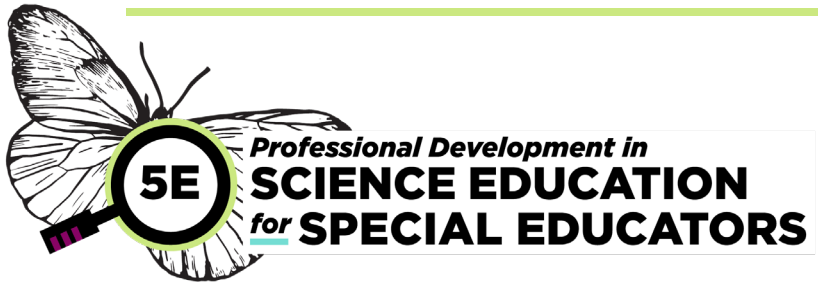
1. Essential Element

Activity/Lesson Title: Forces and Motion

EE.5.LS2-1: Investigate and predict the change in motion of objects based on the forces acting on those objects

Teacher: Dean **Grade Level:** Middle School (8th Grade)



2. Science and Engineering Practice

SEP 3: Planning and Carrying Out an Investigation

- Students are supported as they plan an investigation, define independent and dependent variables and controls, identify what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. Students collect data to serve as the basis for evidence to answer scientific questions.

3. Disciplinary Core Idea

Forces and Motion

- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.

4. Crosscutting Concept

Stability and Change

- Students are supported as they examine changes over time and consider forces at different scales. Students learn changes in one part of a system might cause large changes in another part, and that stability might be disturbed by either sudden events or gradual changes that accumulate over time

5. Linkage Level Descriptors

Initial

- Identify ways to change the movement of an object (e.g., faster, slower, stop)

Precursor

- Investigate and identify ways to change the motion of an object (e.g., change an incline's slope)

Target

- Investigate and predict the change in motion of objects based on the forces acting on those objects

6. Student's Typical Accessibility Supports

- Graphic organizers
- Enlarged pictures
- Models

7. Student Prior Experiences, Prior Knowledge

- The student likes to play with a ball.
- The student likes building with Legos.
- The student likes riding in cars and going on trips.
- Has previous knowledge about how to reduce the speed of an object.

8. Phenomenon to Explore

Question to investigate or design problem to solve

- Does the height of a ramp impact the speed of a toy car traveling down the ramp?

9. Possible Alternative Conceptions

- Everything that moves will eventually come to a stop. Rest is the "natural" state of all objects
- An object is hard to push or pull because it is heavy.
- Speed, velocity, and acceleration are the same concept.
- A continuous force is needed for continuous motion.

10. UDL Options and Solutions to Potential Barriers

- Work with a peer to set up the ramps
- Use checklists to monitor progress
- Present materials using a variety of formats and materials
- Conduct the investigation several times to promote perception
- Use graphic organizers and picture supports along with oral directions

11. Engage

Think

- How to access student prior learning?
- How to use the CCC to connect everyday language with scientific language of the phenomenon?
- How to support student participation by scaffolding the SEP?

Teacher Will

- Share a video of a car setting the world distance record for jumping off a ramp
- Ask the students questions like
  - » Why does the car start out so high up on the tower?
  - » What kind of jump might result if the car started on the ground?
  - » What kind of jump might result if the car started on a smaller ramp?
  - » Which jump do you think would give the best chance for setting a world record?

Students Will

- Watch the video
- Think about the phenomenon while responding to the teacher's questions

12. Explore

Think

- What is invisible or inaccessible about the phenomenon and how can the Explore phase make it more visible?
- How can students collect data in a way that reveals patterns in data?
- How to emphasize careful observation and ask good questions vs. looking for only the "right answer"?

Teacher Will

- Set up two ramps of different heights to compare the distances a toy car travels
- Ask the students to predict how the height of each ramp will impact how far the car travels
- Work with the student to identify the question being answered in this investigation

Students Will

- Identify the question ("How does changing the height of a ramp change the distance that a car travels?"
- Investigate by sending a toy car down each ramp and measuring the distance traveled (use the same toy car to assure that there is only one variable being changed – the ramp's height); record the distance traveled after multiple runs on each ramp height

13. Explain

Think

- How can students connect science topic, phenomena, data, and everyday experiences? How can students connect everyday language and scientific language? What reasoning helps students see or explain the invisible

Teacher Will

- Assist the student in reviewing the data collected
- Ask prompting, open-ended questions to help the student make connections between the data and the question that they are trying to answer (e.g., which ramp caused the car to travel the furthest distance? Shortest distance? Why did the higher ramp cause the car to travel further?Provide a CER organizer to assist the student

Students Will

- Review the data collected
- Create a CER statement using two pieces of evidence that the higher the ramp, the further the car will travel
  - i. Claim: A car travels further after traveling down a higher ramp than after traveling down a lower ramp.
  - ii. Evidence: I tested a toy car on 2 levels of ramps. In each run, the car travelled furthest on the higher ramp. It travelled the least far on the lowest height ramp. I also saw in the video that the world record of an actual car jump happened with a very steep ramp.
  - iii. Reasoning: Cars travel further down higher or steeper ramps. There is more gravity acting on the car due to the steeper ramp.

14. Elaborate

Think

- How can I enrich or extend student ideas? Are there related science concepts or processes that would support student learning?

Teacher Will

- Ask the student why a higher ramp makes the toy cars go faster
- Ask the student to consider what forces are acting on the car and the ramp

Students Will

- Apply their knowledge to a new context testing a car of different weight, using the same ramp heights, then comparing data to determine if the higher ramp still results in the different car traveling further.
- Collect data from the new investigation and complete a CER statement

15. Evaluate

Think

What information do I need to collect to inform my teaching throughout the lesson? What do I need to see or hear from my students that assures that they have learned the science content?

Teacher will

Monitor students' responses to questions during the lesson and review students' data collected in their data tables (or t-charts) after each trial of the investigation.

Students will

Respond to questions posed by teacher, complete their data tables using results from the trials of rolling a car down different ramp heights, and complete their CER statement.