Lesson Plan: Push, Pull, and Ponder

Grades and Contents:

2nd Grade Science
2nd ELA

Topic:

Force & Motion
Cause & Effect

Enduring Understanding

- An object that is not moving will only move if it is pushed or pulled. Pushes and pulls can vary in strength and direction and can affect the motion of an object. Gravity is a pull that makes objects fall to the ground. Friction is produced when two objects come in contact with each other and can be reduced if needed.
- Cause and Effect relationship explain why events happen the way they do.
- Events in a story have an effect on one another.
- Scientists and Engineers need to develop certain habits of minds to be successful, one of those habits is innovation.

Primary Standards

Science

2.P.4A.1 Analyze and interpret data from observations and measurements to compare the effects of different strengths and directions of pushing and pulling on the motion of an object.
2.P.4A.2 Develop and use models to exemplify the effects of pushing and pulling on an object
2.P.4A.3 Construct explanations of the relationship between the motion of an object and the pull of gravity using observations and data collected.
2.P.4A.4 Conduct structured investigations to answer questions about the relationship between friction and the motion of objects.

Secondary Standards

ELA - Literary Text

2.RL.8.1 Read or listen closely to:
c. explain how cause and effect relationships affect the development of plot.

Objective/Language Function

- Design a car that can overcome different textures on a track to ensure it stays in motion.
- Explain in writing how gravity (a force) affects an object's motion.
- Explain verbally how different textures on a track (friction) affect the motion of an object (specifically speed).
- Explain in writing how cause/effect relationships from the story affected the plot.

Academic Language

Vocabulary

- Motion
- Force (gravity, friction, magnetism)

- Plot: beginning (introduction), middle, ending (resolution)
- Conflict (Problem)

Assessment Plan

- Pre-Assessment-
    - Anticipation Guide with questions about self-efficacy about innovation and cause/effect relationships.
- Post-Assessment-
    - Students will explain how forces such as friction and gravity affect the motion (speed) of their designed car.
    - Students will return to the anticipation guide to note any changes after the lesson.
    - Criteria for Mastery:
      -Students should be able to explain how the type of material on the ramp causes the car to have more (or less) friction which affects the speed of the car. The thinner the material on the ramp, the less friction it causes and the faster their car is able to go. They may also be able to determine that the height or angle that the ramp is placed on will also affect how much the force of gravity impacts the speed of their car (the higher the angle of the ramp the faster the car). In order to notice the cause and effect relationships a data table needs to be created and analyzed from their car trials.

Materials

- Car Kit
- Read Aloud, If I Built a Car by Chris Van Dusen
- Ramps w/ different materials (poster board plain, poster board with duct tape, poster board with sandpaper, poster board with liner)
- Stopwatches
- Anticipation Guide and Data table

Teacher Preparation

This lesson reinforces the concepts of force and motion and introduces friction and its effects on motion. It would be best to do after studying force/motion and magnetism. It also reinforces cause and effect relationships how those relationships can affect the plot of a story and how cause/effect relationship exist in many other ways. Having previous knowledge of basic literary elements and plot is needed.

To keep students on task, it is helpful to stress that during Makerspace time, they are the experts and need to help each other if they get stuck. The discussion guide is a helpful tool to ensure important concepts are covered. There are suggestions for pre- and post-assessments as a way to measure student learning.

Meat of Lesson

- **Hook**

1. Ask students what feature of cars that they really like. You may need to prompt a bit: *"I really like having a foot activated trunk gate, so if my hands are full I can still open/close the trunk.*"
   Have students share out, and ask how do you think people come up with the ideas for that? How does an inventor know that their idea may work/may not work? If you try to add a feature to a car and it doesn't work, what are the effects of that? *No one uses it or buys it. No company manufactures it.*
   What are the effects if an inventor has an idea and it works great? *It becomes standard or popular.*
2. Next, Read Aloud: *If I Built A Car*
   a. Read Text.
   b. Discuss book. (see discussion guide)

3. Next, review concepts about motion and types of forces. Why might it be hard to Actually drive his car? *It's heavy! Some parts might rub along the road or be too wide for the road.*
   a. Ask students what might make a car slow down or speed up?
   b. Introduce the concept of Friction and how it affects motion.
   c. For cars, certain road conditions have a cause/effect relationship on their movement.

4. Introduction: Today, we will build a model car quickly. We will then test the car's motion on three ramps. Each ramp will have different conditions, which may or may not affect friction. We need to test the effects of the condition on the speed of the car. We will do this with a cause/effect relationship. Because the ramp has ------, the car moved -----.
You will collect data on each trial run, by timing your car on each ramp.

- **Brainstorm**
  - Students will plan the car they want to build.
  - Students will also generate cause/effect relationships that they predict their design will affect. It may be helpful to provide a list of common transition words or phrases for students to use on an anchor chart. *For example, Because I am using two bigger tires in the front and two smaller tires in the back, I predict that the car will….*

- **Prototype**
  - Students will create their car.
  - Students should test their car on at least 3 ramp surfaces. Timing each ramp and recording the information on the data table.
  - Once time has elapsed, call back all students. Explain that they have a chance to do one redesign of their car to make improvements to shorten their time. Have them talk it over and then retest on one track to see if they can make their car move faster and overcome friction. **This could be done in a different class time if desired**

- **Share**
    - Have groups go around and say which track their car had the fastest time on. Tally mark this to compare class results. Did all cars go fast on a specific ramp? Why? Where some consistently slower? Why?
    - Ask then for students to then share what they changed about the design or their car to make it travel down the ramps faster. Have students practice talking about the revision of their design using a cause/effect transition word, for example: "Because we took some blocks off the back of the car, it moved faster down all the tracks we tested" or "As a result of us changing the front tire size, our car moved faster down ramp 2 than before but no improvement on ramp 1"
- **Synthesize**
    - Bring students back together for a final discussion. See discussion guide.
    - Finally, have students refer back to the pre assessment questions and complete the "after" portion.

Supports for Student Learning

Accommodations

- **ELs**- If students need additional support with cause/effect relationships provide sentence skeletons.
- **Grade Level adaptations**- depending on grade level
- **Advanced students**- Have students create another ramp condition and then challenge the other cars to redesign in order to still successfully stay in motion on the ramp.
- **Additional supports**- As needed.

Discussion Guides

- Read Aloud-
    - What causes Jack to want to design a different type of car than his dad's?
    - Why does Jack think it is important to "analyze, tweak, and refine?"
    - What might be the effect of Jack analyzing a jet plane and a boat on his car design? What about the Wienermobile?
    - Because Jack designs his car with special jet engines that don't make a sound, what can we infer about the way Jack feels about his dad's car engines?
    - What is the effect of Jack's pool design portion of his car? How does his dad react according to the picture?
- Synthesis-
    - Were there any redesigns that didn't work? What did they teach you?
    - How did keeping the data table of times, help you determine what to redesign on your car?
    - What was challenging about this lesson?
    - What was fun?