Can Your Force a Graph?

Materials: Force Plate, Motion Detector, Go!Link, Logger Lite, Computer, Fathom

Groups: Teachers need to be in groups of 3-4.   Roles include: experimenter to apply force to force plate, person to set up and turn on experiment, and recorder (to have activity open on their computer).

Mathematical goals:
  • For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* (F-IF.4.)
  • Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* (F.IF.5.)

Technological goals:
  • Teachers will be able to match forces applied to a force plate to a graph
  • Teachers will be able to import their data into Fathom
  • Teachers will be able to create tables and graphs in Fathom based on their data

Lesson Outline:

Background:
Weight is a force based on the mass of an object times it's acceleration due to gravity. This comes directly from Newton's Second Law of Motion: *F=ma.* This is why objects weigh less on the moon. In this activity you'll try to match the graph of forces over time using a force plate.

Set up the experiments in Logger Lite.

  1) Open a new Logger Lite Window
  2) Connect the force plate to the Go!Link cable and connect to your computers USB port.
  3) Connect your Motion Detector to your computer. (Logger Lite only activates the Graph Match feature when the Motion Detector is attached, but we can trick it.)
  4) Once you see the Match icon on the menu bar you can unplug the Motion Sensor.

4) Click on Match on the top menu bar. It will give you a graph to match in an experiment.

Make Predictions and Conjectures:

 Predict what you need to do to create:

a) A line that is increasing
b) A line that is decreasing
c) A line that is constant (horizontal)
d) A graph with a given y-intercept
e) A graph with a negative y-intercept
f) A graph that begins at zero
g) A graph with a steep positive slope
h) A graph with a gradual negative slope

Matching Graphs and Making Sense of the Data

Discuss with your group the following questions. Record your answers.

1) Try to match various graphs to your data. What part is most challenging?
2) Were your predictions correct?
3) What did the different parts of your graph represent?
4) Are there any graphs you could draw that would be impossible to model with the force plate?
5) How could you use this activity in your Algebra 1 classes?

Conclusion

In this activity you tried to match graphs by applying forces to a force plate. You experienced what it means to increase a force, decrease a force, and how to keep it constant. You also learned to model steeper and gradual slopes of lines.

For Further Exploration:

Draw graphs on paper and try to see if your group member can model them. Why might some of these graphs be impossible?