Name: _____

Period: _____ Group Name: _____

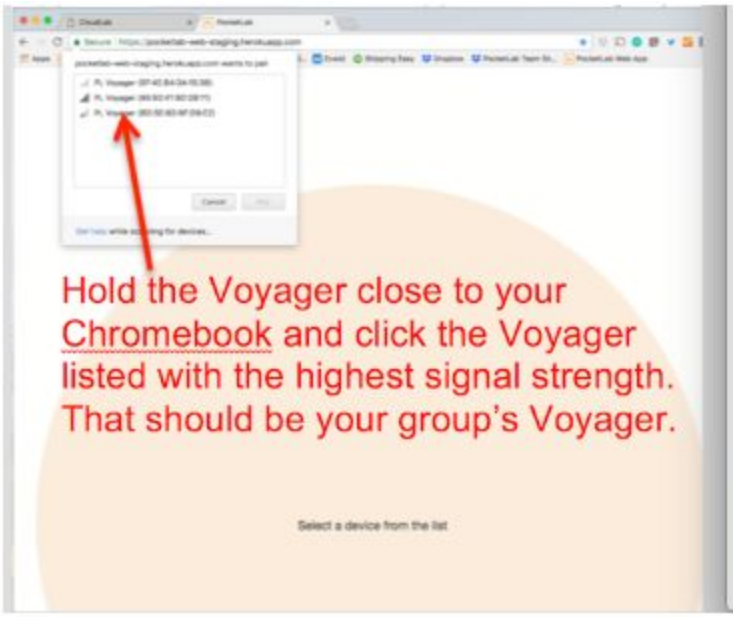
Lab Activity: Understanding Linear Motion - Match Graphing Activity

Introduction:
In the PocketLab activity Modeling Linear Motion - Position, Velocity versus Time, we learned how graphs can be used to model an object's motion. In that activity, a cart was pushed up a ramp and PocketLab's rangefinder measured it's change in position and velocity vs. time as it traveled up the ramp, changed direction and came down the ramp. The graphs were able to model the cart's direction of movement and speed. In this activity, we will take the concept further. You will be the object whose motion will be modeled graphically. You and your group members will take turns moving back and forth using the PocketLab's rangefinder to graph position and velocity vs. time graphs to model your direction and speed of motion.

Objective:
In this experiment, students will:
-Make Hypotheses based on background knowledge about how position and velocity vs time graphs should look for certain movements.
-Test those Hypotheses by modeling the motion of a person as he/she walks back and forth to mimic those movements.
-Match specific linear motion graphs with a person's movements to better understand how to model linear motion graphically.
-Draw conclusions about linear motion based on evidence/data gathered during the lab activity and scientific reasoning.

Materials:
-PocketLab Voyager
-PocketLab App with compatible device
-Wall space for Voyager's rangefinder signal.

Pre-Lab Warm-up:
In the Pre-Lab , your group will use PocketLab Voyager's rangefinder to collect some quick data to help you write your Hypothesis. (The screenshots were taken using the PocketLab web app. The PocketLab mobile app will look slightly different.) Follow the steps below to get connected:



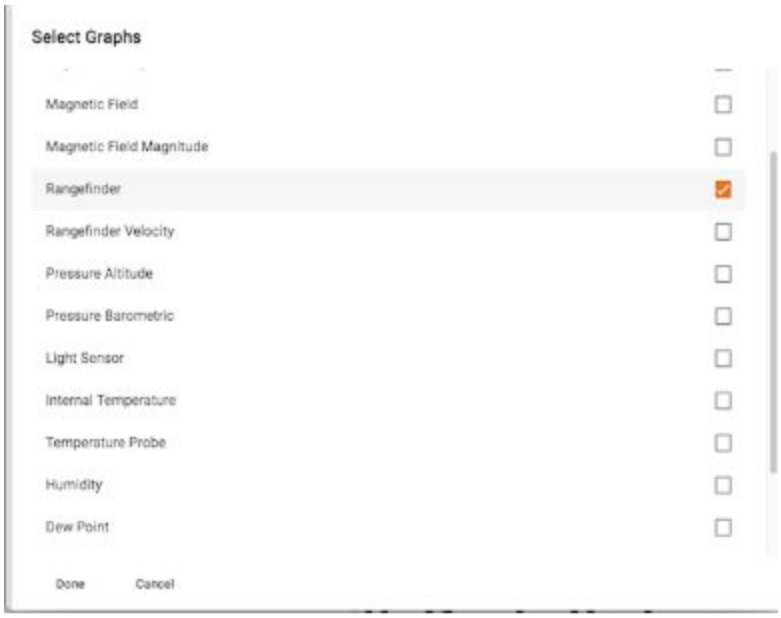
-Go to the PocketLab web app (in a Chrome browser) using the following address: thepocketlab.com/app or open up the PocketLab mobile app.

