Activity: What's your Graph?

Background information:

Today, we will be going outside to observe how displacement/time graphs can be created for individuals that will be walking, running, and accelerating in a straight line. Two to four students will be the 'runners' and everyone else will be the timers. Each student 'timer' will be spread out along the track at 3 metre intervals and will have a stopwatch. As the runner starts, all the timers along the track will start their watches and they will record the time it takes for the runner to get to their position. This information will then be collected and recorded back in class so that you will be able to graph the runner's position as a function of time. Then you will do the necessary calculations to graph the runner's velocity and acceleration as well.

Materials required:

- Measuring sticks, stop watches, and someone wearing running shoes
- Graph paper, pencils, erasers, rulers, etc.

Method:

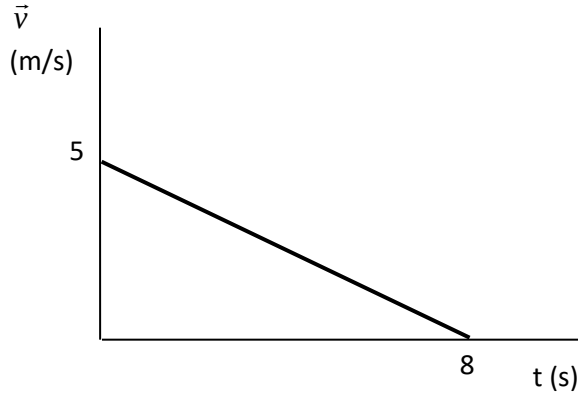
1. Brainstorm, how we will ensure that all timers will start at the same time. Decide on a method before we start the activity.
2. Two students will measure the timers and make sure they are all 3 metres apart.
3. Two runners will stretch out while the timers are being placed (to avoid injured muscles).
4. Your teacher will be the starter.
5. There will be 4 trials:
    a) The runner will walk at a slow and steady pace.
    b) The runner will try to maintain a fast, constant speed along the length of the track.
    c) The runner will attempt to smoothly accelerate along the entire length of the track.
    d) The runner will run as quickly as possible $\frac{1}{2}$ way along the track and then turn around and walk slowly back to the start.
6. Each timer is responsible for recording what distance they are from the start and how long it takes the runner to reach their position for each trial. I.e. the timers will be collecting the data to make the (x, y) points on each graph, or, more precisely, the (t, d) points.
7. We will all go back inside and collect our data, do our analysis, and answer the following questions.

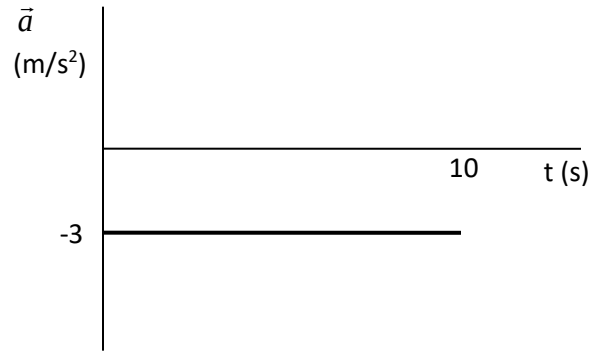
Analysis:

1. Create your graphs:
   a. Copy all the data into 4 separate tables of values.
   b. Create the 4 Displacement versus Time graphs. DO NOT connect your points… DO create best fit line and/or smooth curves.
   c. Use these graphs to accurately create the Velocity versus Time graphs. If the graph is curved, you will need to take tangents off of your best-fit lines.
   d. Use your Velocity graphs to make your Acceleration versus Time graphs. Again, you may need to take the tangents off of your lines/curves of best fit.
2. Make descriptive paragraphs
   a. First, make a paragraph for each set of graphs to explain what they represent. In other words, tell 4 stories, one for each trial/run. Be as detailed and precise as you can. Include descriptions and values for displacement, velocity, and acceleration.
   b. Second, make a short paragraph detailing the sources of error that were present in this experiment. I.e. Give reasons why the graphs may not be true and/or accurate representations of what the runners actually did.

Follow-up Questions:

1. Use the velocity/time graph below to create a possible displacement/time graph. What problem(s) do you encounter?
2. Use the acceleration/time graph below to create possible velocity and displacement graphs. Again, what problem(s) do you encounter?
3. Why do acceleration graphs not indicate the direction of travel the way a displacement or velocity graph does?
4. If a displacement/time graph is a straight line, what does that tell us?
5. If a displacement/time graph is curved what does that tell us? Give examples of the 4 different types of curves.





Graphing Assignment Learning Goals

Learning goal: I can create proper and accurate graphs of position, velocity, and acceleration for objects moving in a straight line.

Learning goal: I can accurately describe the motion of a moving object that each graph represents with well written paragraphs.

Learning goal: I can apply my knowledge of d, v, and a graphs to new situations.

Perfect	Mastering	Accomplished	Developing	Remedial