Let's calculate the kinetic energy in the center of mass frame of two objects that are colliding.

I'm going to use prime for the center of mass frame velocity.

So we have V1 prime.

And we have V2 prime.

And recall two things that when we calculated V1 prime in the center of mass frame, we found that this was equal to the reduced mass divided by m1 times the relative velocities of the two objects, V1 prime minus V2 prime.

Now in the center of mass frame, this quantity is a reference frame independent.

And so we can just write that as V1, 2.

It's the relative velocity is reference frame independent.

So we also knew that V2 prime was equal to minus mu over m2 V1, 2.

So now let's calculate the kinetic energy in the center of mass frame.

So K cm is 1/2 m1 V1 prime squared plus 1/2 m2 V2 prime squared.

Now let's use our results in terms of relative velocity.

So we have 1/2 m1 mu over and m1 times V1, 2 squared-- because we're squaring that-- plus 1/2 m2 mu-- the minus sign doesn't matter anymore because we're squaring it-- V2 squared-- I could put that in there, it wouldn't matter.

And now what we have is we have 1/2.

One of the m1s cancels so we have a mu squared over m1 V1, 2 squared plus 1/2 another mu square over m2 times V1, 2 squared.

So I pull out the common terms, mu square, V1, 2 squared.

I have 1 over m1 plus 1 over m2.

But recall that the reduced mass was precisely 1 over m1 plus 1 over m2.

And so I get 1/2 mu times V1, 2 squared is the kinetic energy in the center of mass frame.

So what that means is a way of thinking if this were just a simple reduced mass problem with a relative speed of V1, 2 squared, I can write down the kinetic energy.

But that's the kinetic energy in the center of mass frame.

And therefore, the change in kinetic energy in a collision is just 1/2 V1, 2 V final squared minus-- and it's the same mu, so we'll just put a parentheses-- minus V1, 2 initial squared.

And if the collision is elastic-- remember, our elastic collision show that V1, 2 initial was minus V1, 2 final.

So an elastic collision satisfies that condition.

And you can see directly that delta Kcm is 0 in that case.

And a completely inelastic collision has the two objects moving together at the end.

So V1, 2 final is 0.

So completely inelastic is the condition that V1, 2 final is 0 because the objects stick together.

And then have a very simple result for the change in kinetic energy for completely inelastic collision.

It's only negative 1/2 mu V1, 2 initial quantity squared.