-Turn on the PocketLab Voyager by clicking the button on the top.

-If using the web app, click the text that reads, “Click here to connect”. If using the mobile app, the PocketLab Voyager should automatically connect.

-Web app only: A pop-up box should appear showing all the PocketLab Voyagers that are turned on. Hold your PocketLab Voyager close to your computer/Chromebook. Click the PocketLab Voyager with the highest “signal strength.”

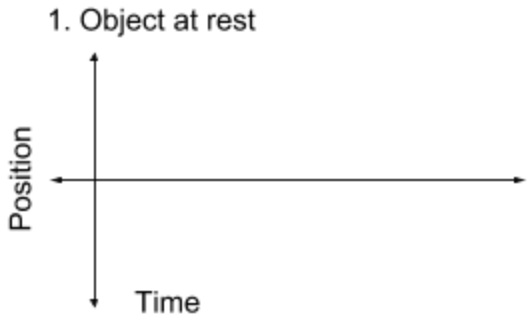
-Click on the “Change Graph” icon .
Click “Rangefinder Position” and unclick “Acceleration.”

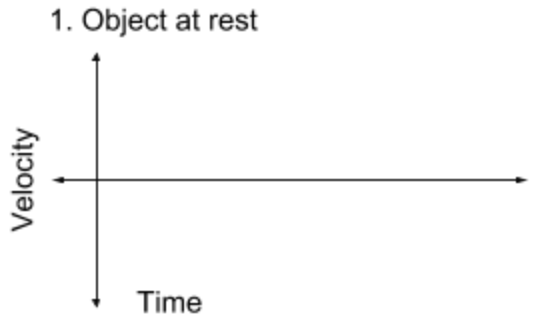


Now follow these steps for the “Warm-up”:
-Point Voyager at a the table, approximately 1 foot from the surface.
-Move the Voyager up and down. Take turns with your group trying this out.
-Next, place Voyager on the desk facing up. Place your hand on top of Voyager and move your hand up and down. Take turns with your group trying this out.
-As a group, discuss how the graph models PocketLab Voyager’s movements.

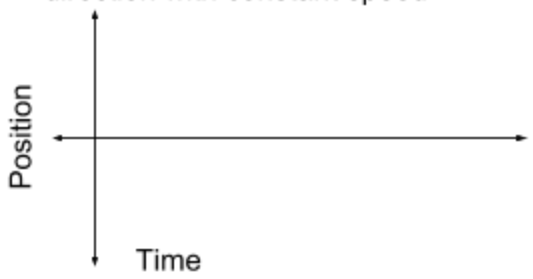
Now switch to “Rangefinder Velocity” and repeat the “Warm-up” steps. When you are finished with the discussion, turn the Voyager off or set it aside to complete your Hypothesis.

Hypothesis:
In today’s lab activity, your hypothesis will be a series of sketches that predict what the position vs. time and velocity vs. time graphs will looks like for the following scenarios.

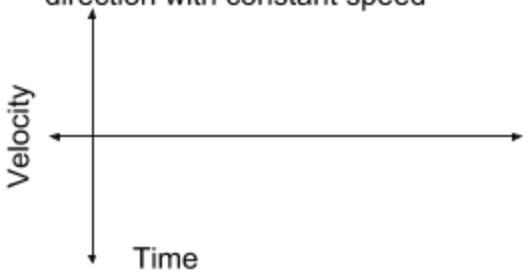




2. Objective moving in a positive direction with constant speed



2. Objective moving in a positive direction with constant speed



3. Objective moving in a negative direction with constant speed

3. Objective moving in a negative direction with constant speed

4. Objective moving in negative direction with constant acceleration.

4. Objective moving in negative direction with constant acceleration.

Pick three of your graphs, including at least one position vs. time graph and one velocity vs. time graph. Describe your reasoning behind your prediction sketch below.

Part 1: Collecting data as a group with PocketLab

You are now ready to collect data for your two runs and answer data analysis questions. Follow the previous steps to connect with your PocketLab Voyager. Keep the data rate at 10 samples per second.

