Falling Body Spreadsheet Lab

Teacher's Guide

Topic:

Newton's Laws of Motion

The following information is provided to the student:

Question:
(To be identified by the student.)

Purpose:
(To be identified by the student.)

A complete lab write-up includes a Title, a Purpose, a Description of Study section, a Data section, a Conclusion/Discussion of Results. In this lab, you will be provided a spreadsheet which models the motion of a falling object under the dual influence of both gravity and air resistance. Input variables for the spreadsheet include object mass, initial height, initial velocity, launch angle, acceleration of gravity, and cross-sectional area. Output variables include velocity, air resistance, net force, acceleration, and position - each being listed as a function of time. You will identify a purpose you wish to study using the spreadsheet. You must run at least two trials as a comparison-contrast associated with your question. The Purpose should be a succinct statement which focuses on an intriguing and ambitious question which can be answered by the spreadsheet. The Description of Study section should include a discussion of how you conducted your study so as to accomplish the purpose; explain what input variables you modified or kept fixed and what output variables you observed. The Data section should list the input data and include pertinent output data related to your purpose. The Data section should also include a trajectory plot (y-position vs. time for 1-D motion or y-position vs. x-position for 2-D motion) and one other plot related to your study. The Conclusion/Discussion should provide the answer to the question posed in the purpose of the lab and include a discussion of the evidence and rationale which lead from data to answer.

Materials Required:

Falling Bodies spreadsheet file; computer lab; Microsoft Excel.

Description of Procedure:

This activity provides students an opportunity to creatively explore a question of their own. The use of a spreadsheet allows students to change a variable and quickly observe the effect of that change on a target variable. The use of the spreadsheet is demonstrated so that students can gain a familiarity with what it can and cannot do. An example question could be explored during the demonstration. Once familiar with the spreadsheet, students brainstorm possible questions, select a question to explore, express the question as a Purpose, enter input variables into the spreadsheet and obtain and analyze the results. Input variables should be manipulated in an effort to provide realistic results and/or answer the question which was presented in the Purpose. Two or more columns of data should be selected for the creation of a spreadsheet chart which is relevant to the Purpose of the lab.

Alternative Materials and Procedure:

An alternative approach to this activity involves generating a collection of questions to study. Each student or student lab group is then assigned their own question to explore.

The Laboratory

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. Access to a computer lab and a license to use Microsoft Excel is required for this activity.
2. This activity is more of a project than it is a lab. Students will need some time to explore. It is a wise tactic to break the project up into attainable sub-goals. For instance, the project could be divided into the following sections: brainstorming, project proposal and approval, development of a methodology, collection of data, reporting of results.
3. Encourage students to restrict their study in this unit to a one-dimensional falling motion. Two dimensional motions can be reserved for a Projectiles unit or a two-dimensional motion unit.
4. The inclusion of air resistance effects makes the spreadsheet unique and interesting. Realistic modeling of the motion of objects is possible.
5. The launch angle is expressed as counter-clockwise angle of rotation from due East. Use 270 degrees for a one-dimensional falling motion.

Auxiliary Materials:

None

Scoring Rubric:

NL7.	**Falling Body Spreadsheet Study**	**Score**
___	Included, labeled and organized all parts of the lab report.	
___	Purpose section includes a succinctly worded statement which clarifies the intention of the study.	____/____
___	Description of Study section describes details related to how the study was conducted. Independent and dependent variables are discussed. The procedure which was used was related to the purpose.	
___	Data section identifies the input variables for all trials; units are stated. Reasonable values were used for all inputs. Relevant output variables are clearly stated in an organized fashion. Included a relevant trajectory plot and at least one other plot for each trial.	
___	Conclusion/Discussion provides the answer to the question posed in the Purpose. Answer is relevant to the purpose and reasonable. Evidence which supports the conclusions are discussed in a rational manner.	

Connections to The Physics Classroom Tutorial:

The following reading is a suitable accompaniment to this lab:

http://www.physicsclassroom.com/Class/newtlaws/u2l3e.cfm

Connections to Minds on Physics Internet Modules:

Sublevel 10 of the Newton's Law module is a suitable accompaniment to this lab:

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