Now that we've seen how coordinates are related between two inertial frames, I want to consider a slightly more advanced example for a moment, which is supposed that capital V, the vector velocity of frame S prime relative to inertial frame S, is not a constant.

So in this case, suppose that frame S prime has an acceleration, capital A, relative to S.

We now say that as prime is a non-inertial frame, because it is accelerated relative to frame S. Now we saw that in inertial frames, one always measures the same acceleration for the same object, even though you'll measure different velocities in different positions in general.

That's not going to true in a non-inertial frame.

In a non-inertial frame, the acceleration, A prime, is equal to the acceleration of frame S minus capital A, the acceleration of frame S prime relative to S. Remember, capital A is 0 for S prime being an inertial frame, when capital V is a constant.

But if capital V is not a constant, then capital A is not 0.

So you will measure different accelerations in these different frames.

Now what that tells us is that Newton's laws are going to look a little different.

And let's see how that works.

So now, the force measured in frame S prime-- I'll call that F prime-- we expect that from Newton's second law to be the mass times the acceleration A prime.

But that is the mass times the acceleration measured in frame S minus m capital A, the acceleration of frame S prime relative to frame S.

Now I can rewrite this as two terms.

One I'll call F physical, which represents the physical forces acting on the object.

And the second term, I'm going to call F fictitious for reasons that we'll see in a moment.

So what this means is the following is that an observer in frame S prime in order to explain the motion of the object using Newton's laws will have to invoke not just the physical forces interacting on the object, which might be due to gravity or rope pulling or an engine pushing or a hand acting on something, but will also have to both an apparent force, which I'll call F fictitious, that acts on everything.

And in this case, F fictitious is equal to minus m capital A.

But that force will not be associated, will not be identifiable with any actual, real physical interaction.

It's an artifact of the choice of coordinate system.

It's an artifact of the non-inertial coordinate system that frame S prime is in.

For that reason, we call it a fictitious force.

And it's to be distinguished from real, physical forces of the type that we've been talking about up until now.

So you may have seen earlier that for the motion of an object in a circle around some center point implies the presence of an inward acceleration toward the center of the circle.

So as a consequence of that, a rotating reference frame, for example, a reference frame that rotates with the Earth's rotation, is accelerated relative to an inertial frame.

This results in a fictitious force that has two terms, a centrifugal term and a Coriolis term.

You may have come across this Coriolis force and centrifugal force before.

These are examples of fictitious forces because they arise from the choice of coordinate system.

They're an artificial force.

They don't correspond to actual, physical interactions, but are an artifact of the rotating, non-inertial coordinate system.

Now, in this course we will confine ourselves to inertial reference frames.

And therefore, we'll only be considering real, physical forces and interactions.

However, there are advanced applications where the use of a non-inertial frame has certain advantages.

And you may encounter those as you go to more advanced courses.