Lesson Title: How Fast am I Moving? **Date:**_____

Subject: Forces and Motion **Topic:** Velocity

Grade: 8 or 9 **Designer:** Concord Consortium

Stage 1 - Desired Results

Lesson Overview

In this lesson, students will identify the position of an object at several times and will use that data to determine the direction and velocity traveled during different time intervals. Prior knowledge of slope is recommended.

Standards Addressed

- The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph. (NSES p154, grades 5-8)
- Graphs can show a variety of possible relationships between two variables. (BSL 9B/M3, grades 6-8)
- Tables, graphs, and symbols are alternative ways of representing data and relationships that can be translated from one to another. (BSL 9B/H4, grades 9-12)
- Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. (PA 3.2.P.B1)

Enduring Understanding:	**Essential Question(s):** How can we measure and communicate velocity?
An object's velocity can be determined by analyzing position and time data in a table or graph.	

Students will need to know:	**Students will be able to:**
• **Key terms:** position, time, steady, fast, normal, slow, change in position, change in time, slope, shape, direction, steepness, average velocity, instantaneous velocity, start point, end point • How to measure the slope of a line	• Describe how fast an object is moving qualitatively • Compare position-time tables and graphs of fast, steady motion to those of slow, steady motion • Predict and determine an object's average velocity using an equation or graph • Determine an object's instantaneous velocity using an equation or graph

Stage 2 - Assessment Evidence

Performance Tasks	**Other Evidence:**
In this activity, students: • Predict, collect, and analyze position-time and velocity-time data to determine absolute and relative velocities during different motion scenarios. • (other tasks to be filled in by teacher)	• *How Fast am I Moving* Check-In • (other assessments to be filled in by teacher)

(over)

Stage 3 - Learning Plan	
Learning Procedure **Many days before:** • Review lesson plan, practice activity, secure materials, design additional teaching instruments, as desired. **Day of:** • Set up groups, computers, motion detectors, walking tracks, projector. • Introduce lesson (method tbd by teacher). • Have students complete *How Fast and I Moving?* • Conclude lesson (method tbd by teacher).	**Required Materials:** • Vernier Go!Motion probes: 1 per group • PC or Macintosh Computers: 1 per group • Supported Internet browser with access to SmartGraphs portal • Projection device (LCD, SmartBoard, or large monitor) preferred but not required • Masking tape, meter stick, and marker for walking track
Possible Discussion Questions for Students:	**Sample Answers to Discussion Questions:**
How can you determine who ran a race faster?	To tell who ran a race faster, you can compare how long it took each runner to run the same distance.
What instruments might you use to measure position? Time?	To measure position, you could use a meter or yard stick. To measure time, you could use a stopwatch.
What units of measure indicate how fast you are moving?	Sample units are miles per hour, meters per second, etc…
How do you compute your average velocity?	To compute average velocity, divide total distance traveled by total time traveled. This is the same as finding the slope of the segment connecting the start and end points of a position-time graph.
What is the difference between speed and velocity?	Velocity measures change in position per change in time. It is positive or negative, depending on direction. Speed is the absolute value of velocity ---it always positive and therefore does not indicate direction.
How can you tell how fast you are moving by looking at a position-time graph, assuming constant velocity?	To tell how fast you are moving, measure the slope of the position-time graph. A larger slope (steeper line) indicates faster motion than a smaller slope (flatter line).
What does a straight line on a position-time graph indicate?	A straight line indicates constant velocity. If it tilts up, motion is in the forward direction. If it tilts down, motion is in the backward direction. If it is horizontal, the velocity is 0, which means the object is stopped.
What does a curve on a position-time graph indicate?	On a position-time graph, a curve indicates that velocity is not constant --- speed or direction changed.
What is instantaneous velocity?	Instantaneous velocity is the velocity at a particular point in time. It is approximated by finding the velocity during a very short time interval.

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