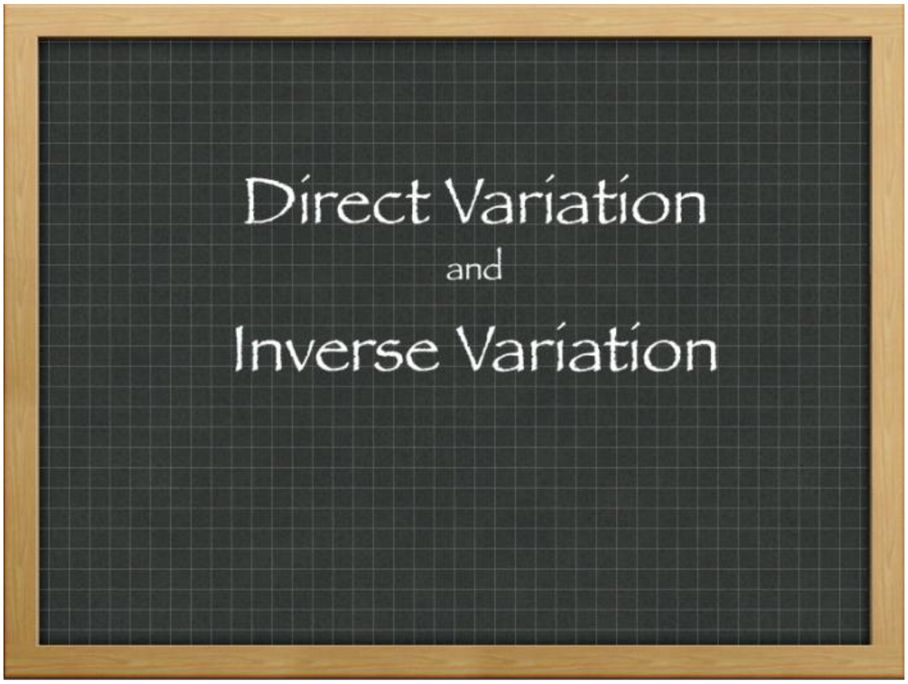
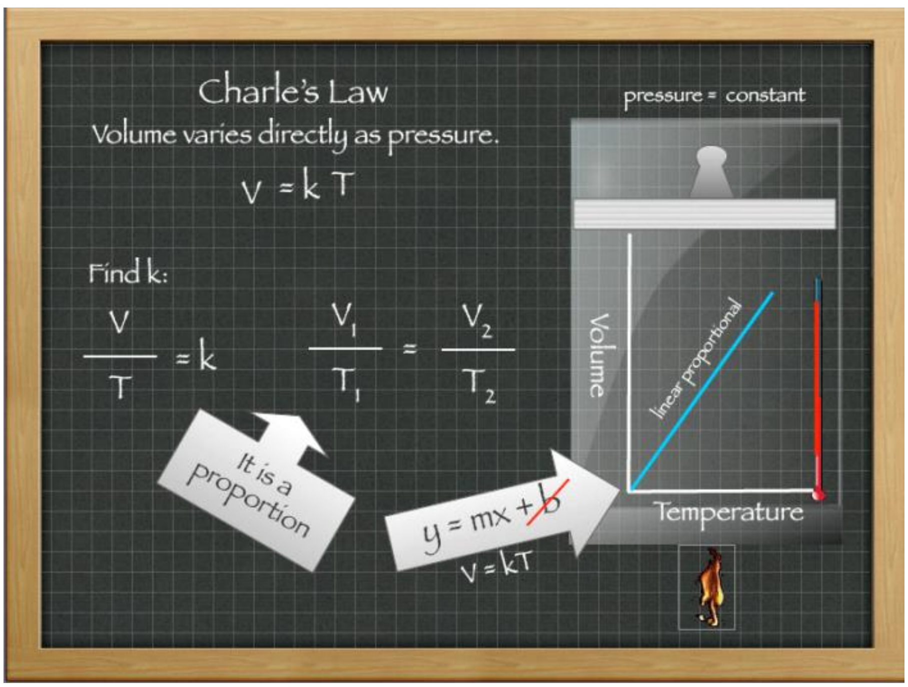
Direct and Inverse Variation

