Coffee Filter Air Resistance

When an object is **falling with a constant velocity**, we describe it with the term *terminal velocity*, or v_T. Air resistance is sometimes referred to as a *drag force*.

- Determine how air resistance and mass affect the terminal velocity of a falling object.

When falling, there are two forces acting on an object: the weight, *mg*, and air

In this experiment, you will measure terminal velocity as a function of mass for falling coffee filters. Coffee filters were chosen because they are light enough to reach terminal velocity in a short distance.

PROCEDURE

1. Support the Motion Detector about 2 m above the floor, pointing down, as shown in Figure 1.

2. If your Motion Detector has a switch, set it to Normal. Connect the Motion Detector to DIG 1 of LabQuest and choose New from the File menu.

3. Place a coffee filter in the palm of your hand and hold it about 0.5 m under the Motion Detector. Do not hold the filter closer than 0.15 m.

4. Start data collection. **After a moment,** release the coffee filter directly below the Motion Detector so that it falls toward the floor. **Move your hand out of the beam of the Motion Detector as quickly as possible so that only the motion of the filter is recorded on the graph.**

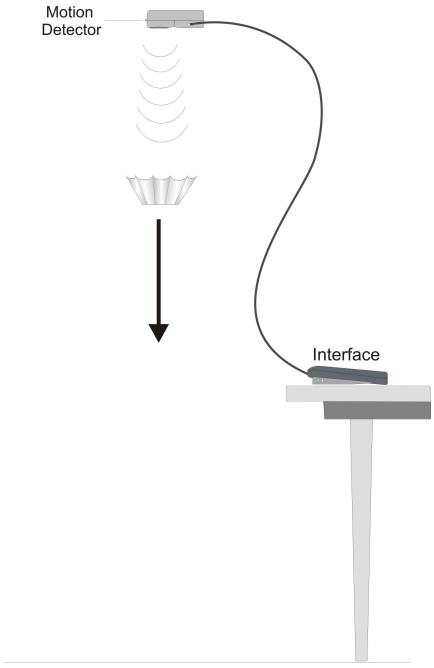

Figure 1

5. Examine your position graph.
   a. If the motion of the filter was too erratic to get a smooth graph, you will need to repeat the measurement. With practice, the filter will fall almost straight down with little sideways motion.
   b. To collect data again, simply start data collection when you are ready to release the filter. Continue to repeat this process until you get a smooth graph.

6. The velocity of the coffee filter can be determined from the slope of the position *vs*. time graph. At the start of the graph, there should be a region of increasing slope (increasing velocity), and then the plot should become linear. Since the slope of this line is velocity, the linear portion indicates that the filter was falling with a constant or terminal velocity (v_T) during that time.
   a. Tap and drag your stylus across the linear region to select it.
   b. Choose Curve Fit from the Analyze menu.
   c. Select Linear as the Fit Equation.
   d. Record the slope in the data table (a velocity in m/s). Select OK.
7. Repeat Steps 3–6 for two, three, four, and five coffee filters.