Energy Resources Utilizing a Sphero4th Grade

Total Number of Lessons: 7

Total Estimated Time for Module: 400 minutes (30-45 minutes per session)

transferred to slides

Section 1: Module Overview and Curricular Connections – Required

- **Module goal**: At the end of this module, students will be able to identify, utilize, and explain how potential and kinetic energy works. They will code a Sphero bolt to demonstrate how kinetic and potential energy can be manipulated.

- **Connection to standards**:
  - 4-PS3-3 Ask questions and predict outcomes about the changes in energy that occur when objects collide.
  - 4-PS4-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
  - 3-5.PA.1: Collaborate with peers to implement problem-solving steps to create a variety of programming solutions. (E)
  - 4.IPS.1 Plan and conduct an investigation to answer a specific question or solve a specific problem.

- **RET materials/ideas to be leveraged**:
  - We will start with a story: This summer we were able to attend the RET (Research Experience for Teachers) program at Notre Dame. While we were there we learned all about computer science. Things such as how a program works, how to recognize fake news, ways computers can be used to help students and adults with school and life, and how to use AI (artificial intelligence) in our day to day lives.
  - Next we will use code.org and scratch to learn how to do basic coding. (This is background information that would have been taught in previous classes)
    Express Course (2024)
    Lesson 1: Programming with Angry Birds
    Lesson 2: Debugging in Maze
  - Apply this knowledge to how to operate a Sphero
  - Then give specific challenges so students can see the differences between potential and kinetic energy.

Section 2: Overview of Module Framework – Required

- **Real-world context**:
  - Potential and Kinetic energy can be further broken down. There are many types of energy that we use everyday and we may not even think about.

        - Electrical- Runs our lights, tvs, electrical outlets
        - Thermal (heat)- warmth from the sun, hot drinks, and ovens
        - Light- stars, lights, and lasers
        - Sound- talking, singing, clapping your hands
        - Mechanical- cars, riding a bike, typing on a keyboard
        - Chemical- chemical batteries, coal, food
        - Radiant- X-rays, radio waves

    - Let's think about going to the fair and riding the Bumper Cars. The point of this ride is to run your bumper car into the bumper cars. You are intentionally running into each other. What happens to all that energy (label the different energies) when you collide into another car? What happens to your speed? What happens to the other car's speed? Let's discover using our Sphero.

    - Students will be able to program a Sphero to discover the difference between potential and kinetic energy. They will see how it goes from at rest (potential energy) to moving across the room (kinetic energy). They will also program the Sphero to collide with a target (a small object at rest) so they can see what happens when a moving object comes into contact with an object at rest. That object will now have kinetic energy when it falls. Seeing these experiments will allow students to fully understand what potential and kinetic energy are and how they work.

- **<u>Background STEM content</u>**:

    - **Lesson Ideas**:
        - Define kinetic and potential energy
        - Program the Sphero to move across the classroom
        - Program the Sphero to collide with an object at rest

- **<u>Description of Main Activity/Project</u>**:

    - The goal is for students to understand potential and kinetic energy and how it works. (identify, utilize, and explain how potential and kinetic energy works) We

will start off with me giving the definitions of kinetic and potential energy which the students will add to their science notebooks.

- Next we will move into the I Do, We Do, You Do Model. I will model for the students how to code the Sphero to do basic movements. Then students will work in groups to program their Sphero while I code mine. Finally they will be in their small groups developing different ways to change the code to make the Sphero travel farther distances, around objects, or in a pattern.
    - Challenge card 1
- The next lesson will build on what we have done. Students will complete a science hypothesis worksheet (the worksheet has been taught previously and used in other experiments). We will develop teacher directed questions as a class: *What happens when a Sphero collides with an object at rest?* Students will then write down their hypothesis of what they think will happen. Next we will list the materials we will be using to test this hypothesis. They will work in groups of 3-4 to test their hypothesis. Students will work off of the base code they were given when shown how to make the Sphero move. They will then need to add to that code to make it collide with the object. Each group of students will develop their own code to make this happen. They will then draw a picture of what their Sphero did. They will then write what they saw. Finally, what is their conclusion? After all groups have had a chance to work through the experiment each group will come up front and show the class what they had their Sphero do. We will talk through the similarities and differences that we saw with the different experiments. Students will glue their science experiment sheet into their interactive science notebooks. Then we will come to a group conclusion which we will record in our science notebooks.
- The next lesson focuses on expanding the previous lesson. Students will answer the following questions through experimentation.
    - What happens if you change the speed of the Sphero?
    - What happens if you move from carpet to tile with the experiment? (Friction involvement)
    - What if you collide with a heavier or lighter object such as a ping pong ball or a book?

Section 3: Module Sequencing and Assessment – Required

- **Sequenced Learning Objectives**:

1. **Foundational Knowledge**:
    - **Objective 1**: Understand basic concepts and terminology. (I Do)
        - *Lesson 1*: Introduce key terms and foundational ideas.
        - *Lesson 2*: Reinforce understanding through examples and basic applications.
2. **Skill Development**:
    - **Objective 2**: Develop fundamental skills related to the concepts. (We Do)
        - *Lesson 3*: Practice foundational skills with guided exercises.
        - *Lesson 4*: Apply skills to simple problems or scenarios.
3. **Concept Integration**:
    - **Objective 3**: Integrate foundational knowledge and skills to solve more complex problems. (You/We Do)
        - *Lesson 5*: Combine multiple concepts in more complex exercises.
4. **Application and Analysis**:
    - **Objective 4**: Analyze and apply knowledge in varied contexts. (You Do)
        - *Lesson 6*: Engage in activities requiring critical thinking and problem-solving.
5. **Mastery and Review**:
    - **Objective 6**: Demonstrate mastery of module content and reflect on learning.
        - *Lesson 7*: Final assessment that encapsulates the module goals.

- **Brief description of formative and summative assessment approaches**:
    - During the lessons we will use observations to check for understanding. (anecdotal)
    - Exit tickets will be used at the end of each experiment.
    - Formal written summative assessments

- **Recommendations for implementation**: [Describe any “safety tips” or advice you have for other educators who might implement this module, including logistical considerations.
    - You will need a large open space to complete the activity.
    - Reminder: Spheros are not indestructible. Remind students that experiments should be completed on the floor, not on a desk where they can fall to the floor. Also they should not intentionally run their Spheros into things that can break them.
    - Make sure you know the codes available for each experiment so that you can quickly help students troubleshoot when they are struggling with different steps. That way you can better help them along.
    - The role of the teacher is primarily one of encouragement and support. Online lessons are meant to be student-centered.

- Some ideas on how to do this are:
    - Encourage students with questions/challenges to start by asking their partner(s).
    - Ask a nearby group your question, they might already know the solution.
    - Remind students to troubleshoot the problem before seeking outside help.
    - Have students describe the problem that they're seeing. What is it supposed to do? What does it do? What does that tell you?
    - Remind frustrated students that frustration is a step on the path to learning, and that persistence will pay off.
    - If a student is still stuck after all of this, ask leading questions to get the student to spot an error on their own.

Section 4: Module Files – Optional

- **List of attached files**:
    - Foundational Knowledge
    - Exit Ticket
    - Challenge Cards - 20 with link to Educator Guide
    - Challenge Card - DIY
    - Link to form for experiment