

Lesson: Science Grades 4-6

Topic: Forces Impacting Motion



It's Outta Here!

Overview: Have you wondered if there is any truth to what the ball players say is the science of hitting? This investigation will help students see that forces do have an impact on the way a ball is hit. By charting the path a baseball travels under differing amounts of force, they will discover that several variables send those balls to deep left, to the infield, and even outta here!

Learning Outcomes:

National Standards:

1. An object's motion can be described by tracing and measuring its position over time.
2. The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.
3. 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.

Ohio Strand Benchmarks:

1. Describe the forces that directly affect objects and their motion.

Getting Started:

Materials per group:

- 1 baseball or softball
- 1 dowel rod approximately 1 inch diameter cut 18 inch length
- Large section of chart paper
- A marker or crayon
- Instructions sheets for each student

Technology:

Video tape students actually hitting or missing balls to use as part of the demonstration in the orientation activity.

Vocabulary:

- Force
- Motion
- Newton's Second Law of Motion

Handouts:

- "It's Outta Here" student hand out

Lesson:

Note: prior to this lesson, students have been introduced to Newton's Laws as well as how variables affect the outcome of investigations.

Orientation activity:

1. Show segments or video clips of pitchers facing hitters in a baseball game. Some should show contact with the ball, a variety of hits going to different parts of the ballpark, and others show swings and misses or called balls. Some students may need explanations of what is happening. Allow your “experts” to describe the game and the types of hits if necessary.
2. Discuss what needs to be considered when evaluating where balls are hit.
3. Have student share observations that they made of the hitters during these exchanges.
4. Record these on chart paper for comparison at a later time.

Learning activity

1. Each group of four students conducts the activity, recording their data on the chart paper and in their Science Journal.
2. Conduct checkpoints throughout the activity. Students will raise their hand when they reach a checkpoint. (See the Checkpoint Discussion Question page for discussion ideas during these checkpoints.)
3. The students will post the charts around the room for other students to compare the data.
4. Conduct a class discussion comparing these results. Does the ball travel in the same path all of the time? What causes the changes in this path? Why would some data be the same and other data very different? What role did force play in completing this activity? What variables make a difference in the science of hitting?

Evaluation and follow-up

Assessment tools and methods:

- Return to the original list of observations. Ask student to justify their observations based upon the experiences they had moving the ball in this activity. Look for inferences supported with logical observations. Rerun the video segments if necessary. Pause at appropriate times for students to see the impact of the ball and bat.
- The student Science Journal entries will provide evidence of their scientific process skills as well as data collection. They can be used as anecdotal notes or a grade taken from them.
- Review the individual student answers to the questions related to the investigation.
- Observe students as they work within the group. Look for evidence that they are using scientific process skills as they collect and record data.

Interdisciplinary connections:

- Language Arts: Written expression of observations and inferences
- Math: Convert the data collected on the charts into graph form.



It's Outta Here!
Group Instructions Hand Out

Think about the examples of the baseball players hitting the baseball to different sections of the ballpark. Consider the locations of the hit balls. Do these ball players have a system for determining where they plan the ball to go? They claim there is a science of hitting? Do you agree?



In your Science Journal, set up an activity page. Start with the title of the activity. Write a prediction stating how the way a baseball is hit could determine where it goes in the ballpark. Use as much scientific logic and vocabulary as possible in your prediction.

Gather the following materials for your group.

- 1 baseball (softball)
- A large piece of chart paper
- A crayon or marker
- Masking tape

Be sure to read all of the directions before beginning. Remember to record all of your observations and data collection in your Journal. You might want to draw pictures and/or describe the activity as it happens. The answers to the follow-up questions should be included in your Journal as well.

Step 1:

Spread the chart paper onto the floor so that you have plenty of room to work. It might be helpful to tape down the corners using a small piece of masking tape. As you move around during the activity, be careful to not tear your work. Be sure that the names of your group members are on the paper.

Step 2:

Draw a line across the width of the paper about 10 centimeters from the edge. This is your starting point. All of the movement of your balls will start from someplace on this line. Place the ball at one location on the line and label it Trial 1.

Step 3:

Using the dowel rod, push the ball slowly across the paper marking its path using the crayon or marker. You will need to work as a team in order to accomplish this task. Think about ways to collect the most accurate data possible. When the ball reaches another edge, draw a short line to show where it stopped.

Checkpoint 1_____ (raise your hand)

Step 4:

Continue as before providing each group member the opportunity to push the ball and to record the path that a ball travels. Your group should determine if the ball should start at the same place each time and be recorded in different colors or if it should start at a different place each time. Every person should apply a different amount of force to the ball as it moves across the paper. This means that you will need to pay close attention to the others in your group as they conduct their portion of the activity. Remember to label each one so that you will have four Trials when you are finished.

Step 5:

Now, that you have four trials on your chart paper, write a brief description of each trial's path. Compare the path that each trial shows. You may need to confer with the person pushing the ball each time to help you with this. What do you think caused the ball to travel the direction that it did? What do you think accounts for the differences and/ or likenesses in the lines that you drew? What variables did you use as you recorded the paths? What other variables might have an impact on the way the ball travels when it is hit?

Step 6:

Place your chart of the wall as directed by your teacher.

Step 7:

Discuss your ideas with your group and come up with a group statement about what the activity demonstrated about the movement of the ball and the force that was applied. Each of you should write this statement in your Journal.

Checkpoint 2_____ (raise your hand)

Step 8:

Look at all of the charts. Try to find similarities and differences in the paths of the balls. Be prepared to share with the class why you believe these occur.

Step 9:

Following the class discussion, answer these questions in your journal.

- a. What relationship is there between the force that was applied to the ball and the path that it traveled?
- b. Describe and draw an example from one of the charts that illustrate this relationship. Label all parts of your diagram.
- c. What happened when the ball was being pushed that would cause it to go in a direction other than a straight line?
- d. What happened to cause the ball to travel in a straight line?
- e. How would this activity help a baseball player with his/her hitting?
- f. What could a player do to control the direction that the ball would travel?
- g. How did your prediction compare with the actual data that you collected?
- h. Do you think that there is a science to hitting as many players claim? Why or why not?



It's Outta Here!

Checkpoint discussion questions for teacher

Checkpoint 1:

- Check predictions. Make sure that the students have the idea related to the hitters and the direction the ball will travel. If their prediction is way off, let it go, but remember to check later to be sure that they understand the key points of the activity.
- Ask the students to recount the method they used to mark the path of their ball's movement. Check to be sure that they are recording and labeling it accurately.
- Have them demonstrate what they did if in doubt that they might miss the point that the amount of force and location of the dowel rod on the ball will determine the path that it travels.

Checkpoint 2:

- Check the description in Step 5. Ask different students to explain each of the questions referring to the data they collected as evidence to support their answer. Look for understanding that the force and location of the dowel rod on the ball when it is pushed will determine the direction that it travels.
- Look for the identification of the variables involved with the movement of the ball. In this activity, students controlled the force and the place where they touched the ball with the dowel rod. In a "real" game, the pitcher also has some control since the velocity and movement of the ball from the pitcher to the batter impacts what happens when the ball is hit. Probe the students to see if they make this connection. Some of the ball players just might do so. Exploit it! Share it with the class.
- Direct the group where to put the chart on the wall.
- Check the group statements for clarity and correctness in concepts as stated above. All should have a similar statement.
- Refer back to the original prediction; ask the group if they would change their prediction. Why or why not?