For one-dimensional collisions, let's talk about two objects, 1 and object 2, moving with velocity V1 and another object V2 moving with velocity V2.

Let's say they're moving on the ground.

Now I'd like to introduce the concept of relative velocity, a concept that we experience all the time in our lives.

But let's see what it actually means.

So V relative, I'm going to define this to be the velocity of V1 minus the velocity of V2.

Now because of this minus sign that seems a little bit about abstract.

But one typical example where we see this all the time is for people traveling on highways.

You might have two cars, one car overtaking the other car.

But if you're sitting in car 1, it looks like car 2 is going quite slow.

So let's just take typical highway example.

So you might have V1.

And we'll give it some speed.

So we'll make it 60 miles per hour.

And we'll just call this one-dimensional problem i hat.

And V2-- notice we're not speeding on a highway-- V2 is going at 50 miles per hour, i hat, very slow.

And the relative velocity, V1 minus V2-- so that's what we're calling V relative-- that's 60 miles per hour minus 50 miles per hour i hat.

And that's just 10 miles per hour.

And that's what people experience when one car is approaching another car.

If you're in car 2, car 1 seems like it's coming at you at 10 miles per hour.

This is what we mean by relative velocity.

There's another important example-- so that's example 1-- the other important example to look at, example 2, is

when two objects are moving in opposite directions.

So let's just see write them in terms of components this time.

So we have V2 x1.

And we have V2.

And let's make V1 x positive.

So object 1 is moving in that direction.

And let's write this one as V2 x.

We don't have to call this initial.

We'll just call it V2 x i hat.

And here V2 x is equal to minus V1 x.

So its component is negative.

And even though we drew an arrow in this picture, the picture is still fine, because if the component is negative, it means it's moving in the opposite direction.

The key arrow is the unit vector when we are writing components.

And now V relative in this case is V1 x i hat minus V2 x i hat.

That's the V1 x i hat minus minus.

So there's another V1 x i hat.

So the relative velocity in this case has a component that's twice the speed of V1.

If two objects are moving together at the same speed, the relative velocity, the way we've defined it, has twice the magnitude of either velocity.

And this is an important example to consider in collisions.

Now this relative velocity concept we'll see we'll add a new way of thinking about elastic collisions with no external forces in one dimension.