

Energy and Motion Activity Bag

Motion and Graphing: Student Activity Guide

Anything that moves is somewhere new each moment. Because of that, we can describe movement by listing how far something went and when it was there. A graph of how far something went, and when it was at a certain place (distance over time) even shows how fast something was going. It can also show the average speed between different places or times, and how its motion changed as it moved. We are about to measure some distances and times, make some graphs, and see what stories graphs tell us.

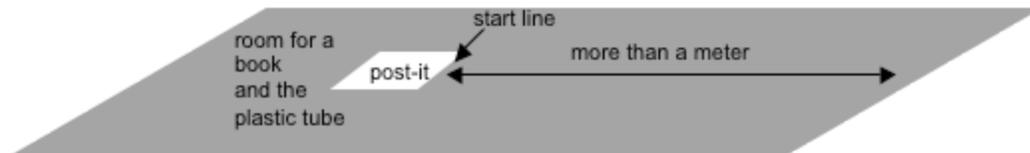
These directions will get you started. Your teacher will be in contact to guide you and provide information.

Materials From The Bag

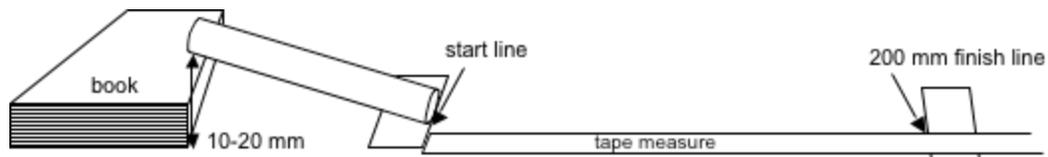
- Plastic tube
- Marble
- Tape Measure
- Post-It Notes

Preparation: Ramp Set-Up

1. Find a smooth, flat place a little longer than a meter where you can roll a marble in a straight line. Use a tape measure to be sure it's long enough. A countertop, floor, or table will work.
2. To make a starting line for the marble, stick a post-it note to the surface of the table. The edge with more than a meter out in front of it is the start line. It looks like this:



3. Put one end of the tube on the start line and use a book to lift the other end of the tube up (rest one end of the tube on the book). The tube will slope down from the book to the start line. To measure the ramp height, measure the distance of the bottom edge of the tube mouth (above the book) down to the surface. Adjust it so that distance is between 10mm-20mm. Place the tape measure down to the surface with "0" on the start line, going straight away from the tube.



4. You will need a timer or stopwatch (phone, computer, watch, or stopwatch) for this. Roll the marble down the tube so that it travels a meter as measured by the tape. Time the marble from the time it touches the start line until it crosses 1 meter. Adjust the height of the tube higher or lower (by pushing the book farther under the tube or away from it) and time it again. Keep adjusting the height, and timing the marble until the marble takes at least 3 seconds to go 1 meter. You might need to get a thinner book.

- Write “finish” on another post-it and place the edge nearest the tube at the 200mm mark on the tape. That edge is your finish line. It is shown in the picture between steps 3 and 4.

Part 1: Graphing Speed Trials

- Use the same timer you used in the set-up.
- Roll the **marble** five times and, each time, record how long it takes to travel 200mm. Start when the marble hits the start line and stop time when it hits the finish line. Record your data in **Data Chart #1**.
- Move the finish line to 400mm and repeat step 2.
- Repeat for 600mm, 800mm, and 1000mm (1 meter). Move your finish line each time.
- Look at **Data Chart #1** and circle the median time (middle value) at each distance.
- Use the median times to graph your data on the **Time vs Distance Graph**.

