Physics A: Accuracy and Precision of Measurements

Scene #	Description	Narration
1	The definition of accuracy is posted on a slide with blue background. The 3 types of accuracy errors are listed on the slide.	Welcome to today's lesson on accuracy and precision of measurements. Accuracy. Accuracy is the correctness of a measurement. I like to think of it as we have the c here. Then it helps me remember because I have the c here as well. So the correctness of a measurement is accuracy. And this is really how close the measurement is to the accepted value-- so if you're looking at a textbook, what you get in your measurement and then how it stacks up against an actual measurement done by a scientist or a published piece of literature. There are three types of accuracy errors. The first is a human error. And this is reading or recording the measurement. We have instrument error, which is defective equipment, maybe equipment that you didn't calibrate properly or maybe was somehow damaged. And then lastly is the method error, which is caused by either poor procedures or parallax. And parallax is really just a bad viewpoint, maybe reading the speedometer on your car from the passenger seat as opposed to the driver's seat.
2	A new slide shows the title: How to avoid inaccuracies in measurement. Key points are added to the slide as the narrator speaks.	How to avoid inaccuracies in measurement-- well, you have to have well-thought-out procedures. You need to take repeated measurements. You have to have several measurements to compare to one another. You have to have a good viewpoint that will avoid parallax. And then you need to calibrate and test the equipment before use. All accuracy errors should be fixed. Precision. Precision is the exactness of the measurement. So therefore, I like to think of this exactness. And then when we look at the precision here, that helps me remember as well, so the E in precision for exactness.

3	The next slide has the title Precision. As the narrator talks about precision key points are shown on the slide.	Precision is also considered repeatability. And it also describes the limitations of the measuring instrument. For example, using a ruler with marks at every centimeter is not going to be as precise as every millimeter. Also, if you want to think about Olympic races, you probably would not use your bedroom clock, because we want to have tenths and hundredths of a second. So we may use some type of electronic timing system for Olympic races. And then significant figures, which we'll talk about in a later presentation, are used in measurement to numerically indicate precision. So we could say 1 gram, but that's not going to be as precise as 1.01 grams and not as precise as 1.0055 grams.
4	The next slide is titled “Accuracy vs. Precision”. 3 bullseye targets are on the slide. 1 bullseye has underneath it “Accurate, not precise”. The narrator draws red x’s around and near the center of the bullseye but not in the center. Another bullseye has underneath it “Precise, not accurate”. The narrator draws red x’s far from the center of the bullseye but all in the same ring on the bullseye. The final Bullseye has underneath it “Accurate and Precise”. The narrator draws red x’s in the center of the bullseye.	So let's take an example of a bull's eye here. If we were to be accurate in a measurement, we may hit the bull's eye with a dart right here. We may hit it right here. We may hit it right here, and we might hit it right here. Now, this is pretty accurate, but it's not very precise, not very repeatable, not very exact. If we want something that's precise, we may put the dart here, here, here, and here. Now we're consistently hitting the same spot, but we're not very accurate in this. And obviously, the goal of darts is to hit the bull's eye every single time. So we may hit here, here, here, and here, and then as well as in here some. And that would be considered accurate and precise. And this is, of course, what we aim for when taking measurements.
5	The next slide has the title “More Examples”on it. The narrator reads the problem out loud.	More examples-- a student measured a sample of iron and found its density to be 7.86 grams per centimeter cubed. The accepted value for density of iron is 7.87 grams per centimeter cubed. This measurement is accurate.
6	The narrator reads the next problem showing on the slide.	The correct value for the speed of sound in air is 343 meters per second. During an experiment, a student calculates the following values for the speed of sound in air-- 240, 241, 240, 242, and 239. The student's results are precise, but not very accurate.

7	The narrator reads the next problem showing on the slide.	The correct value for acceleration due to gravity is 9.81. During an experiment, a student calculates the following values for acceleration due to gravity-- 9.82, 9.80, 9.81, 9.82, and 9.81. These results are both precise and accurate, and this would be a successful experiment.