

Lesson One: On the Move

Grade level: 6-8

Expected length of lesson: 45 minutes

Overview:

Introduction to graphing motion starting with probes to discuss misconceptions. An activity titled “On the Move: Velocity Activity” follows the probes to engage students in kinesthetic learning. The activity produces data that are graphed. Speed and acceleration are calculated based on the data acquired.

Standards and/or benchmarks:

NGSS:

Disciplinary Core Idea:

- MS-PS2-2:
 - All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.

Science and Engineering Practices:

Planning and Carrying Out Investigations

- MS-PS2-2:
 - Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
- MS-PS2-5:
 - Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.

Constructing Explanations and Designing Solutions

- MS-PS2-1:
 - Apply scientific ideas or principles to design an object, tool, process or system.

Cross-Cutting Concept:

Scale, Proportion, and Quantity

- MS-PS3-1, MS-PS3-4:
 - Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

Iowa Core:

- S.6–8.PS.3
 - Essential Concept and/or Skill: Understand and apply knowledge of motions and forces.
 - 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

Learning Goals:

Students will understand:

- Graphs do not directly represent the motion; addresses the “What You See Is What You Get (WYSIWYG)” issue.
- The relationship of position to velocity and acceleration.

Learning Performances:

Students will be able to:

- Collect data to generate graphs.
- Generate graphs:
 - Position vs. time
 - Speed vs. time
 - Acceleration vs. time.
- Identify the motion of the object.

Materials:

- Following Jack Part II
 - Probe teacher guide
- Go Cart Test Run
 - Probe teacher guide
- *On the Move: Velocity Activity* worksheet
 - *On the Move: Velocity Activity* Teacher notes
- Masking tape
- Timer
- Meter stick
- Motion story worksheet

Safety:

Consider location during *On the Move: Velocity Activity*; walking and running is required.

Critical Thinking Question:

What story are the graphs are telling us?

Students’ Ideas:

The students should have some familiarity with distance, direction, speed and/or velocity, acceleration and what those mean scientifically. Students will likely have misconceptions about graphing.

Main Lesson:

1. Teachers present the lesson’s critical thinking question: What story are the graphs telling us?
2. Hand out Go Cart Test Run probe and instruct students to complete it.
3. After students are done with the probe sheets, instruct students to form small groups (2~3 students).
 - a. Students discuss reasoning for their answers.

- b. This is to engage students who are most comfortable with talking in smaller groups.
4. Instruct students to have a class discussion sharing thoughts from the small group discussion.
 - a. Whole class discussion reveals class misconceptions.
5. Instruct students to start *On the Move: Velocity Activity*.
 - a. Use a jigsaw activity to allow students to explain different parts of the instructions to their peers.
 - b. Model the experiment set up. (Applying tape, walking, running etc.)
 - c. Model how to create and/or fill out the table.
6. Pair students to conduct the activity.
 - a. Monitor progress.
 - b. Ensure data table completion.
7. After data is collected, instruct students to return to seats and begin graphing.
 - a. Instruct students work individually or in pairs.
 - b. Monitor the graphing process, and if necessary, model how to fill out the graphs.
 - c. Collect worksheets.
8. Hand out Motion Story Worksheet Homework:
 - a. Read instructions out loud.
 - b. Go over the worksheet example.
 - c. Stories will include 3-5 events such as: stopping for a light, changes in speed, turning left or right, etc.
 - d. The length of the trip can be adjusted to meet student needs

Differentiation:

- Students should be grouped appropriately.
- Activity worksheet differentiation is described in section five *On the Move: Teacher Notes*.
- Homework can be modified with maps and drawing instead of writing long descriptions.

Assessment:

The assessment is *On the Move: Velocity Activity*. Rubric is found in section four of *On the Move: Teacher Notes*.