Thursday, January 19, 2012
5:14 PM

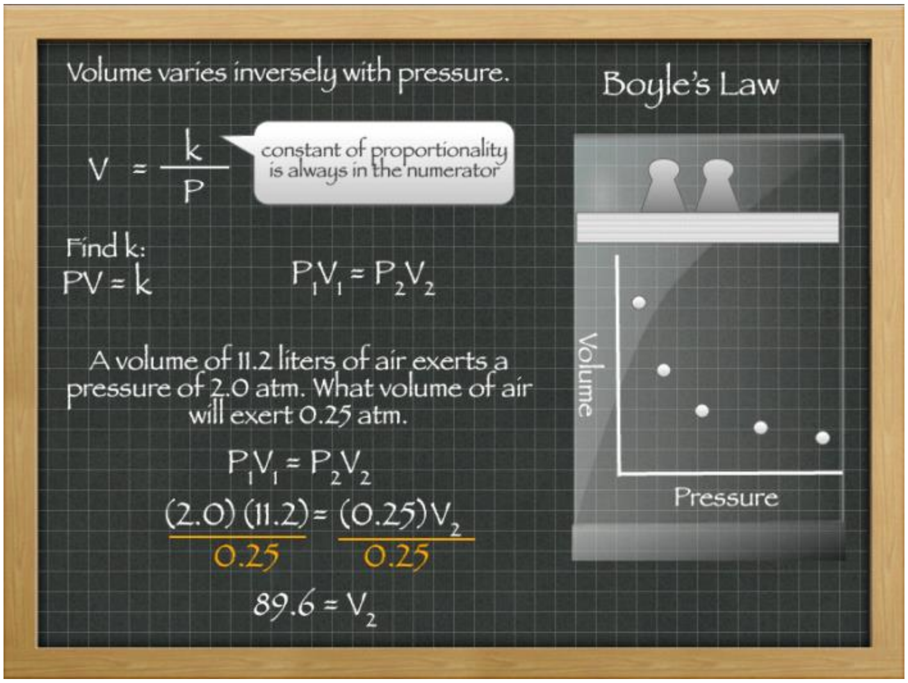
Slides	Notes
	
	Charle's Law is a good example of a direct variation. These are essentially linear equations except that they are a limited type: the line must go through the point 0,0 on the coordinate plane.

Charles equation can do this when the Kelvin scale for temperature is used. We can say that volume varies directly as pressure. When you write it mathematically, you write in the same order with an "= K" standing in for the varies directly as" part. The k is a constant. It will always be the same number for that particular relationship. It isn't as foreign as you might think. Let's look at the standard form of a linear equation. Since the intercept always must be 0,0, we can get rid of the y-intercept. Notice how similar y = mx is to V = kT. Do you see that the constant k is actually the slope in disguise?

Note how with direct variations, as one variable gets larger the other variable does too.

What's more, the way to solve these is familiar too. Let's solve for the k. We get V/T =

k. Now, no matter what combinations of V/T we have they always equal the same k. So we could set two pairs of V/T equal to each other and have a proportion that will let us scale up or down in the conditions. We have been doing proportions for some time now, but now you know where they originate from: direct variations and linear equations.



Now let's try an inverse variation. Boyles law is a good example of these. When you graph the relationship of pressure and volume it gives a curve. This type of line is called a hyperbola. It will never cross the x or the y axis but it will gradually get closer and closer. In Boyle's experiments that phenomenon played out in that it eventually got to when he had to add significantly more weight to the platform to get even a little bit more change to the volume of the gas.

Note with these that if one variable gets bigger the other one gets smaller; though, it doesn't get smaller at a steady rate.

