[MUSIC PLAYING]

JESSICA HARROP: Hi, I'm Jessica. And today, I'm going to talk about her reaction I like to call Midas' Magic. And before I get started, let's watch the reaction in action with the help of Dr. Bassam Shakashiri. And here he is. He's actually the president of the American Chemical Society. And his motto is, "Science is fun." Here he is at MIT. And let's see what he has to show us.

BASSAM SHAKASHIRI: Watch this. Here i take this clear and colorless liquid. And I put some of it in the beaker, about 100 milliliters. How do I know it's about 100 milliliters?

AUDIENCE: It says so.

BASSAM SHAKASHIRI: I'm reading the markers on here, on the beaker. And I take about 100 millimeters of a different clear and colorless liquid. But you don't know that it's different. They look the same, right? And look at this. Look what's going to happen now.

AUDIENCE: Ooh.

AUDIENCE: It's yellow.

BASSAM SHAKASHIRI: Isn't that one of the most fascinating observations you make? You take two clear, colorless liquids. You mix them together, and you get a yellow substance that is insoluble in water. This is lead iodide. I mixed potassium iodide solution with lead nitrate solution. So the magician never tells you how the trick works. But in science, we like to know what's going on.

JESSICA HARROP: So what is going on? Let's break it down. Dr. Shakashiri started with two clear, colorless liquids. He had about 100 milliliters of lead nitrate. And that's aqueous. That's in solution. And about 100 milliliters of potassium iodide, also aqueous, and when he mixed those together, he got a yellow precipitate. Let's color that in yellow. A precipitate is a solid. So how do we know what this yellow solid is?

Well, this is the reaction that's called a double displacement reaction. And in this kind of reaction, the cation and anion pairs switch places. So what exactly does that mean? I'm going to use some colors to help me out. So we've got cations and anions in each of these compounds. The cations have positive charge. So in this case, it's lead, which has a 2+ charge and nitrate, NO3-. You need two of those to have a neutral compound.

Our other compound, over here, has potassium, which has a +1. And our anion is iodide, which is -1. When these two solutions are mixed, we've got lead, which is our +2. And it's going to react with iodide. We need two of them to make it a neutral compound. And potassium nitrate, and we just need one nitrate here. So our cations and anions all switched places.

We're going to need to balance this equation let's throw some twos there and there. So how can we predict which one of these two compounds is the yellow precipitate? Hundreds of years ago, chemists mixed ions together. And they came up with solubility tables, just like this one. Now this chart basically shows us when these two ions, an ion from this column and this column are mixed together, is their product, a compound that they form, soluble or insoluble in water? If it's soluble in water, there's an aq for aqueous on the chart. And if it's insoluble in water, there's an s for solid.

So our two compounds that we want to look at our lead iodide and potassium nitrate. So let's take a look. Potassium nitrate-- we've got potassium down here at the bottom. We've got nitrate here at the top. When mixed together, aqueous solution, soluble in water. So it's more likely that our lead iodide would be the yellow precipitate. But let's see if that's true. Lead mixed with iodide-- voila. It's a solid.

So to recap, solubility tables help chemists predict whether or not a precipitate will form when two solutions are mixed. So going back to our equation here, the lead iodide-- this is the yellow precipitate. It's a solid. And the potassium nitrate is aqueous. And even though I didn't paint my nails with this particular pigment, lead iodide, creating nail polish colors is one of the many different things that chemists can do.

So there we go. I hope you enjoyed Midas' Magic. And I will see you next time.

[MUSIC PLAYING]