

## Rebounding versus Sticking Lab

### Teacher's Guide

**Topic:**

Momentum and Collisions

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

**Question:**

How does the impulse and resulting momentum change of an object compare for two different collisions – an elastic collision involving rebounding and an inelastic collision in which the object sticks to the collision surface?

**Purpose:**

To conduct an impulse-momentum change analysis for two types of collisions - one elastic and the other inelastic - and to compare the momentum change and impulse for the two collision types.

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 sketch of any relevant graphs obtained from the interface software; comments, descriptions and relevant quantitative information should be provided for each graph. The Conclusion should respond to the Purpose of the Lab (as always). The Discussion of Results should include a discussion of the manner in which the evidence supports the conclusion; specific data results should be referenced.

**Materials Required:**

Cart; track; computer interfaced force probe and motion detector; objects to incline track; balloon filled with air; clay putty.

**Description of Procedure:**

A cart is equipped with a computer interfaced force probe and placed upon the track. The track is elevated about 20-30 cm high at one end so as to form an inclined plane. The motion detector is placed at the elevated end. Once the force probe is zeroed and the system is prepared for data collection, the cart is released from the end of the track. A piece of soft putty is held at the height of the force probe at the opposite end; the cart (and force probe) collide with the putty and come to an abrupt stop. Observations are made of the force vs. time plot and of the velocity vs. time plot for the short-lived collision. A second trial is run, releasing the cart from the same position but allowing it to hit a balloon at the end of the track. If positioned correctly, the collision with the balloon will cause the cart to rebound and reverse directions.

**Alternative Materials and Procedure:**

Alternative materials and procedures are not recommended.

**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.

## The Laboratory

### Suggestions, Precautions, Notes:

1. Some trial runs should be performed in order to figure out exactly where the soft putty and the balloon should be held in order to cause an abrupt stop and an elastic rebound.
2. Students learn that rebounding collisions are characterized by larger impulses and momentum changes.

### Auxiliary Materials:

None

### Scoring Rubric:

| <b>M3. Rebounding versus Sticking Lab</b>   | <b>Score</b> |
|---|--------------|
| <ul style="list-style-type: none"><li>— Included, labeled and organized all parts of the lab report.</li><li>— Data section includes quantitative information relevant to the purpose, presented in an organized and informative manner. Such information could include graphs, slope values, data tables of impulse and momentum, etc. Data is reasonably accurate. Data provides evidence which can support an answer to the <i>question</i> posed in the Purpose. Labels, units and calculations are shown.</li><li>— Conclusion/Discussion answers the <i>question</i> posed in the Purpose. Evidence to support the conclusion is presented and elaborated upon; the manner in which the data support the conclusion is discussed.</li></ul> | —/—          |

### Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/momentum/u4l1b.cfm>

<http://www.physicsclassroom.com/Class/momentum/u4l1c.cfm>

### Connections to Minds on Physics Internet Modules:

Sublevels 2 and 3 of the Momentum and Collisions module are a suitable accompaniment to this lab:

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