

The Relationship Between Science And Math

It's often said that "math is the language of science", which means that in order to do sciencey stuff, you have to know a lot of math. On this page, we're going to figure out exactly what the relationship is between math and science. Let's get started!

1. Studying math without studying science is a waste of time.

Imagine a math problem – any math problem. How about $2 + 2 = 4$? It's simple enough to understand, isn't it?

Sure it is. It's also irrelevant. If you say that $2 + 2 = 4$ by itself, you might as well have memorized the equation that " $b + q = 34$." I imagine that you're probably bright enough that you could memorize any number of relationships like this without any trouble – even if they were meaningless.

And that's the point: By itself, math doesn't actually *do* anything. In order to make sense of $2 + 2 = 4$, you need to understand that if you add two of something to two of something else, you'll have four of those things. This simple relationship (and some of the less simple relationships you've doubtlessly seen in math class) are studied not because they're fun to look at, but because they allow us to figure out how things work in the real world. Not all of these things are as easy to understand as "two things plus two things equals four things", but they can be manipulated so that they have meaning.

Without science, learning math is like learning Klingon. Fun for weirdos, but very handy.

2. Science without math won't get you very far

Let's say that I want to launch a bunch of people into space. I know that if I add energy to a mixture of hydrogen and oxygen gases that they'll give me a huge quantity of energy. Let's build a rocket and fire it up!

There's only one problem: We don't want to kill the people inside the rocket. Let's say that we dump a bunch of hydrogen and oxygen into a rocket and light it. Maybe we'll have too much energy and the thing will blow up. Maybe we'll have slightly less energy and just send the people on a one-way trip to Pluto. Maybe the rocket will go 10 km up and then run out of fuel. Or maybe the rocket will make a quiet "pop" and sit on the pad. There's a reason we have rocket scientists: It's hard to make a rocket actually work.

If we don't have math, we'll never be able to predict how much of the fuel to combine to make the rocket do the most unlikely of possible things: Work normally. We'll forever be blowing up rockets and astronauts because we're just using trial-and-error to make the rocket work.

On the other hand, if we use math, we can figure out the relationship of hydrogen and oxygen that will be needed to make the reaction work properly. Once this is done, we'll be able to figure out how much of each will be needed to make it happen. And once the astronauts get into space, we'll be able to predict how many Twinkies will be needed to feed them.

This isn't to say that you can't do science without math. However, if you want to move past the "what happens if I hit my neighbor over the head with a brick" phase, you may want to get studying.

3. Science is messy and math is not.

Let's say that you've got a bunch of 1 cm pieces of wood and you want to simultaneously fit as many as possible into an opening in another piece of wood. How many pieces of wood will this take?

If you're a mathematician, you'll say that if you have 9 pieces of 1 cm wide wood, then they'll fit into a 9 cm wide opening. For those of you that aren't good with the math, $9 \times 1 = 9$.

Which is the wrong answer. We don't live in a perfect world where things fit perfectly together. No matter how awesome I am, I won't be able to make these pieces of wood 9 cm thick nor will I be able to make an opening exactly 9 cm across. In the *real* world, I'll get nine pieces of wood, and then use either glue to fit them if they're too small or shave one of them a little thinner to make it fit.

This is a perfect example of how science and mathematics are related. If I were a mathematician who had no interest in science, I'd be confused why the wood didn't fit correctly. If I were a scientist who had no interest in math, there's an excellent chance I'd pick the wrong number of pieces of wood to start with.

This is why we say that math is the language of science. It's not just an analogy – it's literal truth. When my son was first born, I joked with my wife that it might be funny to teach him Pig Latin as his first language. My wife didn't find this as amusing as I did.

If we'd done this, it would have been the same thing as teaching him math without ever exposing him to science. Sure, he'd have interesting and creative ideas, but without a useful language he'd have no way of making anybody else understand what he was talking about.

Likewise, let's say that my son had an enormous capacity for scientific thought. Unfortunately, let's imagine that we never actually spoke around him so he had no first language at all. How far do you think he'd get in his studies, and if he succeeded in doing something, how would he ever tell anybody.

Conclusion:

We scientists like to make fun of mathematicians as being lame number crunchers who never do anything useful, but the truth is that without their work we'd never be able to figure anything out. At this point in history, the fastest we can travel is light speed (and then only if we're made of light). If there's a way to build a faster-than-light drive, do you *really* think that we'll figure it out without learning a lot of new math? Not likely.

Likewise, mathematicians think that we scientists needless get our hands dirty with a lot of phenomena that make everything more complicated than they should be. And they're right – the world is a messy place and nothing is ever perfect. Mathematics describes how things *should* be, while science takes into account how they really are.