

## Action-Reaction Lab

### Teacher's Guide

**Topic:**

Momentum and Collisions

**The following information is provided to the student:**

**Question:**

How do the post-*explosion* momenta of two carts which are propelled away from each other by an identical force compare to each other?

**Purpose:**

To compare the post-*explosion* momenta of two carts which are propelled away from each other by an identical force.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion/Discussion of Results. The Data section should include a sample sketch of the velocity-time graphs and a table of data, organized in rows and columns in order to describe the results for several trials with carts of varying mass combinations. Both measured and calculated data should be included. At least one example calculation should be provided for each type of calculation. The Conclusion/Discussion should involve a comparison of the post-*explosion* momenta of the two individual carts. An error analysis should be conducted and percent differences should be calculated for the various data trials.

**Materials Required:**

Two carts (equipped with plungers); accompanying masses; mass balance; track; computer-interfaced motion detectors.

**Description of Procedure:**

Two carts are placed in the middle of the track. Two motion detectors are placed at opposite ends of the track to detect the motion of the individual carts. The plungers of both carts are fully engaged. The motion detectors are prepared to collect motion data. A ruler or pencil is used to lightly tap the small button on one of the carts. If tapped with sufficient force, a plunger is released, pushing the two carts away from each other. Post-collision speeds of the two carts are determined from the motion detector output. Several trials are conducted with varying amounts of mass on the two carts.

**Alternative Materials and Procedure:**

Photogates can be used to determine the *post-explosion* speeds of the two carts.

**Safety Concern:**

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.

**Suggestions, Precautions, Notes:**

## The Laboratory

1. [Pasco Scientific](#) is one of several companies which sells low-friction carts equipped with magnets (for elastic collisions), Velcro strips (for inelastic collisions), plungers (for explosions), additional masses and a mass tray. These are ideal for collision studies and other mechanics labs. Their lowest cost model is ME-6950.
2. Before collecting data, students should take some time to practice striking the small button on the cart to initiate the impulse and subsequent explosion. Students will need to develop the skill of tapping the button with enough force to release the plunger but not with so much force that the subsequent motion of the cart is impeded. Instruct students to tap the button with a ruler or pencil and to quickly pull away.
3. The task of engaging the plungers on some carts can give students difficulty. Demonstrate how the plunger must be pushed into the carts and then pulled upward in order to lock it in place.

### Auxiliary Materials:

None

### Scoring Rubric:

<b>M5. Action-Reaction Lab</b>	<b>Score</b>
— Included, labeled and organized all parts of the lab report. — Data section includes a sketch of the graphs used to determine the post-explosion velocities. A table of both measured and calculated data is organized to present the results of several reliable trials. An example calculation is included for each type of calculation performed. — Conclusion/Discussion answers the <i>question</i> posed in the Purpose. Specific evidence for the <i>answer</i> is discussed. An error analysis is conducted. Percent difference calculations (comparing the post-collision momenta of the two carts) for the trials are included; work is shown for one of the trials.	____/____

### Connections to The Physics Classroom Tutorial:

The following reading is a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/momentum/u4l2e.cfm>

### Connections to Minds on Physics Internet Modules:

Sublevel 6 of the Momentum and Collisions module is a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/mop/module.cfm>