Lesson Title: Toward and Away **Date:**_____

Subject: Forces and Motion **Topic:** Direction of Motion

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

Stage 1 - Desired Results

Lesson Overview

This lesson is designed to help students differentiate forward motion (away from a reference point) along a straight line from backward motion (toward 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 does forward motion (away from a reference point) differ from backward motion (toward a reference point) on a position-time graph?
Motion along a straight line can be measured and described. A position-time graph is a conventional way to describe the direction of motion.	
Students will need to know: • **Key terms:** position, time, coordinate, point, origin, reference point, fast, slow, steady, toward, away, forward, backward, starting point, y-intercept, direction • Units of measure for position and time	**Students will be able to:** • Predict, confirm, and describe an object's position and time on a position-time graph while it moves toward and away from the motion sensor, whether starting at the motion sensor or elsewhere. • Differentiate motion away from a reference point from motion toward a reference point on a position-time graph.

Stage 2 - Assessment Evidence

Performance Tasks	**Other Evidence:**
In this activity, students: • Predict, collect, and analyze the position-time data of motion that starts at the motion sensor or elsewhere. • (other tasks to be filled in by teacher)	• *Toward and Away* 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 materials, if desired. **Day of:** • Set up groups, computers, motion detectors, walking tracks, & projector. • Introduce lesson (method tbd by teacher). • Have students complete *Toward and Away.* • Alert students that on pages 9 and 12 their answers need multiple parts (because the questions have multiple parts). You may want to discuss the answers in class. • 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 is meant by a "reference point"?	A reference point is the point from which an object's position is measured. In this activity, the motion detector's position is the reference point.
What is the position at the motion detector?	The position at the motion detector is 0 meters.
What happens to your position as you move away from the motion detector?	Your position increases as you move away from the motion detector.
What happens to your position as you move toward the motion detector?	Your position decreases as you move toward the motion detector.
What happens with time as you record data with the motion detector?	Time increases as you record data. Time never decreases or stays the same.
What does steady motion away from sensor look like on a position-time graph?	Steady motion away from sensor results in a straight line that tilts up to the right in Quadrant I.
What does steady motion toward the sensor look like on a position-time graph?	Steady motion toward the sensor results in a straight line that tilts down to the right in Quadrant I.
How can a position-time graph reveal that your direction changed?	When you move away from a reference point, the position-time graph tilts up and to the right, indicating increasing position; when you move toward a reference point, it tilts down and to the right, indicating decreasing position.

Template adapted from Wiggins and McTighe (2004). Understanding by Design