Project - Terminal Velocity

Teams of 3-4

Learning goal

- **Construct an object that reaches terminal velocity**
- **Use graphs of motion to verify the object reached terminal velocity**
- **Use data to calculate the drag coefficient**

For this project, construct a parachute so that a 200g mass falls at a constant velocity over a distance of 4 meters. You will drop the 200 gram masses with a parachute from the second floor, videotape the motion, and analyze the video using LoggerPro.

Available materials:
One square meter of plastic sheet
String
2 balsa wood sticks (1/8" x 1/8" x 36") (if needed)

Project write-up: This is a typed report that all team members must contribute to. It must include:

1. Your name and your partner's names.
2. Your original design and measurements and any changes you made during construction of the project.
3. Analysis of results:
    - Graph from video analysis of y-position vs. time with inserted trendline.
    - Graph of Y-velocity as a function of Y-position. Go to analyze, then statistics to show the average velocity. Compare the average to the slope of the position vs. time graph.
    - Use the terminal velocity from the video to calculate the drag coefficient of your parachute. The **drag coefficient** is a number that aerodynamicists use to model the complex dependencies of fluid density, speed, and reference area on the drag force. See link

        $c_d = 2F_d/(\rho\, v^2\, A)$

        c_d - *drag coefficient*

        ρ - *density of air*

        v - *terminal velocity*

        A - *cross sectional area*

        F_d - *drag force*
4. A discussion of uncertainties
5. A conclusion summarizing what you have learned.