Science Objectives

- Students will develop an understanding of momentum.
- Students will compare mass and velocity of one object to another to confirm the conservation of momentum.
- Students will measure velocity and mass of two dynamic carts as they push away from one another.

Vocabulary

- conservation
- momentum
- velocity
- mass

About the Lesson

- This lesson involves setting up a dynamic cart track.
- As a result, students will:
  - Attach the CBR 2 to the carts and measure the mass of the whole system.
  - Place the carts on the track with the motion detectors pointing in the direction each cart will be traveling. There should be a large target at the end of each ramp (a book standing at the end of the ramp works well).
  - Start a sample and trigger the carts.
  - Select the linear section of the graph generated while the carts were moving away from one another and strike the data outside of the selection and find linear curve fit to determine the velocity of each cart.

TI-Nspire™ Navigator™ System

- Send *Conservation of momentum Lab.tns* file.
- Monitor student progress using Screen Capture.
- Collect *Conservation of momentum Lab.tns*.
- Analyze student response using Class Analysis.

Activity Materials

- TI-Nspire Technology
- TI-Nspire Lab Cradle
- 2 CBR 2's
- Dynamic Cart Track
- 1 plunger dynamic Cart
- 1 regular dynamic cart
- 1 to 2 kg balance

TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tip:

Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Conservation of momentum Lab.pdf
- Conservation of Momentum Lab.doc

TI-Nspire document

- Conservation of momentum Lab.tns

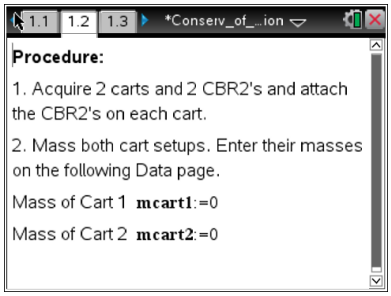
Data Collection Set-Up

Students need to connect the CBR 2 to the carts and weigh the whole system. The cart and the CBR 2 will be the mass when calculating momentum.

Students should manage the cables of both CBR 2's to give the least amount of drag. This will be a source of error later in their experiment.

Discussion Points and Possible Answers

Move to page 1.2.



1. Enter the mass of each cart.

   Sample Answers: Values will vary depending on the carts used.

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2. The slope of the line represents the _____.

   Answer: the velocity of the cart

Move to page 1.8.

3. Enter the velocity for each cart in vcart1 and vcart2. The velocities should be close to one another depending on the mass of each cart.

   Sample Answers: Values will vary.

Move to page 1.9.

4. Calculate the momentum of each cart.

Note: Differences in momentum can be equated to drag of the CBR 2 cords, students holding the carts, and friction of the wheels on the carts.

Sample Answers: Values will vary.

Move to page 1.10.

5. How does the velocity of Cart 1 compare to Cart 2?

   Answer: If the masses of each cart are nearly equivalent, then the velocities should be very similar.

Move to page 1.11.

6. How does the momentum compare between Cart 1 and Cart 2?

   Answer: The momentum should be nearly equal.

Move to page 1.12.

7. If the mass of cart 1 is doubled, what should happen to the carts?

   Answer: Cart 1 will go slower than cart 2.

8. If the mass of cart 1 is doubled, the momentum _____.

   Answer: will be the same for both carts.

Wrap Up

After the students have finished the lab, look back at their answers, and discuss the differences in their results. If they didn't get that the momentum of both carts is equal, discuss reasons that the values might not be the same (friction, cord drag, etc). Ask some questions about increasing the mass of only one cart and what would happen to velocities and the momentum of the carts.