<u>Egg Drop Tutorial</u>

Drop vs. Stop

Mass of egg = 0.0600 kg (60 grams)
Average time of stopwatches = _____ s (get the times from your teacher: t_1 = _____s t_2 = _____s t_3 = _____s)

Before you start this tutorial, remind yourselves of how v-t graphs work and why they are important. What kinds of shapes do we usually see on them? What does the slope of a v-t graph represent? What does the area under the curve represent?

1. Draw a vt-graph of the motion of the egg as it fell but before it was stopped by your device (assume no air resistance). Do not include any numbers yet but be sure to label your axes with units. Also, don't forget that velocity is a vector quantity and includes direction.
2. On the **same** vt-graph above draw the motion of the egg stopping in your device using a different color. (continue from where you left off on the previous question). Assume constant acceleration.
3. At this point you should have 2 shapes on your Vt-graph. Make a small data table that allows you to record any similarities and differences between all the parts of the 2 shapes.
4. Give a detailed <u>description</u> of the acceleration difference between <u>**drop**</u> and <u>**stop**</u>**.** Use the vt-graph as your guide.
5. Place an arrow pointing to the t-axis where the egg begins to stop. Label the numerical value for the time it took for your egg to <u>**drop**</u> on the t-axis of your v-t graph (the average time you calculated).
6. Calculate the velocity of the egg, v_f, just before it landed (in other words, just before it began to stop and assume no air resistance). Show your work! Then, label v_i and v_f with their numerical values on your v-t graph. Note: v_f for the <u>**drop**</u> is v_i for the <u>**stop**</u>. You'll need to consider this for #14 and #21.
7. Showing all work, calculate the distance the egg fell (assume the time measured was from dropping point to the moment just before it began to stop. Use the vt-graph as your guide calculating the area under the curve. Also calculate this a second way using a kinematic equation <u>**and**</u> compare your answers.)
8. What is the product of velocity and mass called in Physics?
9. Calculate the $\mathbf{v_f m}$ of the egg just before it began to stop.
10. How much **Δvm** [$m(v_f - v_i)$] did the egg undergo **only while it was dropping??**
11. What's another name for the change in momentum? What is the formula for this other concept? (In other words, what is **Δvm** also equal to**?**
12. How does your answer to #10 compare to the **Δvm** of the egg **while it was stopping**?
13. How much **Δvm** would the egg undergo **while it was stopping** if it **wasn't** inside your devise (if we just dropped an egg by itself)?
14. Draw a labeled graph of **vm** on the **y axis** and **t** on the **x axis** of the egg <u>**stopping**</u> inside your device. Label $v_i m$ with its numerical value (based on your answer to #6).
15. Draw a similar graph of just an egg **alone** being stopped by the concrete. (no devise to protect it). No data points necessary.
16. What things are similar or different in each graph? (Compare the shapes again like in #3)
17. What does the **slope** of graphs 14 and 15 represent?
18. What are your thoughts on the difference between the egg being stopped by your device and the egg being stopped by the concrete? Why does the egg break in one situation and not the other. **Be specific!! Be sure to mention the parts of the shapes on the momentum-time graphs in your explanation.**
19. Calculate the time it took the egg to stop. In order to do this you must <u>**estimate the distance**</u> you think your egg moved in the device when it was stopping. <u>*(Consider the material you surrounded your egg with and you may want to look at a ruler for perspective.)*</u> (Show all Work). Use the vt-graph in #2 as a guide, because you'll know the area under the curve. Once you calculate the time, label the time interval on your vt-graph in #2 and the vm-t graph in #14.
20. Calculate the acceleration of the <u>**stop**</u>. (Slope Equation from vt-graph #2) Show your work!
21. Calculate the amount of force necessary to stop the egg. (Show all Work - use graph #14 as a guide. HINT: **-** Use your answer to #17 to help you with this one.) Show your work!
22. Describe the stopping force? What kind of force is it? What exerts this force?
23. Answer # 22 again, except this time discuss the force causing the egg to **Drop**.
24. Calculate the **Dropping Force**. (Draw a vm-t graph for the <u>**DROP**</u> similar to the vm-t graph you drew for the <u>**STOP**</u> in #14. Then, do a similar calculation as in #21.) Show your work!