

Wait! Hmm. Gee. Lab

Teacher's Guide

Topic:

Newton's Laws of Motion

The following information is provided to the student:

Question:

What is the relationship between the mass of an object and the force of gravity which acts upon the object?

Purpose:

To determine the mathematical relationship (i.e., the equation) which relates an object's mass (**m**) to the force of gravity (**F_{grav}**) which acts upon the mass.

A complete lab write-up includes a Title, a Purpose, a Data section, a Conclusion, and a Discussion of Results. The Data section should include a table of data and a plot of the data; the results of a linear regression analysis should also be included. Class data should be reported. The Conclusion should respond to the question raised in the Purpose of the lab (as always). The Discussion of Results section should reference the Data section and discuss the supporting evidence for the conclusion. An error analysis should be included.

Materials Required:

Cart, computer-interfaced force probe, hooked mass set

Description of Procedure:

Hooked masses of known mass are hung from a vertically oriented force probe in an effort to measure the force of gravity. Measurements taken for several different masses and plotted or somehow analyzed in order to determine the relationship between the force of gravity and mass. A plot of the force of gravity (vertical axis) as a function of mass (horizontal axis) is constructed and linear regression analysis is used to determine the slope, y-intercept and regression constant. The equation is written in slope-intercept form.

Alternative Materials and Procedure:

If a computer interfaced force probe is not available, a spring scale could be used to determine the force of gravity acting upon each mass.

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:

1. Many software programs accompanying computer interfaced equipment allow one to plot sets of data taken from discrete trials. This function proves useful for this lab. Once the data is collected

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and plotted, linear regression can be performed to determine the mathematical equation relating the two quantities.

2. It is useful to pool class data on the board for the slope of the line and to discuss the results.
3. The name of this lab represents an effort at humor; and great mileage can be made of it. When students ask (and you know they will) "How do you find the weight of an object (from its mass)?", simply respond - "**Wait** a second, I know this one. **Hmmm**. Let me think. **Gee**, I forgot. You will have to look that one up on your own." The use of humor often takes the edge off your frustration.

Auxiliary Materials:

None

Scoring Rubric:

NL3. Wait! Hmmm. Gee. Lab	Score
____ Included, labeled and organized all parts of the lab report. ____ Data section includes the data table with labeled columns and units. A sketch of plot is included; axes are labeled; results of linear regression analysis is included. Class data is reported ____ Conclusion states the relationship between the mass and the force of gravity. An equation is reported; symbols are defined.	____/4

Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/newtlaws/u2l1d.cfm>

<http://www.physicsclassroom.com/Class/newtlaws/u2l2b.cfm>

Connections to Minds on Physics Internet Modules:

Sublevel 6 of the Newton's Law module is a suitable accompaniment to this lab:

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