We now would like to apply our energy momentum rule and momentum to analyze a one-dimensional elastic collision with no external forces.

Let's remind ourselves, we'll call it the energy momentum equation said that V relative initial was equal to V relative final.

So we have V1x initial minus V2x initial-- that's the x component of initial relative velocity-- is equal to the final x component of the relative velocity.

And that was our energy momentum law.

Now the momentum condition that it's constant was our equation V1x initial plus m2 V2x initial equals m1 V1x final plus m2 V2x final.

Now let's see how this linear system is much, much easier to solve.

Let's look at the same problem that we solved before where m2 was equal 2m1.

And also, we were in the laboratory frame, so V2x initial is 0.

And that tells us that the initial velocity, relative velocity, is simply the velocity of object 1.

So let's just write our two equations down again and see how much simpler our system is.

V1x x initial is minus V1x final plus V2x final.

So we have minus plus.

And our momentum condition, remember V2x initial is 0.

The m1 and 1, m2 will be 2m1.

So we can cancel our m1s.

And we get V1x initial equals V1x final.

And m2 is twice m1, so there's a factor plus 2V2x final.

Now I want to solve for our target variable.

I look at these two equations.

I can see almost immediately that if I add these two equations, V1x initial will cancel.

And I get very simply by adding, we get 2V1x initial.

And this is 3V2x final.

Or V2x final is 2/3 V1x initial.

And let's just call this equation 1 and 2.

So we added.

And now to find V1x final, let's see what we'll do there.

So we can do this a variety of different ways.

I think the simplest thing here to do, we could eliminate V2x final by multiplying through by minus 2.

Or we can simply substitute in V2x final right here.

And we get-- so let's do that.

Let's substitute that in right there.

And we get V1x initial equals V1x final plus 2 times 2/3 V1x initial.

When we bring that over to the other side, 1 minus 4/3 is minus 1/3 V1x initial equals V1x final.

And at the cost of introducing a new concept, we've found the algebra much, much simpler to solve in this problem.

And we can just double check our result that the initial velocity, relative velocity, was simply Vx1.

And the final relative velocity, V relative final, is minus V1x final minus-- let's see, the final relative velocity is V1x final V2x final i hat.

And when we put that in, we have minus 1/3 V1x initial minus 2/3 V1x initial i hat.

And we have minus V1x initial i hat, which is minus V relative initial.

And so we see that the relative velocity simply changed direction.

This approach is much, much easier.

And keep in mind that the energy momentum and the momentum laws are just rewriting our two fundamental constants of motion, kinetic energy and momentum.