

## Graphing Variables and Identifying patterns

Graphs are pictures of the relationships between variables. In Physical Science, which relies heavily on math, is easiest to understand when looked at as a common formula. Many of these formulas are how we get **derived** measurements, measurements that come from two or more different measurements.

For this page we will be using the formula  $d = m / v$  (**density = mass** divided by **volume**) density is the amount of matter in a given area of a substance, it is essential to understanding the buoyant forces that cause lift in fluids. Understanding this relationship will help you later when you learn what causes hot air balloons to float.

### Understanding the relationship between density and mass.

1. In this example mass will be the manipulated variable and density will be the responding variable. Fill in the first chart to the right with a volume of 2 ml, notice that the volume is a controlled variable, this means that we will keep it the same volume in all cases and only change the mass. Calculate the density in each case.

2. Using a full page of graph paper (get some from me if you need it), graph the relationship between the mass and the density using the points you calculated. Make the scale of the graph so that it goes to 30g and to 30g/ml. Make the points and the line in blue ink.

Describe the relationship between the mass of an object and its density.

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Mass (g)	Volume (ml)	Density (g/ml)
2		
4		
6		
8		
10		
15		

3. Now we are going to do the same thing, but we will use a volume of 4ml. Fill in the chart at the right and graph the answers on the same graph you did before but this time use red ink.

The **slope** of the line is the relationship between the two variables. Using the samples in the book, what kind of relationship is it? \_\_\_\_\_

As long as you did not change the volume, no matter what number it was, would the relationship between the mass and density change? \_\_\_\_\_

How do your two lines show this?

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Mass (g)	Volume (ml)	Density (g/ml)
2		
4		
6		
8		
10		
15		

### Making Predictions:

Using your graph (not math) estimate what the density would be for the following masses if the volume was 4ml.

14g \_\_\_\_\_

25g \_\_\_\_\_

28g \_\_\_\_\_

0.5g \_\_\_\_\_

Using your graph (not math) estimate the mass of an object with a volume of 2ml and the following densities.

15 g/ml \_\_\_\_\_

5 g/ml \_\_\_\_\_

0.5 g/ml \_\_\_\_\_

11.5 g/ml \_\_\_\_\_

**Understanding the relationship between volume and density.**

On the back of your graph paper make another graph showing the relationship between volume and density using the two charts shown here. You may pick any numbers for volume that you like. Make the graph using the same colors as before but the scale will depend upon the numbers you choose.

Describe the relationship between the mass of an object and it's density.

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Mass (g)	Volume (ml)	Density (g/ml)
5		
5		
5		
5		
5		
5		

**Making predictions**

Using your graph where the mass is 5, find the density for 4 halfway marks between your numbers. (i.e. if your first number was 5 and your second 6 you would find the density for 5.5)

Volume ml	Density g/ml

Mass (g)	Volume (ml)	Density (g/ml)
8		
8		
8		
8		
8		
8		

Staple this paper in front of your graph paper when you place it in your packet.