

Equipment, Procedures, and Safety

Section 1.1 Handling, Measuring, and Storing Liquids



To understand how biologists work, you first need to know the names of some basic equipment and glassware, and when and how they are used.

Measuring and Dispensing Liquids

Various kinds of glassware are used for the storing, measurement, and handling of liquids, but only a few are used for measurement.

A **graduated cylinder** (figure 1-1) is used to accurately measure the volume of liquids. The most common measurement for volume is milliliters, which is abbreviated mL. To get the most precise and accurate measurement, you would use a graduated cylinder with the smallest marks, or graduations.

Accuracy and **precision** are not the same thing. An accurate measurement is a correct measurement. Precision, on the other hand, is defined by how many decimal places are in a measurement. For example, 15.2 mL is a more precise measurement than 15 mL. Usually a smaller graduated cylinder is more precise than a larger one. Look at this example:

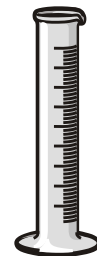
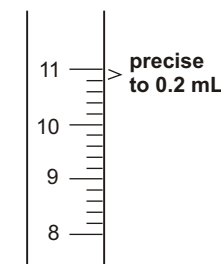


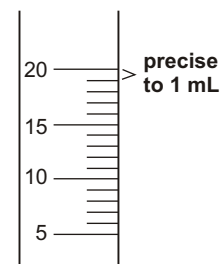
Fig. 1-1

Example: You are given two graduated cylinders. The first graduated cylinder holds 15 mL. Between each long mL mark are 4 shorter marks representing 0.2 mL each. The second graduated cylinder holds 25 mL. Each large mark represents 5 mL, and each smaller mark represents 1 mL. Which could be used to accurately measure 10 mL of liquid? Which graduated cylinder is more precise?

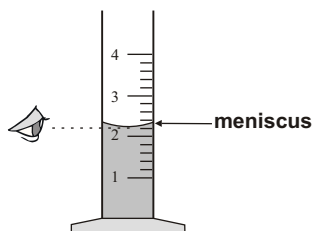
Either one could be used to accurately measure 10 mL of liquid, but the 15 mL graduated cylinder is more precise. It is marked in smaller increments of 0.2 mL instead of the 1 mL marks on the 25 mL graduated cylinder.



15 mL graduated cylinder



25 mL graduated cylinder



When measuring liquid in a graduated cylinder, you read the amount of liquid from the center of the **meniscus**. The meniscus is the curve at the surface of the liquid. The meniscus of most liquids curve down, but the meniscus of mercury curves up.

Graduated cylinders are not the only pieces of glassware used for measurements. For very small liquid measurements, you can use a **pipette** (figure 1-2), **burette** (figure 1-3), or **syringe** (figure 1-4). These pieces of equipment are also used for dispensing liquids in measured amounts.

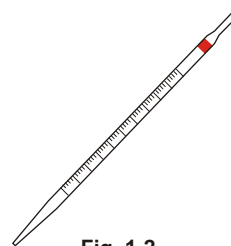


Fig. 1-2



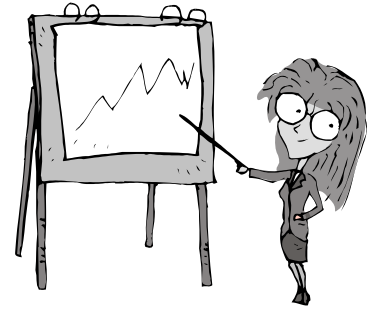
Fig. 1-3



Fig. 1-4

Scientific Experiments

Section 2.4 Using Graphs and Diagrams to Organize and Interpret Data



After data has been gathered, you must interpret the information and present it in such a way that it makes sense to others. One way you saw in Section 2.3 was to summarize the information in a table. Another way to do this is to use one or more graphs or diagrams. Graphs and diagrams present information in a way that makes data easier to interpret visually.

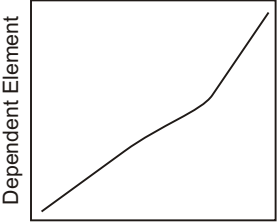
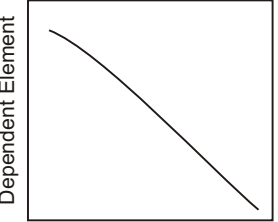
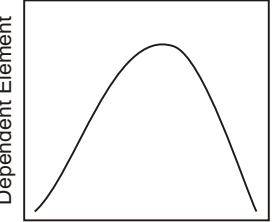
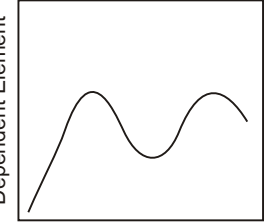
As when reading a table, make sure you understand what kind of data is being given in the graph or diagram. Look at the title of the graph or diagram and all the labeled parts.

First, let's look at graphs. There are different types of graphs that can be used to display data. Each type of graph has a specific use. Remember, you always want to choose the best way to display your data that makes it easiest to interpret.

Line Graphs

Line graphs are frequently used to show how something changes over time. The horizontal, or x-axis, is used to show the time frame. The vertical, or y-axis, is used to show the dependent variable. All graphs should have a title, and both the x and y axes should be labeled.

Since one of the most important features of line graphs is to be able to see *trends*, you can often take a trend and match it to the graph that represents the data. Before we look at reading graphs, let's look at four types of trends: an upward trend, a downward trend, a peaking trend, and an unstable trend with ups and downs. The general type of line for each trend is given below. Make sure you read each example, which shows the type of data that would give that type of trend. (Note: An additional trend not shown here is one that shows no change. No change in data results in a horizontal line.)

 <p>Dependent Element</p> <p>Independent Element</p> <p>Upward Trend</p> <p>The dependent element increases as the independent element increases.</p> <p>Example: A simple example of an upward trend would be the height of plants over time. As the time increases, the height of the plants also increase. This type of data would fit the pattern of an upward trend graph.</p>	 <p>Dependent Element</p> <p>Independent Element</p> <p>Downward Trend</p> <p>The dependent element decreases as the independent element increases.</p> <p>Example: A downward trend in data would be like the decrease in a bacteria population as an antibiotic increases. The line would go down as the bacteria population decreases over time.</p>	 <p>Dependent Element</p> <p>Independent Element</p> <p>Peaking Trend</p> <p>The dependent element increases to a point and then begins to decrease as the independent element increases.</p> <p>Example: A peaking trend would fit data like pain medication effectiveness. The effectiveness increases for awhile and then begins to decrease as the time increases.</p>	 <p>Dependent Element</p> <p>Independent Element</p> <p>Unstable Trend</p> <p>The dependent element increases and decreases several times as the independent element increases.</p> <p>Example: An unstable trend might be seen in a deer population during a year. The population may go up and down each season based on the births of offspring, populations of predators that eat deer, and deer season for hunters.</p>
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