Lesson Title: Maria's Run **Date:**_____

Subject: Forces and Motion **Topic:** Intro to Motion: Moving vs Stopping

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

Stage 1 - Desired Results

Lesson Overview

In this lesson, students will investigate motion along a straight line to differentiate stopping from moving with respect to a reference point.

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 is motion represented on a position-time graph?
Students will need to know: • **Key terms:** position, time, coordinate, point, origin, axes, steady, slow, fast, stopping, moving, steepness, flat • Units of measure for position and time	**Students will be able to:** • Describe the motion of an object qualitatively. • Describe an object's position relative to a reference point. • Predict, confirm, and describe an object's position and time on a position-time graph. • Differentiate moving from stopping on a position-time graph.

Stage 2 - Assessment Evidence

Performance Tasks	**Other Evidence:**
In this activity, students: • Predict, collect, and analyze position-time data for moving and stopping • (other tasks to tbd by teacher)	• *Maria's Run* Check-In • (other assessments tbd by teacher)

(over)

Stage 3 - Learning Plan	
Lesson Procedure **Many days before:** • Practice activity, review lesson plan, 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 *Maria's Run*. • 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:**
What data does the motion detector collect?	It collects position and time data.
In a position-time graph, what information does…: a) the x-coordinate of a point represent? b) the y-coordinate of a point represent? c) a single point tell you?	In a position-time graph, a) The x-coordinate refers to the object's time in seconds. b) The y-coordinate refers to the object's position in meters. c) A single point (x, y) tells you an object's position, y, at a particular time, x.
Why is time represented on the x (horizontal) axis and position represented on the y (vertical) axis?	Time is the independent variable, which is usually represented on the x-axis; position is the dependent variable, usually represented on the x-axis.
What units of measure can you use to measure: a) Time? b) Position? c) Speed or Velocity?	a) Time units: seconds, minutes, hours, days… b) Position units: meters, kilometers, inches, feet, yards… c) Speed and velocity units; meters/sec, km/min, miles/hour…
How is forward motion (away from reference point) represented on a position-time graph?	When you move forward, your position increases with time. The position-time graph tilts up and to the right in Quadrant I.
How is stopping represented on a position-time graph?	When you stop, your position does not change with time. A horizontal line results.
How is slow, steady motion away from the sensor represented on a position-time graph?	Slow, steady motion away from the sensor results in a gently sloped straight line tilted up to the right in Quadrant I.
How is fast, steady motion away from the sensor represented on a position-time graph?	Fast, steady motion away from the sensor results in a steep straight line tilted up to the right in Quadrant I.
How can you tell how much time elapsed as you moved from one position to another?	Look at the time data associated with each position. Find the difference of the two times.
How can you tell how far you moved within a certain time interval?	Look at the position data associated with each time. Find the difference of the two positions.
What does the steepness of a straight position-time graph tell you about the motion?	The steepness tells you how fast the object moved. Lines with steeper slopes indicate faster motion.

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