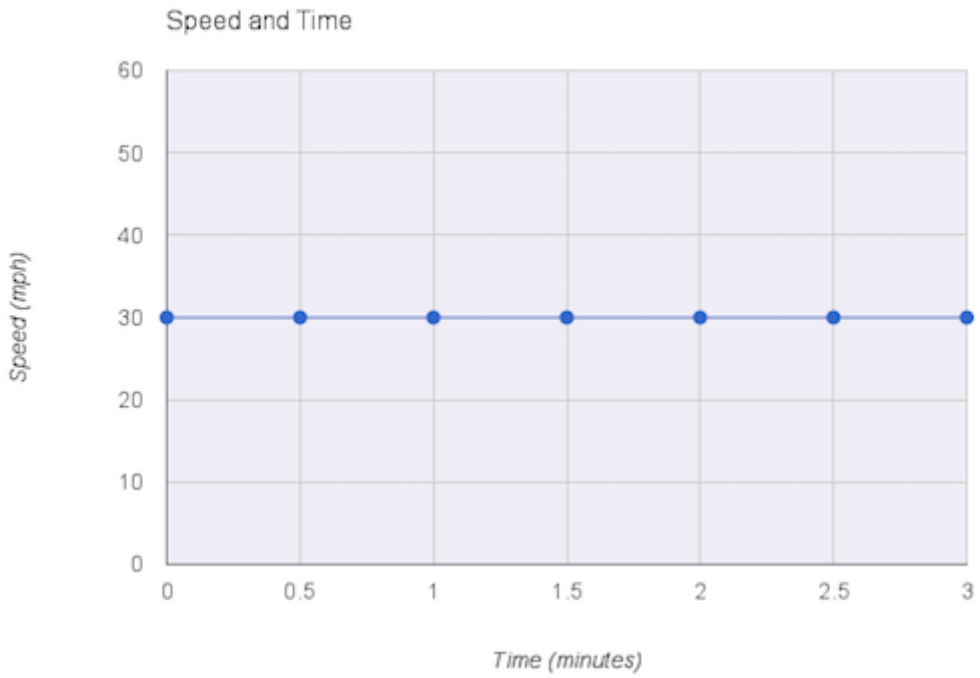
A Flat Line

Let's first start with a very easy scenario to get ourselves settled and ready to go. Imagine that car again, but cruising at a constant speed of 30 miles per hour. Not faster, not slower, just 30 miles per hour. Here's a table showing the speed at various points in time, measured every half a minute.

Time (mins)	Speed (mph)
0.0	30
0.5	30
1.0	30
1.5	30
2.0	30
2.5	30
3.0	30

The following graph visualizes this speed at those several points in time.



You can see that the speed doesn't change over time, that's why it is a straight horizontal line. It doesn't go up (faster) or down (slower), it just stays at 30 miles per hour. The mathematical expression for the speed, which we'll call s, is

$$s = 30$$

Now, if someone asked how the speed changes with time, we'd say it didn't. The rate of change is zero. In other words, the speed doesn't depend on time. That dependency is zero. We've just done calculus! We have, really! Calculus is about establishing how things change as a result of other things changing. Here we are thinking about *how speed changes with time*. There is a mathematical way of writing this.

$$\frac{\delta s}{\delta t} = 0$$

What are those symbols? Think of the symbols meaning "how speed changes when time changes", or "how does s depend on t". So that expression is a

mathematician's concise way of saying the speed doesn't change with time. Or

put another way, the passing of time doesn't affect speed. The dependency of speed on time is zero. That's what the zero in the expression means. They are completely independent. Ok, ok — we get it!

In fact, you can see this independence when you look again at the expression for the speed, $s = 30$. There is no mention of the time in there at all. That is, there is no symbol *t* hidden in that expression. So we don't need to do any fancy calculus to work out that ∂s / ∂t = 0, we can do it by simply looking at the expression. Mathematicians call this "by inspection". Expressions like ∂s / ∂t, which explain a rate of change, are called *derivatives*. We don't need to know this for our purposes, but you may come across that word elsewhere. Now let's see what happens if we press the accelerator. Exciting!