Coffee Filter Skydiver Lab

Teacher's Guide

Topic:

Newton's Laws of Motion

The following information is provided to the student:

Question:
How does the velocity and acceleration of a falling object change over time when under the dual influence of gravity and air resistance?

Purpose:
To describe how the velocity and acceleration of an object change over time when falling under the dual influence of gravity and air resistance and to explain why such changes are observed.

A complete lab write-up includes a Title, a Purpose, a Data section, a Conclusion/Discussion of Results. The Data section should include velocity-time and acceleration-time graphs for a falling filter. The Conclusion/Discussion should reference the data to describe how the velocity and acceleration of the falling filter changed over time. An effort should be made to use the theoretical model of Newton's laws of motion to thoroughly explain why such changes occurred.

Materials Required:

Coffee filter; computer-interfaced motion detector.

Description of Procedure:

Students drop a coffee filter and use a motion detector to capture the velocity of the filter as a function of time. The velocity-time graph is used to accomplish the purpose of the lab.

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. Extreme caution should be taken if students are leaning over stairwell railings or out over the edge of lab tables in order to drop coffee filters or hold motion detectors. Monitor student behavior closely and intervene when safety appears to be forgotten.

Suggestions, Precautions, Notes:

1. Given its small mass and wide cross-sectional area, the filter quickly approaches terminal velocity. By standing on a chair or a lab bench, a greater falling distance can be obtained and the slope of the v-t graph can be observed to approach zero.
2. The use of a laptop computer or the portable interface devices (such as Vernier's LabQuest or Pasco's Spark) allows a class to conduct trials in a stairwell.

3. Megasize coffee filters can often be obtained from party supply wharehouses. These large filters are easily detectable by motion detectors and produce dramatic results.

Auxiliary Materials:

None

Scoring Rubric:

NL5.	**Coffee Filter Skydiver Lab**	**Score**
___	Included, labeled and organized all parts of the lab report.	
___	Data section includes a sketch of the two LabPro plots (velocity-time and acceleration-time) for a falling coffee filter; axes are labeled.	____/____
___	Conclusion/Discussion accurately and thoroughly describes how the velocity and acceleration of the filter changed over time. References are made to specific parts of each graph to support such conclusions. Efforts to explain such changes using Newton's laws are thorough, logical and intelligent.	

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