

Implementation Plan  
Analyzing Position-Time Graphs  
Quarknet Data Camp 6/21

Notebook

<https://colab.research.google.com/drive/1CCYOmCjWINQJXOWBow4JFVvqaB14X-K5?usp=sharing>

Background and prior knowledge:

This is envisioned as part of 1-2 culminating lessons in the kinematics unit (which we strive to keep as brief as possible). Students will have gathered and analyzed data for objects with constant velocity and constant acceleration using spreadsheets, solved problems using the basic kinematic equations, and analyzed graphical representations. This activity is intended to emphasize how a physical phenomenon, like accelerated motion, can be explained using words, equations and visual representations like graphs - and how using all three can result in a better understanding. The addition of coding (in addition to prior use of spreadsheets) provides another entry into understanding how the equations represent physical phenomena, and how what is represented by the coefficients in the equations. It also, of course, introduces students to the use of code and some basic programming,

I would envision one more part further exploring velocity functions and graph and finding acceleration from a graph of  $v$  vs  $t$ . This same format could be applied to analyzing data using Newton's Second Law, Impulse and Ohm's Law - so this could be integrated into the routine of the class.

Objectives:

Overall: Students explain different types of motion using words, equations and graphical representations of data. By using coding as a tool for creating data for graphs, students will predict and analyze how changes in the parameters of a situation affect the motion.

Parts 1-4

Students model the motion of an object with constant velocity and constant acceleration using mathematical functions (aka equations) and graphs.

Students explain the motion of an object using a graph of position vs time.

Students predict and explain how changes in the initial parameters ("givens") of an equation affect the resulting position vs time graph.

Students explain and edit the code used to determine position using the given equation and create a scatter plot.

Parts 5-6

Students explain how the velocity of an object is found using the slope of a position vs time graph

Students interpret the data represented in a velocity vs time graph and explain how it relates to the motion shown of a position vs time graph.

Stretch Objective: Students will learn the basic technique of creating iterative code to create a dataset and create a graphical representation of the data.

Target Class: Grade 10 Introductory Physics

Lesson Format:

Background - in my class students are accustomed to accessing work on Google Classroom and collaborating in groups of 3-4 students. Groups report out either using a shared Google Doc or Form or - the preferred method when we are together in class - whiteboards.

Students have completed the [Intro to Coding](#)

A sample Google Form that would be used as both assignment and assessment tool is here:

[Analyzing Position Graphs Student Form](#)

Assessment: Student Form

Note on Codeworthyness: This dataset could easily be generated on a spreadsheet and students will have already done some of that work. The justification for this activity is that the code is fairly simple - so students can access how this code is generating the dataset and see how to generate an iterative block of code that generates a dataset. This is something we can do with enough repetition so that students can actually learn how this function works - and it can serve as a jumping off point for students who are interested in diving into coding.