Lesson Four: Testing Ramps

Content Objective: Students will be able to build ramps with different heights and test their built gear set on their ramps.

Language Objective: Students will be able to explain their process of building the ramps with different heights and how well their gear set tested on the ramps.

STEM Career: Engineer

Vocabulary:

- Ramps: a sloped plane
- Energy: a process of transfer from one thing to another (i.e Kinetic, Potential energy)
- Engineering Design Process: the process of creating a solution to a given problem

Next Generation State Standard(s):

K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or directions of pushes and pulls on the motion of an object.

K-PS2-2: Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

K-PS3-C: Relationship Between Energy and Forces

- A bigger push or pull makes things speed up or slow down more quickly.

K-ETS1.A: Defining Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.

ISTE Standard(s):

3.d. Build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.

4.c. Develop, test and refine prototypes as part of a cyclical design process.

Materials:

- Wooden blocks (or objects that can create strong ramps and wide enough for the Gears! Gears! Gears! products)
- Gears! Gears! Gears! Flight Gears™
- Gears! Gears! Gears! Rover Gears™
- Gears! Gears! Gears! Cycle Gears™
- Gears! Gears! Gears! Wrecker Gears™
- Coloring paper
- Coloring utensils (markers, crayons)
- Rulers

- Timers

Preparation:

- Have wooden blocks and gear sets ready for use.

Lesson:

1. Introduce the problem to students, "What type of ramp can you build that will have your gear set move the fastest from one end to the other?" (Engineering Design Process: **Define**).
2. You can discuss as a class about the types of ramps they feel can be built (i.e. high, medium, low off the ground). You can give measurements of where the ramp height will need to begin (i.e. High: 24 inches off the ground, Medium: 12 inches off the ground, and Low: 6 inches off the ground).
3. Share that students will need to build three different ramps (high, medium, and low off the ground) and complete tests to compare the speed of their gear set on the ramp.
    a. Have students hypothesize what ramp their gear set will move down the quickest. Why?
4. Show students the type of materials they have available (wooden blocks, Flight Gears™, Rover Gears™, Cycle Gears™, Wrecker Gears™, et. al) (Engineering Design Process: **Identify**).
5. Pass out the coloring paper and coloring utensils. Students will draw out their ramp design ideas that fit the requirement of high, medium, and low (Engineering Design Process: **Brainstorm**).
    a. You can have students draw out designs for high ramps first, then medium ramps, and then low ramps.
    b. Have students think about how many blocks they want to include? What type of support should they have to hold up the blocks?
6. Have students choose their three (high, medium, and low) designs they feel will work best (Engineering Design Process: **Select**).
7. Students will begin by building their high ramp using wooden blocks or other materials you feel work best (Engineering Design Process: **Prototype**).
8. Students build a gear vehicle of their choosing.
9. Once complete, students will set their creation at the top of the ramp and begin testing (Engineering Design Process: **Test**).
    a. Have one student let go of their group's vehicle and the other student times how long it takes for the object to move from the top, once released from their hand, to the end of the ramp.
    b. Students can do a couple of test runs and use the best time for that ramp. Continue the same process for the other ramps.
    c. As students are testing, walk around and ask groups if they feel they can make improvements on their ramp design. What type of improvements are they? How will it help their gear set to move quick down the ramp? (Engineering Design Process: **Modify**).
10. When the tests are completed, ask students which ramp moved their gear set the quickest from one end to the other (Engineering Design Process: **Communicate**).
    a. What evidence do you have to show the ramp that moved the gear set the quickest (i.e timer)?
    b. What changes did you make to your ramp?

c. Introduce the vocabulary word, energy. Based on the project students have completed, what do they feel the word energy means?
    i. Place a gear set at the top of a created ramp and let go. Share how this is energy. How is the energy being transferred?
    ii. You can then also introduce potential (hold the gear set at the top of the ramp) and then kinetic (let go of the gear set). You can have students do this with you by them using their own ramp.

Questions to Guide Students:

- What ramp will their gear set move down the quickest? Why?
- What evidence do you have to show it moved the quickest (i.e timer)?
- What changes did you make to your ramp? How did these changes help your gear set to move quicker down the ramp?

Check for Understanding:

- Check for student data that was collected during the tests (times took) and how they presented their findings during the discussion.

Challenge:

- Have students implement turns to their ramp and/or have the ramp go up and down. Do these obstacles change the times of their gear set? Why?
- Students push their gear set with different strengths. How do the different strengths change the times of their gear set?