Data collection for Run 1: Scenario 1 - Object at Rest

-Open the rangefinder position graph. Have one group member stand 1m away from the wall while holding the PocketLab Voyager. Hold the Voyager at chest height and point it directly at the wall. The group member should remain at rest while recording data for approximately 20 seconds. Sketch the recorded graph below:

-Switch to the rangefinder velocity graph. Have one group member stand 1m away from the wall while holding the PocketLab Voyager. Hold the Voyager at chest height and point it directly at the wall. The group member should remain at rest while recording data for approximately 20 seconds. Sketch the recorded graph below:

Data collection for Run 2: Scenario 2 - Object moving in a positive direction with a constant speed

-Open the rangefinder position graph. Before recording move back and forth. Determine which direction is positive and which is negative. Have one group member stand 1m away from the wall while holding the PocketLab Voyager. Hold the Voyager at chest height and point it directly at the wall. Hit the record button. The group member should then move in a positive direction at a constant speed. (note: the sensor's maximum range is 2m). Sketch the recorded graph below:

-Switch to the rangefinder velocity graph. Have one group member stand 1m away from the wall while holding the PocketLab Voyager. Hold the Voyager at chest height and point it directly at the wall. Hit the record button. The group member should then move in a positive direction at a constant speed. (note: the sensor's maximum range is 2m). Sketch the recorded graph below:

Data collection for Run 3: Scenario 3 - Object moving in a negative direction with a constant speed

-Open the rangefinder position graph. Have one group member stand 1m away from the wall while holding the PocketLab Voyager. Hold the Voyager at chest height and point it directly at the wall. Hit the record button. The group member should then move in a negative direction at a constant speed. (note: the sensor's maximum range is 2m). Sketch the recorded graph below:

-Switch to the rangefinder velocity graph. Have one group member stand 1m away from the wall while holding the PocketLab Voyager. Hold the Voyager at chest height and point it directly at the wall. Hit the record button. The group member should then move in a negative direction at a constant speed. (note: the sensor's maximum range is 2m). Sketch the recorded graph below:

Data collection for Run 4: Scenario 4 - Object moving in a negative direction with a constant acceleration

-Open the rangefinder position graph. Have one group member stand 1m away from the wall while holding the PocketLab Voyager. Hold the Voyager at chest height and point it directly at the wall. Hit the record button. The group member should then move in a negative direction with a constant acceleration. (note: the sensor's maximum range is 2m). Sketch the recorded graph below:

-Switch to the rangefinder velocity graph. Have one group member stand 1m away from the wall while holding the PocketLab Voyager. Hold the Voyager at chest height and point it directly at the wall. Hit the record button. The group member should then move in a negative direction with a constant acceleration. (note: the sensor's maximum range is 2m). Sketch the recorded graph below:

