

[PIANO MUSIC PLAYING]

[SOFT GLISSANDO PLAYING]

**PROFESSOR:** Volumetric techniques-- measuring, essentially. Have you ever added too much pepper to a recipe? I know, it's not so great afterwards, but it's an innocent mistake. But in the lab, you have to be sure to have precise measurements. So we're going to learn how to get those now.

We'll be using the volumetric pipette, the burette, the volumetric flask, and the syringe. Now for some basic rules. First and foremost, keep all glassware clean. You want to be able to clearly read the markings on all your equipment. Therefore, keep it clean.

Also, you always need to read at the bottom of the meniscus. The meniscus is the curved interface between the air and the liquid. You need to read at eye level and at the bottom of the meniscus in order to get a correct reading.

Now for the basics of washing your equipment. First, use soap solution to clean it. Then rinse with tap water. Then rinse with distilled water, rinsing thoroughly each time. Finally, rinse with solvent if appropriate and let dry.

Now let's cover the equipment.

[SOFT GLISSANDO PLAYING]

Pipettes are used to measure small quantities of volume, usually up to 10 milliliters. They work on the principle of creating a vacuum. Notice the pipette's gradation marks.

Now let's learn all about the bulb. Here is the bulb of a volumetric pipette. Squeeze A, and then squeeze this section of the bulb, and you'll create a vacuum. If you want to suction up liquid, squeeze A. If you want to expel liquid, squeeze E.

Here's a demonstration of creating and then releasing the vacuum.

[ALARM SOUNDING]

**MALE** Caution. Never use your mouth to suction up liquids.

**PROFESSOR:**

**PROFESSOR:** Now, for some basic pipetting. First you need to create a vacuum. Squeeze A and push in the bulb to do this. To draw up liquid, squeeze S. There it goes. And to expel your liquid, you then want to squeeze E. Down it goes. When you're all done, squeeze A again to release the vacuum.

Now for filling a pipette. First, create a vacuum. Then draw up past the 0 mark. This is to coat the interior walls. Then expel all your liquid. Draw up past the 0 mark once again, but this time, slowly release to the 0 mark. Or you may choose to slowly draw up to the 0 mark instead.

[ALARM SOUNDING]

**MALE** Caution-- never allow any liquid to enter the bulb.

**PROFESSOR:**

**PROFESSOR:** Finally, cleaning the pipette-- you want to rinse with soap and water and solvent as usual. But remember, don't get anything in the bulb.

[SOFT GLISSANDO PLAYING]

Volumetric flasks are used to dilute solutions. What would we need for this process? The flask, powder or concentrated solution instead, a funnel and stirring rod for guiding in the solution, solvent for rinsing, solvent for pouring in and diluting, and finally a pipette to add the last drops up to the gradation mark.

If you're going to make the solution from powder, uncap the flask and add your whey powder into the flask carefully. Alternatively, you may choose to use concentrated solution instead. Use a funnel and possibly a stirring rod to guide the solution into the flask.

Now it's very important that you rinse with the appropriate solvent. In our case, we're diluting with water. But you may be using something else. Be sure to rinse the beaker, the stirring rod, and the funnel, three times each. Add these washings directly to the flask.

Now for adding the solvent. Take your solvent and fill the flask half full. Swirl or invert to facilitate the solution. Then add more solvent, but be sure not to fill to the gradation mark. Notice here how we didn't fill it up to the mark. Let the flask sit to allow drainage from the interior walls.

[ALARM SOUNDING]

**MALE** Important-- make sure your solute is completely dissolved.

**PROFESSOR:**

**PROFESSOR:** Here is some undissolved solute. Make sure you swirl and invert to dissolve this before you continue with your dilution. After you know all is dissolved, and you've allowed 1 minute for drainage, use a pipette to add the last few drops of solvent up to the gradation mark. And finally, be sure to swirl or invert. You'll notice that the bottom of the meniscus lines up with the gradation mark.

Now, for storage. Use a clean, dry storage bottle. You may choose to rinse it with a small amount from the flask. Swirl and invert the flask to make sure it's all dissolved, then pour it into the storage bottle. Be sure to cap firmly before setting aside.

Finally, cleaning the flask. Wash with soap and water, as usual. And if desired, clamp upside-down to facilitate drying.

[SOFT GLISSANDO PLAYING]

Burettes are used to measure and precisely dispense small quantities, as seen here in titrations. Let's address the proper hand position. Wrap your hand around the burette, as shown. Gently pushing forward the top portion with your forefinger allows titrant to flow. Gently pushing forward the bottom portion with your middle finger seizes the flow of titrant.

Now, for filling the burette. Here is your titrant. Take your burette and add a few milliliters of titrant to it. Then tilt and rotate your burette to coat the interior walls with titrant. Allow all the titrant to drain out. Then fill your burette to above the 0 mark.

But wait, we need to get rid of air bubbles. So what's wrong with this burette? Well, you guessed it. There are air bubbles in the tip. This could be a major problem. To get rid of air bubbles, quickly rotate the valve back and forth, allowing small amounts of liquid to pass through intermittently.

Look, no more air bubbles. Now that they're gone, we can proceed to drain the burette. Remember, you filled it to above the 0 mark. Now you'll slowly drain it to the 0 mark. But you don't have to reach it exactly. Just make sure you record the starting value, regardless of where it is, before you do anything else.

Now let's learn about proper meniscus reading. Remember to read at the bottom of the meniscus and to avoid parallax, which is inaccurate reading, always read at eye level. Here, the burette can easily be read as 3.50 milliliters.

But what happens if you read from below? Well, it's 3.55 milliliters-- more than the actual amount. And if we read from above, it appears as 3.45 milliliters-- less than the actual amount. Moral of the story-- avoid parallax and read at eye level.

Now, cleaning the burette. Use a long burette brush, as shown here. Wash with soap and water, as usual. And make sure that you wash through the tip.

[SOFT GLISSANDO PLAYING]

Syringes are used to measure and transfer very small quantities, such as those in microliters. So let's explore transfer via the syringe. Take your syringe, and with a curved needle, as shown here, draw up more solution than you actually need. You'll have an air bubble in your barrel. Tap it until it reaches the top.

There's the air bubble at the top. Now expel some solution until you get to the amount that you actually need. After you expel some of the solution, you've pushed out the air, so your needle is entirely full of solution. And there should be a little drop at the end.

In order not to lose anything from the needle, you need to withdraw a cushion of air. Now you're ready for transfer. Transfer the solution to the receiving vessel. But wait, even though you think you've transferred it all, you still have liquid in your needle. You need to expel this excess liquid. Invert your syringe, and by withdrawing and releasing the plunger, get rid of the excess liquid by pushing it out.

Finally, cleaning the syringe. Before washing, disassemble the syringe into its components-- needle, barrel, and plunger. Wash with soap and water separately. Rinse with solvent and allow to dry.

Now that you have the skills, go forth and measure. Remember, this video is intended to help you prepare for lab by providing a demonstration of the proper experimental technique. It is not intended as a replacement for reading your lab manual or the supplementary material. In order to become a great experimentalist, it is important that you understand both theory and technique. Now it's your turn. Good luck.