

Marble Energy II Lab

Teacher's Guide

Topic:

Work, Energy and Power

The following information is provided to the student:

Question:

What effect does the angle of an incline have upon the distance which a rolling marble drives a *paper plow* along a level table?

Purpose:

To determine the effect of the incline angle upon the distance which a *paper plow* is driven along the level table by a rolling marble.

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 diagram or sketch of the situation. The strategic variables being measured or investigate should be identified on the diagram. A table of collected data should be included; columns should be labeled and units identified. A plot of distance driven vs. angle should be constructed and sketched. The Conclusion/Discussion should answer the question posed in the Purpose and discuss the evidence which supports the conclusion.

Materials Required:

12-inch ruler with a groove down the middle; meter stick; marble; Dominoes; masking or scotch tape; note card.

Description of Procedure:

An inclined plane is formed by elevating the ruler at one of its ends and propping the very end up on top of two Dominoes. A V-shaped *plow* is formed by bending a small note card in half; the *plow* is placed on the table at the end of the inclined plane. A marble is released from rest at the very end of the ruler. The marble rolls down the ruler and into the V of the *plow*, pushing it along the table to a final resting position. The distance which the *plow* is driven by the marble is measured; the angle of the inclined plane is measured using two distance measurements and a trigonometric function. Trials are repeated for varying angles by changing the number of Dominoes which are placed under the end of the ruler. In each trial, the marble is released from the very end of the ruler. A plot of distance driven vs. incline angle is constructed and a conclusion is drawn.

Alternative Materials and Procedure:

As an alternative to the distance-angle relationship, students could study the distance-height relationship.

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. As an extension to the lab (and as an assessment), challenge students to release the marble from the end of the ruler inclined at some angle in order for it to drive the plow a distance of ___ cm. Be sure to choose a distance which is not part of the collected data set. Allow students one try; their result must be within 2 cm from the requested distance.
2. As a post-lab activity, ponder the question as to whether it was the incline angle which mattered or the height which mattered. After all, steeper angles would increase the height of the end of the ruler. Then demonstrate two different incline angles but the same release height. Choose shallow enough angles such that the marble does not drastically bounce when transitioning from the angled ruler to the level table top.

Auxiliary Materials:

None

Scoring Rubric:

E5. Marble Energy II Lab	Score
___ Included, labeled and organized all parts of the lab report. ___ Data section includes a sketch of the experimental setup (before and after); the distances being measured are indicated on the diagram. Included a table of data with labeled columns and units. Included a sketch of plotted data. ___ Conclusion answers the <i>question</i> posed in the Purpose; <i>answer</i> is correct. Intelligently discusses the evidence which supports the answers.	___/___

Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/energy/u5l1a.cfm>

<http://www.physicsclassroom.com/Class/energy/u5l1aa.cfm>

<http://www.physicsclassroom.com/Class/energy/u5l1b.cfm>

Connections to Minds on Physics Internet Modules:

Sublevels 1 and 3 of the Work and Energy module are a suitable accompaniment to this lab:

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