BABATUNDE OGUNLADE: Hello, everyone. Today we'll be working through Goodie Bag 3, which is on ionic solids. In order to work through this Goodie Bag, you'll need a conductivity meter, some small measuring cups, some medium sized cups, a small scale, a writing utensil, some nitrile gloves, some stirrers, and four unique solids. Today, I'll be using sodium chloride, magnesium sulfate, magnesium oxide, and sucrose.

Our main objective today is to use solubility and conductivity measurements to determine if a given solid is an ionic or covalent compound. And as we do this, I'd like you to think about two questions. First, how do solids dissolve in water? And second, what factors may influence how conductive a given solid is in water?

So first we're going to look at the solubility of our solids in water. And to do this, we're going to dissolve 1 gram of each solid in 30 milliliters of water. I've already weighed out my solids here. And I've also already weighed out my water.

Notice how I'm wearing a pair of nitrile gloves. The compounds that I'm working with today aren't that dangerous, but just as general safety, it's good to wear gloves when handling compounds. So I'm going to pour each solute into each respective cup of water and stir and mix for about a minute to two minutes and see if the compound dissolves.

So after one to two minutes of stirring and dissolving, you can see that our magnesium oxide right here has not dissolved in our water. You can see a very clear boundary between the solute, which has settled at the bottom of the cup, and the water, which is on top. If you compare that to our sodium chloride, though, if you look very carefully, you can see that our solute has dissolved very well in our water.

So the next thing we'll be doing is measuring the conductivity of our compounds when dissolved in water. And to do that, we're going to be using a handy dandy conductivity meter that I have right here. So I have some cups of water prepared here to be used as both a baseline correction when we're measuring our conductivity of our compounds and as a water bath to clean our probe in between measurements.

OK, so first I'm going to turn on my conductivity measure. And I'm going to make sure that my units are set to microsiemens per centimeter, or some equivalent unit. And first I'm going to measure a baseline of just regular water here. I have tap water here.

And so when I do that, I see that I'm measuring around 900 microsiemens per centimeter. So that is the connectivity of my water as is. And I'm going to use that as a baseline when I'm measuring the connectivity of my other compounds.

So since this is water, it's already clean, and now I'm going to measure my sodium chloride, which is right here. And so right now I'm reading around 4,700 microsiemens per centimeter for my sodium chloride. I'm going to take note of that.

And eventually, when I'm collecting my data, I'm going to subtract my water baseline from this value here. Make sure in between each measurement that you dip the probe in the water bath to clean it, and you can continue on with the rest of your measurements.

So the last experiment we're going to do today is to measure the solubility of our compounds in water, except with 2 grams instead of 1 gram. So I've measured out an additional 1 gram of each solid here, and I'm just going to pour each one into each respective cup, mix and stir. And after one to two minutes, I'm going to see if each compound is dissolved.

So again, we have our magnesium oxide after round two of solubility. Again, we can see that our solute has not dissolved in water. There's a very clear boundary between the water on top and the solute on the bottom. So in this case, round one solubility and round two solubility look identical, but it may not be the case for our other three solutes.

All right, so now that we've finished our last solubility test, let's put all our data-- our first solubility test, our connectivity test, and our second solubility test-- on the board. So here we have a chart of all the data from our experiments. I have the compounds that we use going down right here. And I have solubility here at 1 gram and 2 grams, and conductivity after water subtraction here.

So before going into this data, first thing I would like us to notice is that for sodium chloride and for magnesium sulfate, these conductivity values are much lower than I expected. This should be close to the 10,000 microsiemens, and this should be closer to 8,000 microsiemens per centimeter, but the fact that we're able to measure conductivity for these respective compounds gives us insight into what type of compounds they are.

So first, if we look at sodium chloride, we could see that at both 1 gram and 2 grams, our sodium chloride was able to dissolve in water. And we were able to measure conductivity readings for this. This means our sodium chloride was able to dissociate into ions when dissolved in water. And this is an extra check for us to determine that sodium chloride is indeed an ionic compound.

Next we can look at magnesium oxide. And we see that for magnesium oxide, at 1 gram and 2 grams, we weren't able to dissolve the magnesium oxide in water. And not only that, because of that, we weren't able to measure any conductivity.

But we know that magnesium oxide is an ionic compound just from our understanding of bonding. So we had to think more closely about why this is the case. So magnesium oxide and sodium chloride are both ionic compounds, but magnesium oxide has a much higher lattice energy than sodium chloride.

This means that when magnesium oxide is placed in water, it's more energetically favorable for it to stay as a solid than it is to dissociate into ions of magnesium and oxygen. So magnesium oxide is still an ionic compound, but it's lattice energy is high enough such that it does not dissolve and does not give us conductivity measurements. So it's still ionic.

Now we can look at magnesium sulfate. And we see that for 1 gram, we do get some solubility. And at 2 grams, we get no solubility. It was not able to dissolve. And we're able to measure some conductivity.

This means that magnesium sulfate dissociated into respective ions and we're able to measure some conductivity while in water. But magnesium sulfate has a limited solubility in water, which is why at 2 grams it wasn't able to dissolve completely. So magnesium sulfate is still an ionic compound.

Finally, if we look at sucrose, we see that we were able to get 1 gram of sucrose to dissolve in water, and 2 grams of sucrose was able to dissolve in water. But we were not able to get any conductivity. This means that sucrose dissolved in water, but did not dissociate into respective ions. So if you think about the structure of sucrose, sucrose has a bunch of polar groups on it, which make it able to dissolve in water. But sucrose does not dissociate into ions, which is why we were not able to measure any conductivity.

So sucrose is a covalent compound. So by using our knowledge of bonding and our solubility and conductivity data, we're able to affirm the identity of our compounds. That is, whether or not they're ionic or covalent.

So today we looked at how the type and strength of bonding of a solid influences its properties. Specifically, we looked at how these aspects of bonding influence these solubility and conductivity of these solids in water.