We've now described what we call the instantaneous velocity at some time t.

And we talked about it as a limit as delta t goes to 0 of the displacement over the time, which we wrote as the derivative of the position function in terms of i-hat.

Now this derivative, we're going to use a notation.

We'll just write that as v of t i-hat, where v of t is the component of the instantaneous velocity at time t.

Now remember, this is just a symbol.

But we describe this as the derivative of the position function, which I'll indicate as a function of time.

And that's what we mean by the component of the instantaneous velocity.

Now what we would like to do is ask ourselves, how does the velocity change in time, if the runner is increasing their velocity?

Well, in general, we'll do exactly what we did before.

What we'd like to introduce first is the concept of the change in the velocity delta v, which will describe as the velocity at time t plus delta t minus the velocity at time t.

So what we have in here is the change-- the component of the change of the velocity.

And this quantity is how the velocity changed in into time interval between t and t plus delta t.

Remember, this is very specifically for this time interval.

Now what we would like to do is take the same limiting process.

Let's take the limit as delta t goes to 0 of this change in velocity over time.

So we have the limit as delta t goes to 0 of delta v, delta t, i-hat.

And this quantity is what we call the instantaneous acceleration.

Now as before, what we're doing is we're plotting the component of the velocity as a function of time.

Let's just say, again, that we have some unusual function.

I'll just draw it like this.

And here's the picture at time t.

Here is the picture at time t plus delta t.

This change, delta v over delta t, this is v at t.

Up here, this is what we mean by-- let's just-- remember, we're plotting the velocity as a function of time v of t plus delta t and this quantity here, which is delta v over delta t.

Again, we can even call as we said before, we can call this average acceleration.

But what we're interested in is that as we take the limit as delta t goes to 0, then the slope changes.

You can see.

And we continue this limiting process, until we shrink delta t down to 0.

And that what we have here is this is the slope of the tangent line.

And that's what we call the instantaneous acceleration.

So if we want to use a notation, we don't want to keep on writing limit delta t goes to 0.

So what we can write is a of t.

It has a component a of t i-hat and that component of a of t.

This is precisely the derivative of the velocity function as a function of time.

And so now we've described the position vector, the velocity vector, and the acceleration vector associated with motion.