

1-4 Tools and Procedures

What measurement system do most scientists use?

A Common Measurement System

Scientists need a common system of measurements in order to replicate each other's experiments.

Most scientists use the metric system when collecting data and performing experiments.

The metric system is a decimal system of measurement whose units are based on certain physical standards and are scaled on multiples of 10.

Because the metric system is based on multiples of 10, it is easy to use.

A revised version of the original metric system is called the International System of Units, or SI.

Common Metric Units	
Length	Mass
1 meter (m) = 100 centimeters (cm) 1 meter = 1000 millimeters (mm) 1000 meters = 1 kilometer (km)	1 kilogram (kg) = 1000 grams (g) 1 gram = 1000 milligrams (mg) 1000 kilograms = 1 metric ton (t)
Volume	Temperature
1 liter (L) = 1000 milliliters (mL) 1 liter = 1000 cubic centimeters (cm ³)	0°C = freezing point of water 100°C = boiling point of water

Analyzing Biological Data

Scientists collect data to find out whether certain factors change or remain the same.

Often, the simplest way to do that is to record the data in a table and then make a graph.

Computers help scientists to gather, analyze, and present large quantities of data.

Analyses of data are used to make predictions about complex phenomena.

How are light microscopes and electron microscopes similar? How are they different?

Microscopes

Microscopes are devices that produce magnified images of structures that are too small to see with the unaided eye.

Light microscopes produce magnified images by focusing visible light rays.

Electron microscopes produce magnified images by focusing beams of electrons.

Light Microscopes

The most commonly used microscope is the light microscope.

Light microscopes produce clear images of objects at a magnification of about 1000 times.

Compound light microscopes allow light to pass through the specimen and use two lenses to form an image.

Light microscopes make it possible to study dead organisms and their parts, and to observe some small organisms and cells while they are still alive.

Electron Microscopes

Light microscopes cannot produce clear images of objects smaller than 0.2 micrometers, or about one-fiftieth the diameter of a typical cell.

To study even smaller objects, scientists use electron microscopes.

Electron microscopes use beams of electrons, rather than light, to produce images.

The best electron microscopes can produce images almost 1000 times more detailed than light microscopes can.

Laboratory Techniques

Cell Cultures

To obtain enough material to study, biologists sometimes place a single cell into a dish containing a nutrient solution.

The cell is able to reproduce so that a group of cells, called a **cell culture**, develops from the single original cell.

Cell cultures can be used to:

- test cell responses under controlled conditions
- study interactions between cells
- select specific cells for further study

Cell Fractionation

Biologists often use a technique known as **cell fractionation** to separate the different cell parts.

Cells are broken into pieces in a special blender.

The broken cell bits are added to a liquid and placed in a tube.

The tube is inserted into a centrifuge that spins, causing the cell parts to separate, with the most dense parts settling near the bottom of the tube.

A biologist can then remove the specific part of the cell to be studied by selecting the appropriate layer.

Working Safely in Biology

Scientists working in a laboratory or in the field are trained to use safe procedures.

Laboratory work may involve contact with dangerous materials or organisms.

Follow safe practices.

- Study the safety rules.
- Read all the steps and safety precautions.
- Follow your teacher's instructions and textbook directions exactly.
- If in doubt, ask your teacher for an explanation.
- Wash your hands thoroughly with soap and warm water after every scientific activity.

Remember you are responsible for your own safety as well as that of your teacher, classmates, and any live animals you handle.