Marble Energy Lab

Teacher's Guide

Topic:

Work, Energy and Power

The following information is provided to the student:

Question:
What is the effect of varying the release location of a marble along an incline upon the distance which the marble drives *a paper plow* along a level table? Can an equation be written which describes the effect (presuming that there is one)?

Purpose:
To determine the effect of the release location (distance from the bottom) of a marble along an incline upon the distance which a *paper plow* is driven along the level table; and to determine a mathematical equation which describes the relationship between these two variables.

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 investigated should be identified on the diagram. A table of collected data should be included; columns should be labeled and units identified. A plot of the two measured quantities should be constructed and sketched; linear regression or power regression should be performed and statistical information (e.g., slope, y-intercept, and regression constant) should be reported. The Conclusion/Discussion should answer the questions posed in the Purpose and discuss the evidence which supports such answers.

Materials Required:

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

Description of Procedure:

An inclined plane is formed by elevating the ruler at one of the ends by propping it up on top of a stack of 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 a given location on the inclined plane; the distance from the bottom of the plane is measured off the ruler. The marble rolls into the V of the *plow* and pushes it along the table to a final resting position. The distance which the *plow* is driven by the marble is measured. Trials are repeated for varying release locations along the incline. A linear regression analysis is performed to determine the mathematical relationship between these two variables.

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. As an extension to the lab (and as an assessment), challenge students to release the marble from a given location 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. This lab provides an experience which can be referred to quite regularly throughout the remainder of the unit. At the elevated position along the ruler, the marble possesses energy - the ability to do work. This energy is in the form of potential energy. Once released, the potential energy is converted to kinetic energy - the marble is in motion. Once on the tabletop, the marble begins to do work on the *plow* to drive it across the tabletop a given distance. Once the marble stops, it is out of energy. The energy it originally possessed has done work upon the *plow*.

Auxiliary Materials:

None

Scoring Rubric:

E4.	**Marble Energy 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 and reported the statistical information (slope, y-intercept and regression constant).	____/____
___	Conclusion/Discussion describes the effect of release location upon the distance the *paper plow* is driven. The mathematical equation relating the two variables is reported. Discussed the evidence which supports the conclusion in a logical fashion.	

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:

Sublevel 1 of the Work and Energy module is a suitable accompaniment to this lab:

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