4. Students will draw conclusions about physical science concepts and connect their learning to a broader cross cutting science concept.

Essential Question: How can cause and effect relationships help predict or explain future events?

Focusing Questions:
What forces can be observed?
How does a balanced or unbalanced force affect the motion of the object?
How can you use patterns to predict the motion of objects?
How does the speed of an object affect its energy?
How is energy transferred from one object to another? When can you observe this?

Vermont Standard(s): Next Generation Science Standards

Standard	**Description**
Crosscutting concept	Cause and Effect: Mechanism and explanation
3 PS2-1	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
3 PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
4 PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.
4 PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4 PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.
4 PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
5 PS1-3	Make observations and measurements to identify materials based on their properties.
5 PS2-1	Support an argument that the gravitational force exerted by Earth on objects is directed down.
Science and Engineering Practices	Developing and Using Models Planning and Carrying out Investigations Constructing Explanations and Designing Solutions

Vocabulary: Students may gain an understanding of certain vocabulary words through active participation and explanation.

Air pressure
Balanced force
Collide/Collision
Energy
Energy transfer
Force
Friction
Gravity
Inertia
Levitate
Momentum
Speed
Unbalanced force

LEARNING PLAN:

Resources/Materials:

1. Optional free admission for teacher walkthrough visit
    - Contact ephillips@echovermont.org
2. Museum Map
3. Slide presentation of exhibitions
4. ECHO Exhibit Preview sheet
5. ECHO Exhibit Exploration sheet
6. Links to extension activities

Before your ECHO trip:

Introduction

1. *When our class visits ECHO, you will have a chance to explore many science exhibits. Today we're going to preview a few of them and start thinking about some of the challenges you might explore when we are there.*
2. *At many of the exhibits, you'll be able to think about cause and effect. If necessary, introduce or review this crosscutting concept.*
3. Hand out the ECHO Exhibit Preview sheet

Exhibit Preview

1. Begin slideshow. Show Levitating Balls slide, then discuss:
    a. *What do you notice in this picture?* Take several responses. If no one comments on the levitating orange balls, call students' attention to it.
    b. *What are some possible explanations for the levitating balls?* If no one suggests air pressure, ask:
        i. *What force would normally cause the ball to drop to the ground?* Gravity
        ii. *What force might be pushing in the opposite direction?* Air pressure
    c. Show the next slide. *How could you position the pipes to move the ball through a hoop?*
    d. Allow students time to record ideas on their worksheet. Share and discuss.
2. Show first slide of Air Cannons, then discuss:
    a. *What do you notice in these pictures?* Take several responses.
    b. *This is called an air cannon. Why do you think it's called that?* Take several responses.
    c. *How do you think the air cannon works?* If no one suggests hitting the end of the drum, ask:
        i. *How could you transfer energy from your body to the cannon?*
        ii. *What might happen to that energy?*
    d. Show second slide of Air Cannons*. In this exhibit the air cannons interact with the moons. What is your hypothesis about how the air cannon will affect the moon?*
    e. Allow students time to record ideas on their worksheet. Share and discuss.

3. Show video of Spinning Table, then discuss:

a. *What do you notice in this video?* Take several responses. If no one mentions that the movement of the table affects the ball's straight line path, ask:
    i. *What path does the yellow ball start moving along? Straight line*
    ii. *What happens to the ball instead?* It gets pulled in a different direction.
b. *What are some possible explanations for the ball's path? If no one suggests this, introduce the idea that different parts of the table are moving at different speeds and this might affect the ball's movement.*
c. *How could you determine the fastest position on the table?*
d. Allow students time to record ideas on their worksheet. Share and discuss.

4. Show slide of Rippling Water, then discuss:
    a. *What do you notice in this picture?* Take several responses. If no one notices that the exhibit is on two levels, point this out. Then show the next slide.
    b. *How do the two parts of the exhibit work together?* A tapping mechanism on the top part creates ripple patterns on the floor. If you are in Present mode and do an additional click, a yellow oval will appear around the tapping mechanism.
    c. *How will we be able to change the ripple patterns?* Adjust the speed of the tapping mechanism
    d. *How will the ripples change when you increase or decrease the tapping rate?*
    e. Allow students time to record ideas on their worksheet. Share and discuss.

<u>Closure and Connections</u>

1. *What are you most excited about seeing, doing or learning on our ECHO field trip?*
2. *During our visit, you will get to discover many other exhibits. Some relate to earth sciences and lots of them include animals. If you are looking for more exhibits that explore energy, motion, forces and cause/effect relationships, you can look for these exhibits*. Show slides of additional exhibits.

During your ECHO trip:

1. It may be helpful to have students identify which of the previewed exhibits they are most excited about. They can be split up into small chaperoned groups by their interest. We will help direct your groups to different areas of the museum to begin your ECHO explore time.
2. Give each student or partner group a copy of the ECHO Exhibit Exploration sheet to guide them as they interact with the exhibits.

After your ECHO trip:

1. *Now that everyone has explored the exhibits at ECHO, let's hear what you thought.* Allow a quick share where everyone can share one favorite exhibit/experience/etc.
2. *Let's discuss what you've learned about energy, forces, motion and cause/effect relationships from the exhibits.*

    a. *At Levitating Balls, how did you position the pipes to make the ball go through the hoop?* Encourage discussion of balanced and unbalanced forces and/or the effects of air on larger particles.
    b. *At Rushing Air, how did the air cannon affect the moon?* Encourage discussion about energy transfer, changes in energy when objects collide, and the effects of air on larger particles.
    c. *Where is the fastest position on the Spinning Table?* Encourage discussion relating the speed of an object to its energy.
    d. *At Rippling Waters, how did the ripples change when you increased or decreased the tapping rate?* Encourage discussion about changes in energy when objects collide and how observations of motion can be used to predict future motion.
3. *What connections can you make between one of the four focus exhibits and another exhibit?* Example: The Vertical Flyer and Levitating Balls both show how air pressure can affect the motion of an object.
4. *How can understanding physical cause and effect relationships help us in the real world?* Example: Airbags sensors notice when a car is stopping suddenly and deploy the airbag. The airbag absorbs energy from the driver's body and prevents them from colliding with the steering wheel.
    a. This may also be a logical place to make connections with the current science unit under study.

Extensions

Levitating Balls:

- Conduct a floating ball experiment in the classroom.
- Craig Beals demonstrates the Bernoulli principle in this video.

Rushing Air:

- Create air cannons and modify them to test variables.
- Craig Beals demonstrates how to make a giant smoke ring cannon in this video

Spinning Table:

- Greg Kestin explains the Coriolis Effect in this video.

Rippling Waters:

- Make your own ripple tank with these simple video instructions.