AIR RESISTANCE AND TERMINAL VELOCITY

Concepts Illustrated:

(1) All objects fall at the same rate in the absence of air resistance.
(2) Objects fall with a terminal velocity when the gravitational force down on an object is exactly balanced by the upward force of air resistance on the object.
(3) The faster and object moves through air, the greater the air resistance.

Time Requirements: 10 minutes

Grade Level of Audience: This qualitative demonstration is suitable (and enjoyed) by students at all age levels. However, detailed discussion is best reserved for students in grades 9-12.

I. Materials and Equipment Utilized

1. One, expendable, heavy, hard covered book
2. One half of an 8½" x 11" sheet of paper
3. Minimum of six coffee filters

II. Description of Set-up and/or Construction of Apparatus

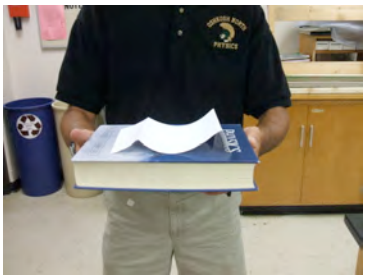
1. Partially fold the half piece of paper so that it rests like a tent.
2. Have a single coffee filter, two coffee filter nested together, and three coffee filters nested together.

III. Details of Student Implementation

1. Ask students what will happen if the hard cover book and piece of paper are dropped side-by-side. Discuss why the students answered the way they did.
2. Drop both objects and discuss the results.

3. Ask students what will happen, if, instead, the half piece of paper is placed on top of the heavy book. Discuss with students why they answered the way

they did. Drop the book with the paper on it and discuss the results. The implications: In the absence of air resistance, all objects will fall the same.



4. Ask students what they think will happen if a single coffee filter is dropped.
5. Drop the filter and discuss the behavior that results. What is happening here is that the air resistance on the single coffee filter very quickly matches the weight of the coffee filter, such that, the filter no longer speeds up. The velocity when the forces are the same is called the terminal velocity. NOTE: When the forces are equal, the filter doesn't stop moving, it simply STOPS ACCELERATING.

6. Ask students what will happen if two nested filters, then three nested filters are dropped. Drop the filters in these configurations and note the results. As the weight of each new coffee filter configuration INCREASES, each has a GREATER terminal velocity, as the filters must fall FASTER to produce a greater upward force of air resistance to balance the greater weight.