Now that we've calculated the change in potential energy between some initial and final heights for the gravitational problem, mg of y final minus y initial.

For this conservative force of gravity, and we had our coordinate system like that, we were able to calculate the change in potential energy.

And remember our theorem is that non-conservative work equals Delta K plus Delta U.

Now what we'd like to do is establish the concept of a reference point for potential energy.

And we'll do that as follows, see the change in potential energy only depended on say, our initial state and our final state.

What we'd like to do is introduce the concept of a reference point.

So let's identify some point Yp to be our reference point.

And we'll define a potential Yp to be the reference potential.

And if we want to talk about the potential energy in a final state, we'll always refer it to the difference between that and the reference point.

So this is Delta U between the final state and the reference point.

Likewise, for the initial state, we'll always refer that with respect to our reference point.

So any state that we have, we can always refer the potential energy difference between some state and some reference point.

Why do we do this?

Because notice that if we look at U final minus U reference point, and we subtract from that U initial minus U reference point, then the difference-- the reference points here we have a minus, here we have a plus-- this is just equal to U final minus U initial, which is Delta U.

So the change in potential energy between any two states is independent of how we choose our reference potential.

But it can make calculations easier when we can identify what the potential energy is for a little state.

Now let's look at our example.

So for our gravitational problem we will choose y reference point to be 0.

And we'll choose the potential energy at this reference point also to be 0.

So our reference potential at the origin is 0, and I'll denote it like that.

Then the potential energy at some initial state minus the reference point-- well, we can use our formula here, because this is between any two states.

So this is mg y initial minus the reference point.

But our reference point was 0, and so we see that U initial minus y reference point, which was also 0, is just equal to mg Yi.

And so we have this statement that the potential energy difference between our initial state and the reference point is just mg where Yi is the height that the initial state is above the reference point.

In a similar way, we have U final is mg y final.

And so we see we recover what we expect.

This is just mg y final minus y initial.

Now this we can generalize just a little bit by saying that for any-- let's write that for us our mass, which is for any height y our potential energy function for the gravitational force U(y) is equal to mg y.

That's a formula that many of you have seen before.

But it's very important to note that with this formula, U of 0 equals 0, because that's our reference point.

And that becomes our potential energy function for the gravitational force.

Now our next step will be to do the same thing for spring forces and inverse square gravitational forces.

And we'll also look at graphical analysis of this function.