

Now that we've described the instantaneous velocity of an object, we'd now like to describe what its acceleration is.

Philosophy and acceleration are complicated things.

One of the reasons why acceleration is such an abstract quantity is for example, if I take this marker that's in my hand and I throw it up in the air and I catch it, you can see with your eye, velocity.

You can see the speed.

You have a sense for it.

You can see it change its direction.

So velocity is something that as a human being, with our eye as a mechanism for determining motion-- velocity is a very basic concept.

But acceleration is a much harder concept.

For instance, when I take that same object and I drop that-- as it falls down, its velocity is increasing.

And so we say it has an acceleration, but is that acceleration a function of time?

Or is it constant in time?

Is it varying in time?

Is it a polynomial?

Is it a constant?

Those are much harder to see.

Again, let's drop this object.

So when I drop that object and I catch it down here, our eye does not tell us intuitively anything about the mathematical nature of that acceleration.

And that's why acceleration is a much more abstract quantity.

In fact, a great question is the following.

When I throw this object up in the air-- let's focus at its highest point.

So I throw it in the air and it comes down.

When the object was at its highest point, was its velocity zero?

Was its acceleration zero or non-zero?

A hint to this question is in Newton's second law, F equals ma .

If there is a force acting on this object, there must be an acceleration.

And that force is the gravitational force.

And when this object was at the top of its motion I didn't turn the earth off.

So there is still a gravitational force.

And so for an object in free fall-- now free fall just as under the-- which means under the influence of the gravitational force.

We can conclude from Newton's second law that the gravitational force, ma -- so this gravitational force is non-zero.

And so therefore, the acceleration is also non-zero.

So once again, as I throw this object up in the air nobody turned gravity off, we're not in empty space, and near the surface of the Earth the gravitational force is not zero.

The acceleration is not zero.

So throughout this motion this object is accelerating.

I choose this example to show you that acceleration is a very abstract concept.

And now our goal is to figure out how to mathematically define acceleration in terms of our velocity.