



Science Objectives

- Students will use an animation to explore the concept of momentum.
- Students will develop an understanding how mass affects velocity.
- Students will compare the relationship between the mass of two objects and their velocities to further understand conservation of Momentum.

Vocabulary

- mass
- velocity
- force
- Newtons
- momentum

About the Lesson

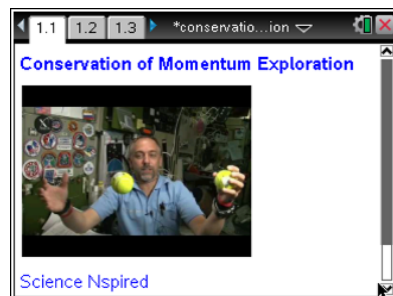
- This lesson involves students animating two masses, observing their velocities, and comparing the products of the mass and velocity of each cart to one another.
- As a result, students will:
 - Develop an understanding that the product of mass and velocity, i.e., momentum, for each cart is the same.

TI-Nspire™ Navigator™ System

- Use Screen Capture to observe student progress throughout the activity.
- Use Live Presenter to allow students to share their results and conclusions.

Activity Materials

- TI-Nspire™ Technology



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Entering and graphing data
- Tracing and interpolating

Tech Tips:

- You can hide the function entry line by pressing **ctrl** **G**.

Lesson Files:

Student Activity

Exploration C-M.pdf

TI-Nspire document

Conserv of Momentum

Exploration. tns



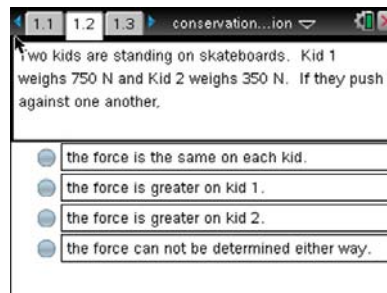
Discussion Points and Possible Answers

Tech Tip: Students can push **ctrl** ▲ to see the questions they have already answered.

Move to page 1.2.

1. Two kids are standing on skateboards. Kid 1 weighs 750 N, and Kid 2 weighs 350 N. If they push against one another, _____.

Answer: the force is the same for each kid.



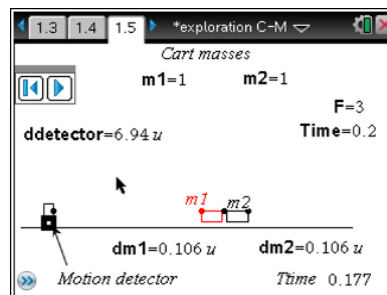
Move to page 1.3.

2. Two kids are standing on skateboards. Kid 1 weighs 750 N, and Kid 2 weighs 350 N. If they push against one another, _____.

Answer: Kid 2 will have a greater velocity.

Move to page 1.5.

3. Press the play button, and observe the two carts as they move away from each other.
- **ddetector** is the distance to the motion detector.
 - **dm1** is the distance from the center point to cart 1.
 - **dm2** is the distance from the center point to cart 2.



Move to page 1.6.

4. With a force pushing on each of the carts, the position between the starting point _____.
- Answer:** is the same for each cart



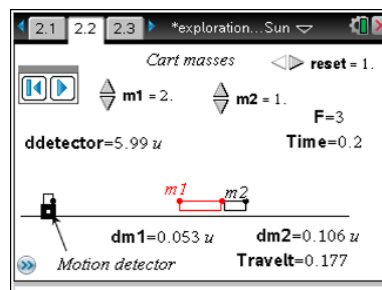
Move to page 1.7.

- If the masses are the same, the carts will move away from the center point by the same distance each time.

Answer: Always

Move to page 2.1.

- Increase the mass of Cart 1 on the next page to 2 units, and press the play button. Then examine the data and graphs on the pages that follows.
- Click on the up button of m1.
- Observe the graph produced from the two carts. Determine a linear regression for the graphs.



Move to page 2.5.

- On the graph page, what does the best fit line through the data represent?

Answer: Velocity

- Click on the vcart1 and enter the velocity of cart 1 then click on vcart2 and enter the velocity of cart 2.

The screenshot shows a software interface for a conservation of momentum exploration. At the top, it says 'exploration C-M'. Below this, there are two questions: 'What is the velocity of cart 1? m1 > 2.' and 'What is the velocity of cart 2? m2 > 1.'. Below the first question, there is a text input field with 'vcart1=0' and a small '0' button. Below the second question, there is a text input field with 'vcart2=0' and a small '0' button. At the bottom, there is a question: 'What is the product of the mass and velocity of cart 1?'. There are also navigation buttons at the top: '2.3', '2.4', and '2.5'.



11. Determine the mass times the velocity of cart 1 and enter it in List 1. Determine the mass times the velocity of cart 2 and enter it in List 2.

The screenshot shows a TI-Nspire Navigator window titled '*exploration C-M'. It contains a text box with the instruction: 'Enter the product of the mass and the velocity of cart in list 1 and the product of mass and velocity of cart 2 in list2.' Below the text box is a table with two columns labeled 'list1' and 'list2'. The table has three rows, each starting with a number (1, 2, 3) in the first column, followed by empty cells for data entry under the 'list1' and 'list2' headers.

Move to page 2.8.

12. Will the products of the velocity and the mass for each cart equal one another?

Answer: Always

13. Move back to the animation of the carts and reset. Change the mass of cart one and run the experiment again. Do you still agree with your last answer?

Sample Answers: Answers will vary.

TI-Nspire Navigator Opportunity:

TI-Nspire Navigator can be used to assess the students' progress as they go through the exploration. Making a student the Live Presenter can help to get the point across to the group.

Wrap Up

Reinforce the idea that if two objects push against each other their velocity and mass multiplied together will equal one another.

Assessment

Formative assessment will consist of questions embedded in the .tns file. The questions will be graded when the .tns file is retrieved. The Slide Show can be utilized to give students immediate feedback on their assessment.