[MUSIC PLAYING]

PRESENTER: The balance is arguably the most used piece of equipment in the chemistry laboratory. However, only proper technique, care, and maintenance will allow accurate measurements and will keep the balance functioning correctly. A balance is used to determine the mass of a solid or liquid.

You should remember that mass is defined as a measure of the amount of matter, regardless of location, and that weight is defined as the force resulting from gravity, which varies from place to place depending on the distance from the center of the Earth. Because weight is directly proportional to mass on any location on Earth, we will use these terms interchangeably. If you decide to do some space travel, however, take care to remember the differences.

Four major types of balances are commonly used, the triple beam balance, the top-loading balance, the analytical balance, and the microanalytical balance. The difference between these balances is the amount of precision they afford. The triple beam balance is precise to 10 milligrams, the top-loading to 1 milligram, the analytical to 1/10 of a milligram, and the microanalytical to 1/1,000 of a milligram.

Precision comes at a cost, however. As precision increases, so does the susceptibility of the balance to environmental conditions as well as balanced cost. Therefore, you should choose a balance that is only as precise as necessary.

The two balances that you will most commonly encounter include the top-loading balance and the analytical balance. The top-loading balance is typically used for rough measurements or for weighing chemicals that will be used in excess. The analytical balance is used when precise measurements are desired. This video will focus on the use, care, and maintenance of an analytical balance. The topics discussed can be extrapolated to the top-loading balance as well.

To weigh an object on an analytical balance, turn the balance on if it is not on already and allow it to warm up for 30 minutes. Inspect the balance and make sure that it is clean. If necessary, clean off the balance pan with a soft painter's brush. Make sure the doors are closed and press the control bar to tare the balance. A reading of 0.0 milligrams with no other display should appear if the balance is stable.

Gently place the object to be weighed in the center of the balance pan, close the doors, and record the weight that is indicated on the display after the numbers have ceased to fluctuate. Remove the object from the balance pan and repeat the process two more times to ensure precision. Finally, average the three readings to determine the weight of the object.

When weighing a chemical, care must be taken to never allow the chemical to touch the balanced pan. Instead, weigh the chemical in an appropriate container. If possible, weigh the chemical directly into the destination vessel. This action eliminates the transfer step and the potential loss of material.

If using the destination vessel is not possible, choose the smallest weigh boat or piece of paper that will effectively hold the desired amount of chemical. The heavier the container, the less accurate the measurement because just a small weight difference will exist between relatively large numbers. In addition, the more surface area, the more places for chemicals to stick to instead of being transferred to the destination vessel.

Place the weighing container on the balance pan, close the doors, and tare the balance if you are using weigh paper, first, crease the paper along the diagonal to facilitate the transfer of chemicals. Remove the weighing vessel from the balance and load an estimated amount of chemical onto it with a spatula. Placed the loaded weighing vessel back on the balance pan and close the doors to obtain a reading.

If the weight is too high, take the weigh vessel off the balance pan and transfer the excess chemical into an appropriate waste container, never back into the original reagent bottle. If the weight is too low, introduce more chemicals to the weigh container. Remove the weigh vessel from the balance pan every time additional chemical is introduced.

Finally, transfer the chemical from the waste paper or weigh boat into the appropriate reaction vessel. Reweigh the paper boat to determine the exact amount of chemical that was transferred. After finishing with the balance, use a soft brush to clean up any solids from the balance pan and wipe up any liquids.

Close the doors to prevent dust and dirt from entering the balance. Clean the surrounding area and remove all items that you brought there. Leave the balance and area surrounding it in better shape than when you found it.

The accuracy of your measurements depends on both good technique and environmental factors. This video will highlight the most important of these guidelines. Keep the balance doors closed at all times to prevent air currents from causing the balance pan to bounce slightly. Never lean or lay a hand on the balance table to prevent unstable measurements.

Wear gloves to prevent oil from depositing on the glassware which falsely increases the mass. Weigh a chemical directly into the reaction vessel. If that is not possible, use the smallest weigh boat or weigh paper that will hold your desired amount of chemical.

Ensure that the outside of the way vessel is completely dry before placing it on the balance pan, and be sure to place the object on the center of the balance pan. Allow moist chemicals to dry completely to avoid elevated readings and avoid breathing on an object which condenses moisture on it and falsely increases its mass. Weigh ultra dry objects or ones immediately removed from a desiccator at identical time intervals because they absorb moisture and gain weight the longer they sit in the atmosphere.

Finally, allow hot or cold objects to reach room temperature before weighing. A hot object should be cooled in a desiccator to prevent the pick up of moisture. Hot or cold objects create a convection current in the air around the balance pan, which reduces the air pressure on the balance pan and results in an unstable reading.

The accuracy of a measurement is only as good as the instrument that is used. To keep your balance functioning correctly, the following precautions should be taken. Never weigh chemicals directly on the balance pan.

Never add chemicals to the weighing vessel while it is on the balance pan. Never pour a chemical directly out of a reagent bottle and into the weigh vessel. Use a spatula instead. Pay attention to the maximum weight allowed by a particular balance and do not overload it. When using a balance, be aware of the warning signs which indicate that the balance is malfunctioning.

After recording the weight of a chemical, remove it from the balance pan. The numbers and the display should again read 0.0 milligrams. If the displayed value is 0.3 milligrams or greater, then the 0 level was significantly shifted during the weighing process and the chemical must be reweighed.

Check the amount of drift that is occurring. Drift is characterized by weight readings that do not stabilize or by unstable readings with no weight applied. All analytical balances show some degree of fluctuation on their display and care should be taken to keep this shift at a minimum. If you notice a change in the amount of instability on a particular balance, then it is malfunctioning.

Drift is affected by two environmental factors, temperature and static electricity. It can be minimized through their manipulation. The temperature of the room and the internal temperature of the balance should be kept constant within 2 degrees Celsius. Static electricity can be minimized by avoiding the use of plastic containers and by maintaining the humidity above 40%.

If you notice excessive drift, the following situations may be occurring. The balance may be exposed to a draft. Close the doors. The sample may be moist and undergoing evaporation on the balance pan.

The sample might be ultra dry and absorbing moisture on the balance pan. The sample may not be at ambient temperature, which causes it to produce convection currents. The sample may be electrostatic. If you notice drift while weighing a sample, the most accurate reading is the first number that appeared and was maintained for two seconds.

So far, we've discussed the use of a balance for weighing solids, however, a balance may also be used to weigh liquid samples. Generally, it is easier and more accurate to determine the volume of a liquid by using precision volumetric glassware, such as a burette, glass pipette, syringe, or automatic pipette, and then use the liquid's density to calculate its mass.

However, directly measuring the weight of a liquid is preferred in some situations, such as when working with a vicious liquid. As a final note, when weighing a volatile liquid or one that evaporates readily, use a weighing bottle with a lid. Although using a balance is a relatively simple task, accurate measurements can only be ensured through good technique. Exceptional care must be taken to maintain a clean environment which helps to keep the balance functioning properly.

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