Lesson 5 - Post-Visit
Speed & Distance

Objective: Students will be able to:
  • Reflect on the information gained from their learning experience with the Baseball Hall of Fame.
  • Review Newton's Laws of Motion.
  • Demonstrate an understanding of the relationship between speed, distance, and time.
  • Compute average speed.
  • Construct a graph that shows information about speed.

Time Required: One class period

Materials Needed:
  - Bases (ball field, playground or indoor gym)
  - Stopwatches (at least 2)
  - Copies of the "Base Running Lab Data Sheet" (included) for each student

Vocabulary:
Distance - The amount of space between two things, points, lines, etc.
Motion - A change in position measured by distance and time
Rate - A certain quantity or amount of one thing considered in relation to a unit of another thing and used as a standard or measure
Speed - Rate of change in position of a moving object
Applicable Common Core State Standards:

**CCSS.ELA-Literacy.RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect.

**CCSS.ELA-Literacy.RI.3.4, RI.4.4, RI.5.4** Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a *grade-appropriate topic or subject area*.

**CCSS.ELA-Literacy.RI.4.3, RI.5.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

**CCSS.ELA-Literacy.W.3.7** Conduct short research projects that build knowledge about a topic.

**CCSS.ELA-Literacy.W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic.

**CCSS.ELA-Literacy.W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

**CCSS.Math.Content.3.MD.A.1** Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram.

**CCSS.Math.Content.3.MD.B.3** Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs.

**CCSS.Math.Content.4.MD.A.2** Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.
Additional Relevant National Learning Standards:
(Based on Mid-continent Research for Education and Learning)

Science. Standard 9. Level II [Grade 3-5]. Understands the sources and properties of energy

Science. Standard 10. Level II [Grade 3-5]. Understands forces and motion

Science. Standard 11. Level II [Grade 3-5]. Understands the nature of scientific knowledge

Science. Standard 12. Level II [Grade 3-5]. Understands the nature of scientific inquiry
Now that students have a firm understanding of forces and motion in baseball, they can put that knowledge to use with a fun experiment.

1. To begin, review Newton's Three Laws of Motion.

   **First law**: The velocity of an object remains constant unless the body is acted upon by an external force.

   **Second law**: The force exerted by an object \( F \) is equal to its mass \( m \) times its acceleration \( a \). \( F = ma \)

   **Third law**: For every action there is an equal and opposite reaction.

2. Ask students what they might notice about an object in motion.
   
   *Possible answers*: how fast something is moving, in what direction something is moving, etc.

3. Discuss that when you describe how fast an object is moving, you are describing its **speed**. Speed is how fast an object's position changes. Speed combines information about how far an object moves (**distance**) and how long it takes to move that distance (**time**.) For example, a car traveling 60 miles per hour is traveling faster than a car with a speed of 45 miles per hour. The first car's change in position is greater over the same period of time, so its speed is greater.

4. Speed can be calculated using the following formula:
   
   **Speed** = **distance**/**time**

5. If you divide the total distance traveled by the amount of time, you get the average speed. Explain that traveling with an average speed of 5 km/h does not mean that you actually moved at 5 km/h for the whole trip. You may have traveled faster or slower at some points. On average, your speed was 5 km/h.

6. Introduce the activity.
1. Explain that as a class, you will be doing time trials to determine the average speed it takes a runner to go from home plate to first base, and the average speed it takes a runner to run all four bases.

2. Provide all students with Base Running Lab Data Sheets (included).

3. You may use a base path that has already been set up, or you may set one up yourself. Either way, make sure that students know the distance between the bases.

4. Recruit five runners, and recruit at least two students to run stop watches.

5. For the first part of the lab, have the runners take turns running the distance from home plate to first base. Class members acting as time keepers should start the stopwatch when the runner leaves home plate and stop the stopwatch when the runner touches first base.

6. At the completion of each time trial, have the time keepers share the time with all other class members. Students should write down the time data on their lab sheets.

7. Repeat the procedure with runners taking turns running the distance between all four bases.

8. Back in the classroom, have students work out the speed for each runner, as well as average time and speed for each of the two distances run.

9. Have students create graphs comparing each runner's speed in the two time trials.

**Conclusion:**

To conclude the lesson and check for understanding, have students compare the results of the two time trials. Were the runners running at the same average speed for both trials? Did the runners average a faster speed for one of the two distances?
Base Running Lab Data Sheet

Time Trial 1: Home Plate to First Base

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<thead>
<tr>
<th>Runner's Name</th>
<th>Distance (ft)</th>
<th>Time (sec)</th>
<th>Speed (ft/s)</th>
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Time Trial 2: All Four Bases

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<th>Speed (ft/s)</th>
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