So now what we'd like to do is try to understand how to apply the law of addition of velocities.

So we can express the velocity of the point on the rim in the reference frame fixed to the ground.

Now, the important thing to realize is v is the velocity of the center of mass of the wheel with respect to the ground, and every single point on the wheel has that same velocity v.

So let's draw a picture of our wheel.

Here we're in the ground reference frame.

And let's first draw four points on the wheel and draw this velocity v. Every single one of these points has the same velocity v, v, v, and v.

Now, let's add to that the velocity of a point on the rim as seen in the reference frame moving with the center of mass.

We just saw that every single point on the wheel is undergoing circular motion in that reference frame.

So now let's draw those velocities.

I'll just draw it right below-- vcmp, down here vcmp.

Notice here it's in the opposite direction, vcmp, and up here it's pointing up.

So when we add these two vectors together, what we get is a longer vector in this direction.

It would be the sum of these two pieces.

So it would point like that.

That's vp.

Over here it's the vector decomposition.

So it's in that direction.

Here it's a shorter vector vp.

And over here it's the vector sum vp.

So now what we've been able to do is describe the velocity of the point p as a combination, the vector addition, of how the center of mass of the wheel is moving and the circular motion as seen in a reference frame moving with the center of mass.

Now what we want to explore is special conditions, which we'll refer to as rolling without slipping, slipping, or sliding.