We are now going to derive the work-energy principle.

We're going to do so by using Newton's second law, but we're not going to consider it with respect to time as what we've previously done, but we're now going to consider it with respect to space.

So F equals ma, and we're going to take the x component of that.

And now, we're going to integrate this.

So Fx dx prime, and it runs from x prime equals x initial to some final value.

And then over here, we're going to pull the m out. m integral, and it also goes from some initial to some final value.

And we're going to have ax dx.

We have previously shown that this integral here is one-half v final squared minus v initial squared.

And if we're going to plug this in here, we're going to get that this expression is one-half mv final squared minus v initial squared.

And you should recognize this term.

This is the change in kinetic energy.

And what we have here, on the other side, this integral fx dx is defined to be the work-- work done on the system, which we're going to call w.

And that work done on the system, it's change in kinetic energy.

So this is the work-energy principle.