

Now that we've described the position vector of the runner, let's try to describe what happens in time as a runner moves along our road.

Suppose at a later time our runner has gone down the road just a little bit.

And so the runner has moved a little bit.

Remember, at time  $t$ , we described the position vector  $r(t)$  was equal to the coordinate function  $x$  as a function of time  $\hat{i}$ .

And this distance here was our  $x(t)$ .

Now, our position vector a little bit later.

So here we are at time  $t$  plus  $\Delta t$ .

The runner has moved a little bit.

And we'll now describe the position vector-- because I don't want to overlap it-- that center point is up here.

It's going to point in this direction.

And this is what we call  $r(t) + \Delta t$ .

In that vector,  $r(t) + \Delta t$ , the coordinate function is no longer at time  $t$  but  $t + \Delta t$   $\hat{i}$ .

And we would now like to describe the displacement vector.

So our next step is to describe the displacement vector for the interval  $t$  to  $t + \Delta t$ .

And that displacement vector is defined-- we use the symbol  $\Delta r$ , and what we mean is the vector  $r(t) + \Delta t$  minus the vector  $r(t)$ .

Now, what that vector corresponds to is the vector right here.

This is our  $\Delta r$ .

And if we now use our two definitions here, then this becomes  $x(t) + \Delta t$  minus  $x(t)$   $\hat{i}$ .

And this quantity here we refer to as the component of the displacement vector.

So  $\Delta x$  is the component of the displacement vector.

And as before, the component can be positive, which would correspond to the person moving a positive component, positive  $\hat{i}$  direction, in the positive  $x$  direction as shown in this figure.

If the displacement of vector is zero, the person could have run forward and come back and at time  $t + \Delta t$  be in exactly the same spot as time  $t$ .

The displacement vector is zero in that case.

The displacement vector could have a component that's negative.

And what negative means is at the end of this interval--  $t + \Delta t$ -- that the person is to the left of the runner.

And so this quantity would be negative.

And so this is our crucial displacement vector that describes only the difference in positions between the person, between time  $t + \Delta t$ , and time  $t$ .