PROFESSOR: The left hand side here is 0 because H0 and N0 by taking the eigenstate equation is equal to En0 times N0. So this really evaluates to En0 and therefore the two cancel, so this thing is 0.

The right hand side, this is a number, En1. It's a number. It's in an expectation value. N0 has a unit expectation value, so this is En1. That's the number.

And then I have an operator here. So this is minus N0 delta H N0. So we get a very famous and important equation that En1 is equal to N0 delta H N0.

The first correction to the energy is obtained by finding the expectation value of the perturbation in the unperturbed state. So you should be happy to hear that. It says that to find the first correction in the energy, you don't need to know what happens to the state.

I didn't need to know what N1 was, how the state changes, to know how the energy changes. The energy changed before, and I just don't need it. I just need the original state and the perturbation. So it's a very nice result, and it has a simple generalization.

The simple generalization is that I'm going to use another blackboard, but let's look at it. The simple generalization comes from doing the same exact thing with the order k equation. So let's do that.

I put an N0 to the left of this equation. Now what do we get? From this term, we get 0 for the same reason. There's an N0 now here, and the H0 is killed by this term, gives you 0.

And then we're going to continue with this and see what happens with this various terms. Let's look at it. So I'll put the N0-- 0 on the left hand side was equal to 0. And on the right hand side, what do we get?

Well, let me do a couple of terms. N0 En1 minus delta H and k minus 1 plus all these other terms.

So look what happens here. Let's do the next term, for example. En2, N0, and k minus 2. Well, from here, this is a number, so I have here this goes out the overlap of N0 with nk minus 1. But we said that all the higher corrections have no component along N0. So this thing will give you 0.

On the other hand, here is an operator, so there's nothing I can say. So I'll write it minus N0 delta H and k minus 1.

And then what else? Well, you have N0 then k minus 2 here. That's 0 because this is a higher state and all the terms give you 0 until you get here where the N0 with the N0 give you 1. So the only term that survives is the last one, and we get enk.

So this gives you the result that enk is equal to N0 delta H and k minus 1.

I box it because it's another nice formula. It tells you that the kth order energy is given if you know the k minus 1 state. If you have figured out the k minus 1 correction to the state, then you know the energy of the kth correction.

This formula certainly works when k is equal to 1 in which case it reproduces the formula we had on the blackboard to the right. When k is equal to 1, you get the expectation value of delta H around zero.