Data Analysis for Runs 1-4

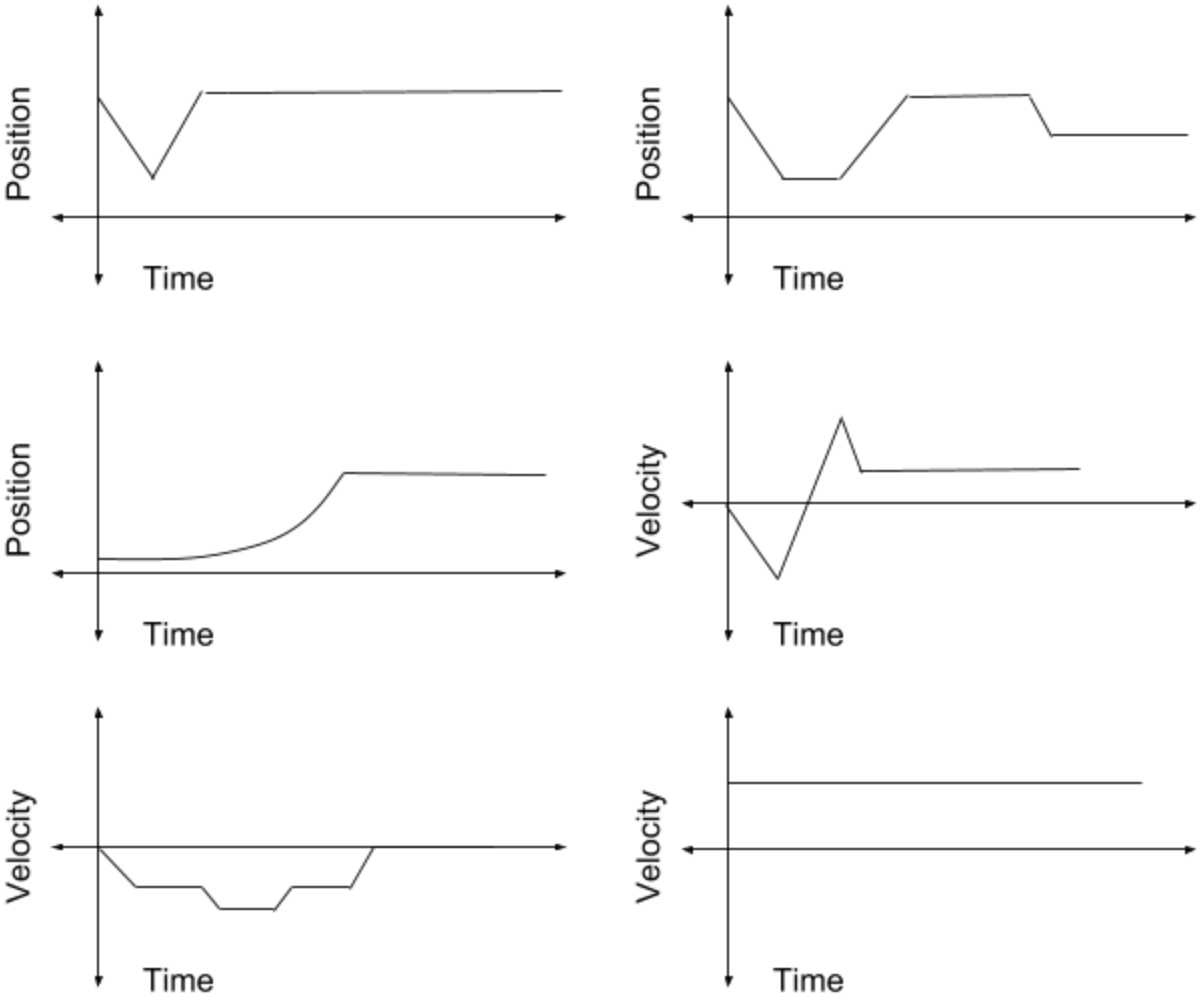
Run 1: Scenario 1 - Object at Rest
-Did the graphs match your predictions? Explain why or why not.

Run 2: Scenario 2 - Scenario 2 - Object moving in a positive direction with a constant speed
-Did the graphs match your predictions? Explain why or why not.

Run 3: Scenario 3 - Scenario 3 - Object moving in a negative direction with a constant speed
-Did the graphs match your predictions? Explain why or why not.

Run 4: Scenario 4 - Scenario 4 - Object moving in a negative direction with a constant acceleration
-Did the graphs match your prediction?. Explain why or why not.

Data collection for Run 5: Match the Graph
Using the same procedure that your group used to test your hypotheses, try to "match" the graphs below with a group member's movements.



Data Analysis for Runs 5
For each matched graph below, explain what the group member had to do in order to "match" the different sections of each graph.

Part 2: Conclusion and Lab Report

Option 1: Write a concluding paragraph that answers the Conclusion Questions at the bottom of the page.
Option 2: Write a full lab report for this lab activity. A lab report is a great way to summarize how you conducted your experiment and tested your hypothesis, the data collected, and any conclusions you can draw about the scientific question that was tested.

In your lab report include:

1. Your original hypothesis from the beginning of the lab (in this case, your sketches).
2. The objectives or scientific questions you wanted to answer with the lab activity.
3. What materials you used in the experiment.
4. A detailed description of how the lab was set up and how you tested your hypothesis.
5. A summary of your data and the answers to your data analysis questions.
6. Any observations you made with your group.
7. A conclusion that answers the Conclusion Questions below.

Conclusion Questions

-What is significant about the slope of a position vs. time graph? Remember slope = rise/run. In a position (x) vs. time (t) graph that equates to $\Delta x/\Delta t$. In your answer, be sure to discuss velocity, the significance of a positive or negative slope, and evidence/data you collected during your experiment.

-After answering the previous question, explain how does the position vs. time graphs and the velocity vs. time graphs relate to one another? Given a position vs. time graph, could you draw its corresponding velocity vs. time graph? Explain your answer, using evidence collected during runs 1-4.

-Draw a velocity vs. time graph for the first position vs. time graph in run 5 below. Explain how you knew to draw each section of the graph.

-Draw a position vs. time graph for the last velocity vs. time graph in run 5 below. Explain how you knew to draw each section of the graph.

-If the slope of a position vs. time graph is zero, what motion is happening? What about a velocity vs. time graph?

-If the slope of a position vs. time graph is constant and does not equal zero, what motion is happening? What about a velocity vs. time graph?

-If the slope of a position vs. time graph is changing, what motion is happening? What about a velocity vs. time graph?