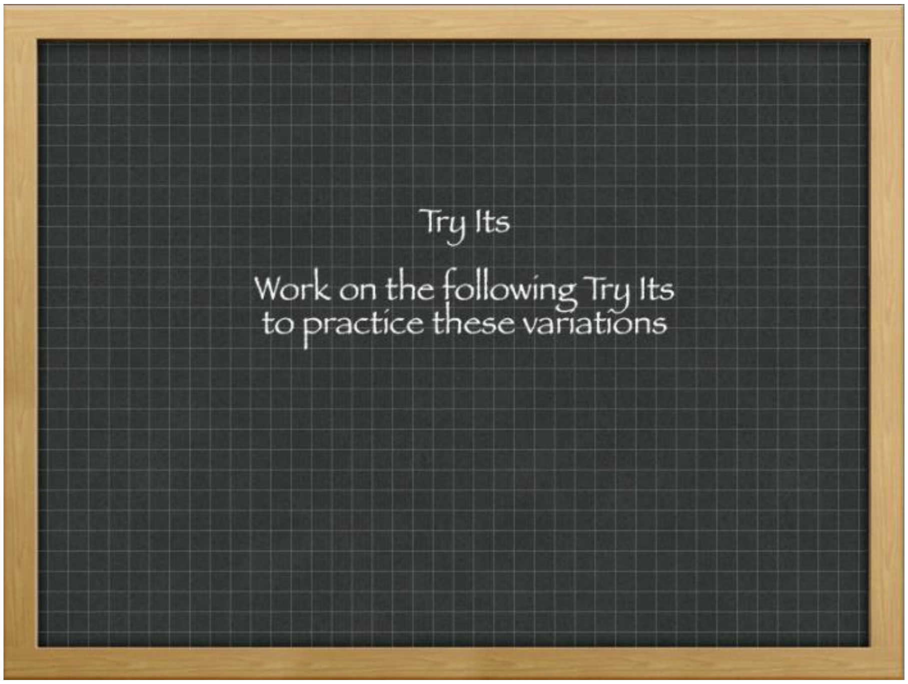
The way that we state this inverse variation is "volume varies inversely with pressure" . This is another one that you can write mathematically in the same order as you read it except you will have the k always as a numerator as you write it.

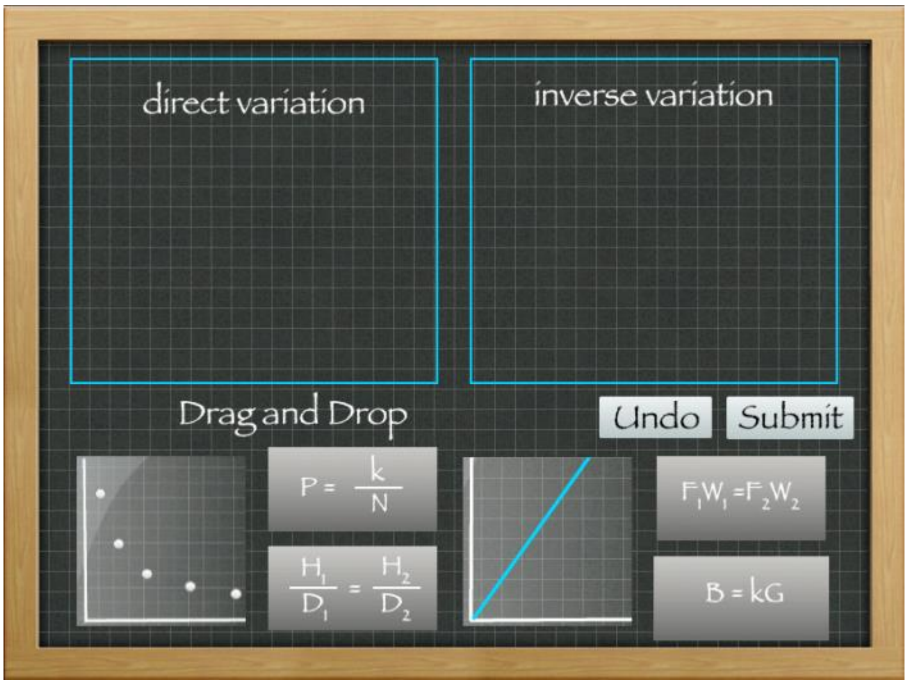
That doesn't mean that you cannot solve for k though. When we do we get PV = k. Just as in the direct variations we can set two scenarios equal to each other because they both would be equal to the same k.

