

Teachers: **Ms. Lee & Ms. Kim**

Subject: **7th Grade Science**

## Unit 2: Forces & Motion

**Topic:** Measuring and Describing Motion

**Lesson Title:** How do we interpret motion graphs?

**LG:** I can describe an object's motion based on its motion graphs.

### Standard(s):

**MS-PS2-2.** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. (Lesson is part of an arc to help students understand how forces affect an object's motion).

### Sci. & Engineering Practices:

- |   |   |
|---|---|
| <input type="checkbox"/> Asking questions                         | <input checked="" type="checkbox"/> Using mathematical and computational thinking |
| <input checked="" type="checkbox"/> Developing and using models   | <input type="checkbox"/> Constructing explanations                                |
| <input type="checkbox"/> Planning and carrying out investigations | <input type="checkbox"/> Engaging in argument                                     |
| <input type="checkbox"/> Analyzing and interpreting data          | <input type="checkbox"/> Obtaining, evaluating, and communicating information     |

### NGSSS Crosscutting Concepts:

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|--|---|
| <input checked="" type="checkbox"/> Patterns             | <input type="checkbox"/> Energy & Matter      |
| <input type="checkbox"/> Causes and effects              | <input type="checkbox"/> Structure & function |
| <input type="checkbox"/> Scale, proportion, and quantity | <input type="checkbox"/> Stability & Change   |
| <input type="checkbox"/> System & system models          |   |

### Student Population:

- Nest Classrooms (ICT): up to 5 students on the autism spectrum, up to 20 gen-ed students.
- Horizon Classroom (ICT + Para): up to 25 gen-ed students and students with IEP, a group of 8 students on the autism spectrum push in.

### Key Concepts:

- There are different types of motion graphs to describe the motion of an object:
  - Position-time graphs represent how an object's position changes over time.
  - Velocity-time graphs represent how an object's velocity changes over time.
  - Acceleration-time graphs represent how an object's acceleration changes over time.
- The slope of a position time graph reveals the object's velocity.
- The slope of a position time graph also indicates the direction of an object's motion, velocity, or acceleration.
- The origin represents the frame of reference from which measurements are taken.

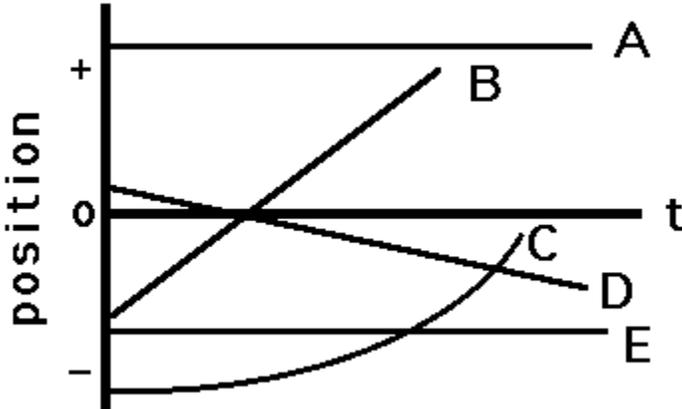
### Misconceptions:

- Students may rely on the quadrant (negative or positive) to determine the direction of the vector, when it should be the slope.

### Materials:

- Slides
- Handout
- Laptop for displaying slides
- Individual chromebooks for students

<ul style="list-style-type: none"> <li>Students may incorrectly equate zero slope with motionless</li> </ul> <p><b>Anticipated Struggles:</b></p> <ul style="list-style-type: none"> <li>Some students may require a refresh on some graphing vocabulary (X-axis, Y-axis, origin, slope).</li> </ul> <p><b>Differentiated Supports:</b></p> <ul style="list-style-type: none"> <li>Heterogeneous Small Group to reduce student:teacher ratio</li> <li>Guided question</li> <li>Self-Paced Investigation Activity</li> </ul>	
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<p><b>Do Now</b> 5 min + 3 min debrief</p>	<p><b>Prompt:</b> The graph below represents the position of 5 different objects (A-E) over time (t). Answer the questions below based on your interpretation of the graph.</p>  <p>Which object(s) is/are not moving at all? _____</p> <p>What makes you say that?</p> <p>Which object(s) is/are moving to the left? _____</p> <p>What makes you say that?</p> <p>Which statement is true about objects B and C? (choose one)</p> <ol style="list-style-type: none"> <li>B is always faster than C</li> <li>B is moving to the right</li> <li>C is moving to the left</li> <li>Both B and C</li> </ol> <p><b>Purpose:</b> Pre-assess students' understanding of position-time graphs.</p> <p><b>Debrief:</b> Students turn and talk to discuss their answers to the Do Now Prompts. Students may revise to update their thinking.</p>
<p><b>Announcements</b> (1 minute)</p>	<p>Provide reminders about approaching deadlines or upcoming events.</p>
<p><b>Mini Lesson - Intro to Motion Graphs</b></p>	<p>Ask 2 students to walk from one end of the classroom to another separately (one person at a time). Ask students to describe the motions of each person as specifically as possible. Most likely students will have used descriptive words like "faster" or "slower" to compare the speed between both walkers. Guide students to come up with a way to track each person's speed and how it changes. (Example: Measure distance traveled in</p>

	<p>every 2 seconds).</p> <p>Plot the collected data on the graph provided. Inform students that this is an example of a motion graph called position-time graphs. Tell students that they will be conducting a self-paced investigation to figure out how to interpret a position-time graph in order to appreciate its application in the real world.</p>
<b>Self-Paced Investigation</b>	<p>Students are provided some guided questions to help them explore the <a href="#">PHET Moving Man Simulation</a>. For this lesson, students can focus on just the position-time graph. Students play around with scenario to answer the following questions:</p> <ol style="list-style-type: none"> <li>1. When the person is standing still, the motion graph looks like...</li> <li>2. When the person is moving to the right, the motion graph looks like...</li> <li>3. When the person is moving to the right, the motion graph looks like...</li> <li>4. When the person is speeding up, the motion graph looks like...</li> <li>5. When the person is slowing down, the motion graph looks like...</li> </ol>
<b>Exit Ticket &amp; Closing</b>	<ol style="list-style-type: none"> <li>1. Students share their findings with the class.</li> <li>2. Assessment: Students return to the Do Now position time graph. This time, students will describe the movement of each object (A-E) in their own words. Students also brainstorm ways in which a position-time graph may be useful in the real world.</li> <li>3. Collect completed work &amp; Clean up</li> </ol>

**Level of Inquiry:** This lesson falls into the discovery learning category, because students are engaging with the simulation to explore what position-time graphs look like for different types of motion. This experience will help students learn to interpret this type of motion graph. For subsequent lessons on velocity-time graphs and acceleration time-graphs, we can increase the level of inquiry to a guided one because students will be used to the procedure and have enough background knowledge to become more independent learners. As a summative assessment, students can predict the shape of various motion graphs to describe the motion of a rocket launch based on provided data.