Data Chart #1

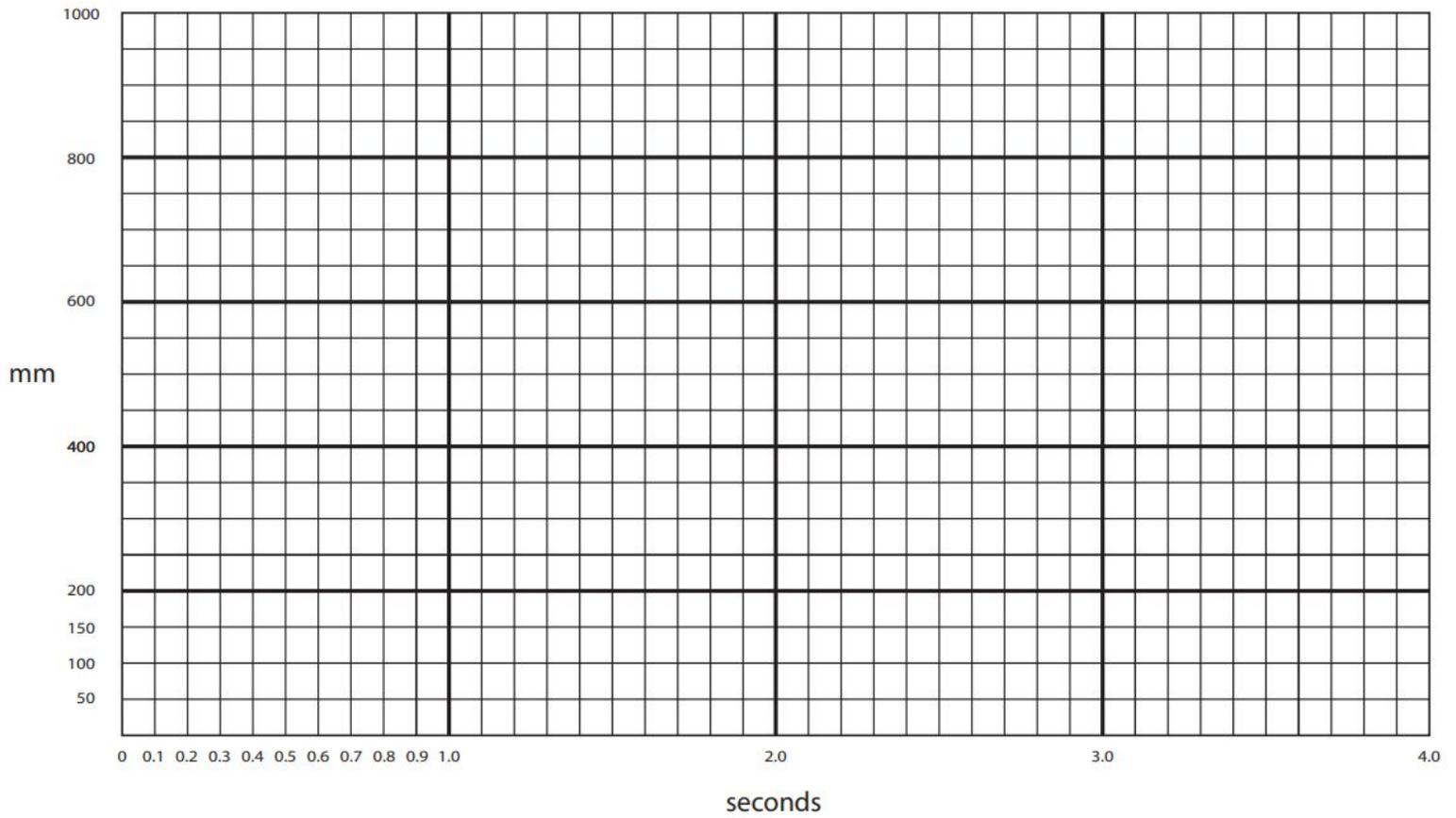
| TRIAL # | 1 | 2 | 3 | 4 | 5 |
|----------------|------------|---|---|---|---|
| DISTANCE | TIME (sec) | | | | |
| 200 mm | | | | | |
| 400 mm | | | | | |
| 600 mm | | | | | |
| 800 mm | | | | | |
| 1000 mm | | | | | |

Answer the following questions about your time and distance graph.

- Where do you think the marble was going the fastest? Where do you think the marble was going the slowest? Compare those two points on your graph. What do you notice?
- Calculate the average speed of the whole graph. Calculate the average speed of the fastest 200mm. Calculate the average speed of the slowest 200m

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

TIME vs DISTANCE



Part 2: Distance/Time Graphs

Your teacher will provide you with four different Distance/Time graphs. For each, use evidence from the graph to tell the story of the marble's travel over time.