A volume of 11.2 liters of air exerts a pressure of 2.0 atm. What volume of air will exert 0.25 atm?

We will substitute the original conditions in for the subscripted 1 variables and the final condition for pressure in with the P2. Now we will solve for the final volume, V2. That is 89.7 L.

So, you have new terms and new ways to think about relationships, but they are not hard. Just remember that the inverse k is rather kingly and likes to be at the top in the numerator.





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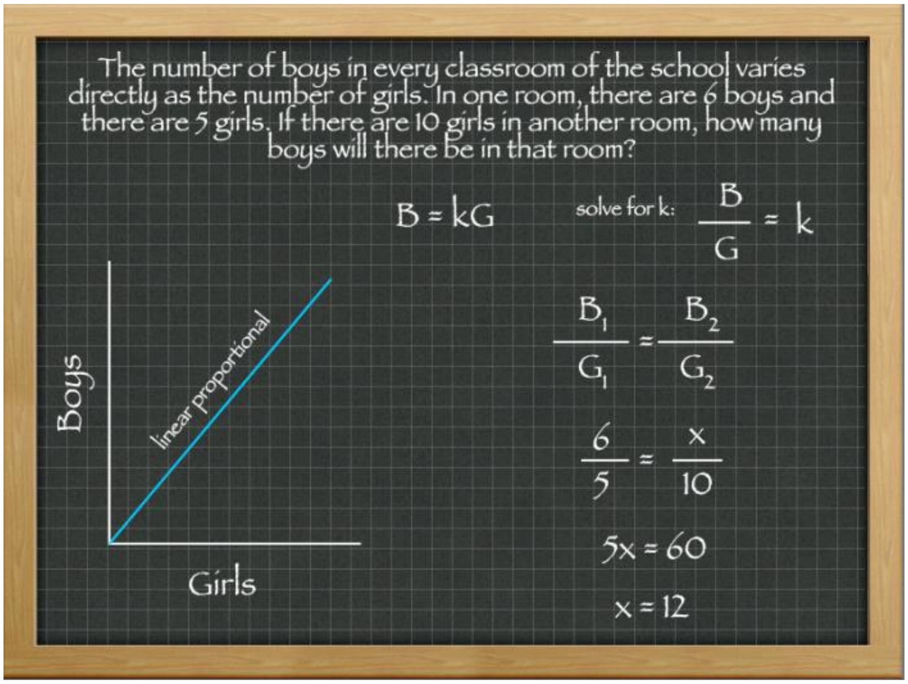
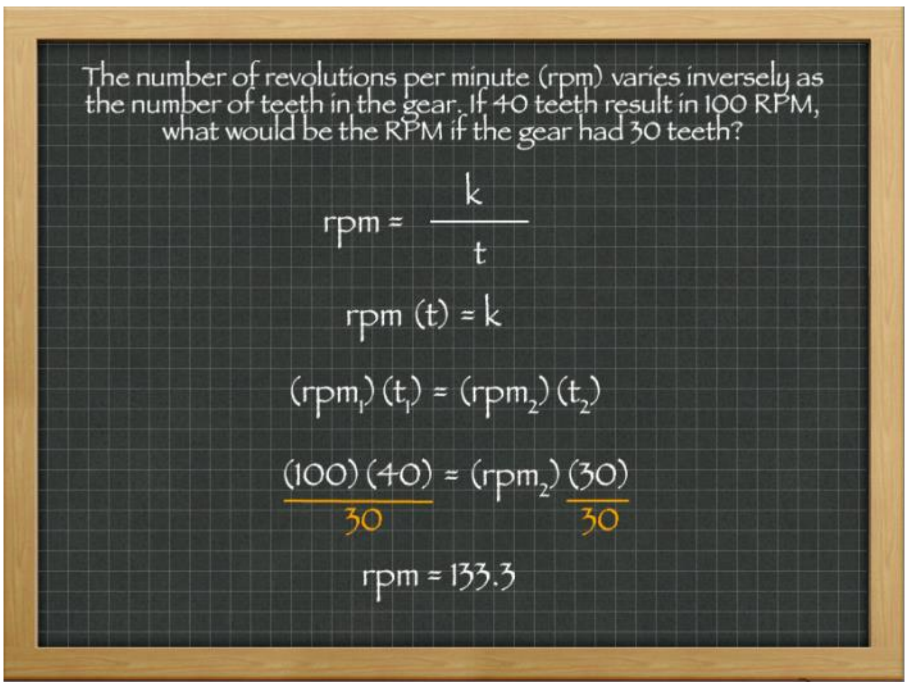
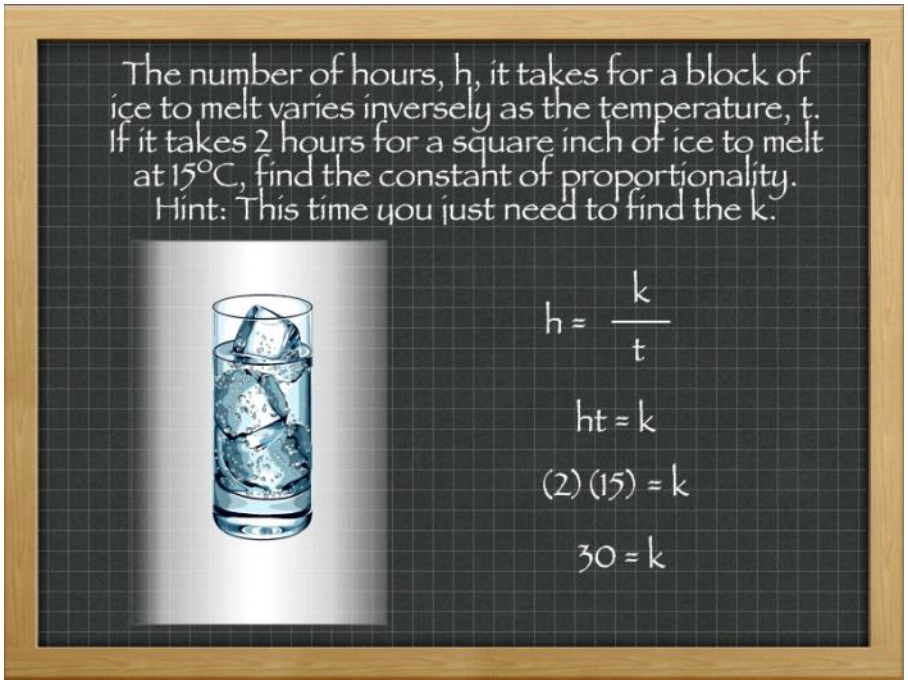

The number of boys in every classroom of the school varies directly as the number of girls. In one room, there are 6 boys and there are 5 girls. If there are 10 girls in another room, how many boys will there be in that room?
B = kG
solve for k: B/G = k
B1/G1 = B2/G2
6/5 = x/10
5x = 60
x = 12
Boys
Girls
linear proportional


The number of revolutions per minute (rpm) varies inversely as the number of teeth in the gear. If 40 teeth result in 100 RPM, what would be the RPM if the gear had 30 teeth?
rpm = k/t
rpm (t) = k
(rpm1) (t1) = (rpm2) (t2)
(100) (40) / 30 = (rpm2) (30) / 30
rpm = 133.3


The number of hours, h, it takes for a block of ice to melt varies inversely as the temperature, t. If it takes 2 hours for a square inch of ice to melt at 15°C, find the constant of proportionality.
Hint: This time you just need to find the k.
$h = \frac{k}{t}$
$ht = k$
$(2)(15) = k$
$30 = k$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