

1. Essential Element

Activity/Lesson Title: Forces and Motion

EE: EE.MS.PS2-2: Investigate and predict the change in motion of objects based on the forces acting on those objects

Teacher: Dean

Grade Level: Middle (Grade 8)

Student: Rory

Level: Precursor



2. Science and Engineering Practice

SEP 3: Planning and Carrying Out Investigations

SEP description: Supports students as they plan an investigation, define independent and dependent variables and controls, identify what tools are needed to gather data, how measurements will be recorded, and how much data is needed to support a claim. Students collect data as evidence to answer scientific questions.

3. Disciplinary Core Idea

Forces and Motion

Core Idea description: 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.

4. Crosscutting Concept

Stability and Change

Concept Description: Students examine changes over time and consider forces at different scales. Students learn that 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 basketball.
- The student likes building with Legos.
- The student likes riding in cars and going on trips.
- The student rides bikes and knows how to make them go faster or slower.

8. Phenomenon to Explore

Question: How does the height of a ramp change the speed of a toy car traveling down the ramp?

9. Possible Alternative Conceptions

Some students may think (incorrectly) that:

- 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 all 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 adapted tools to support measurement (rulers with large, high contrast markings, talking scales or thermometers, etc.)
- 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 ramp ?
 - » 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
- Respond to teacher questions about ramp height and how it might affect car speed

12. Explore

Think

- What is difficult or inaccessible about the phenomenon, and how can I make it more accessible in the Explore phase?
- How can students collect data in a way that helps answer a scientific question?
- How can I encourage students' careful observation and asking 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 students to predict how the height of each ramp will impact how far the car travels
- Support students to identify the question being answered in the 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)
- Use a data chart to record the distance traveled after multiple runs on each ramp height
- Understand that it is the height of the ramp that changes the motion of the car.

13. Explain

Think

- How can I help students connect science topics, phenomena, data, and everyday experiences? How can I help my students differentiate everyday language from scientific language? What reasoning helps students see or explain the invisible?

Teacher Will

- Assist students in reviewing data collected
- Ask prompting, open-ended questions to help students 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?)
- Assist students in completing a CER organizer

Students Will

- Complete a CER statement
- Claim: The height of the ramp changes how far a car travels
- 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.
- Reasoning: Cars travel further down higher or steeper ramps.

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
- Complete a CER statement

15. Evaluate

Think:

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

Teacher Will

- Monitor students' responses to questions during the lesson; adapt the lesson as needed to address student ideas; administer a summative assessment.

Students Will

- Respond to questions posed by teacher, make measurements and observations, organize data they gather, complete a CER statement using data as evidence, complete a graphic organizer of "things that change a car's motion", include height of a ramp with examples.