

# LABORATORY TECHNIQUES AND SAFETY

## 1-4 Tools and Procedures

1. Researchers need to be able to replicate each others experiments. Most experiments involve measurements, so a common system of measurement is helpful.

Most scientists use the \_\_\_\_\_ which is a \_\_\_\_\_ of measurement whose units are based on multiples of \_\_\_\_\_.

### 2. Common metric units:

Length	Mass

Volume	Temperature

Scientists record a great deal of data. The best way to see which factors changed during an experiment is to \_\_\_\_\_

see Figure 1-22. At what time of day is the rate of water released by leaves equal to the rate of water absorbed by roots? \_\_\_\_\_ Where did you look, at the table or the graph? \_\_\_\_\_ Why?

## Commonly Used Metric system Units, Symbols, and Prefixes

Quantity measured	Unit	Symbol	Relationship
Length, width, distance, thickness, girth, etc.	millimeter	mm	10 mm = 1 cm
	centimeter	cm	100 cm = 1 m
	meter	m	
	kilometer	km	1 km = 1000 m
Mass ("weight")*	milligram	mg	1000 mg = 1 g
	gram	g	
	kilogram	kg	1 kg = 1000 g
	metric ton	t	1 t = 1000 kg
Time	second	s	
Temperature	degree Celsius	°C	
Area	square meter	m <sup>2</sup>	
	hectare	ha	1 ha = 10 000 m <sup>2</sup>
	square kilometer	km <sup>2</sup>	1 km <sup>2</sup> = 100 ha
Volume	milliliter	mL	1000 mL = 1 L
	cubic centimeter	cm <sup>3</sup>	1 cm <sup>3</sup> = 1 mL
	liter	L	1000 L = 1 m <sup>3</sup>
	cubic meter	m <sup>3</sup>	
Speed, velocity	meter per second	m/s	
	kilometer per hour	km/h	1 km/h = 0.278 m/s
Density	kilogram per cubic meter	kg/m <sup>3</sup>	
Force	newton	N	
Pressure, stress	kilopascal	kPa	
Power	watt	W	
	kilowatt	kW	1 kW = 1000 W
Energy	kilojoule	kJ	
	megajoule	MJ	1 MJ = 1000 kJ
	kilowatt hour	kW·h	1 kW·h = 3.6 MJ
Electric current	ampere	A	

## The most commonly used metric prefixes

Prefix	Symbol	Factor	Numerically	Name
giga	G	10 <sup>9</sup>	1 000 000 000	billion**
mega	M	10 <sup>6</sup>	1 000 000	million
kilo	k	10 <sup>3</sup>	1 000	thousand
centi	c	10 <sup>-2</sup>	0.01	hundredth
milli	m	10 <sup>-3</sup>	0.001	thousandth
micro	μ	10 <sup>-6</sup>	0.000 001	millionth
nano	n	10 <sup>-9</sup>	0.000 000 001	billionth

Symbols are case sensitive (upper and lower case have different meanings (mm = millimeter but Mm is the megameter (one million meters)

Symbols don't have singular and plural forms—it's 1mL, 2 mL, (no "s" at the end) and since they are not abbreviations there is no period at the end unless it falls at the end of a sentence.

Some examples and relationships among units:

**1 mL = 1 cm<sup>3</sup>**

**The mass of a nickel is 5 g**

**1 mL of water weighs 1 g**

**A doorknob is 1 m high**

**1 L of water weighs 1 kg**

**The diameter of a CD is 12 cm**

**1 m<sup>3</sup> of water weighs 1 t**

**1 ha is 10,000 m<sup>2</sup>**

### Microscopes

1. Microscopes \_\_\_\_\_  
\_\_\_\_\_

Light microscopes

Electron microscopes

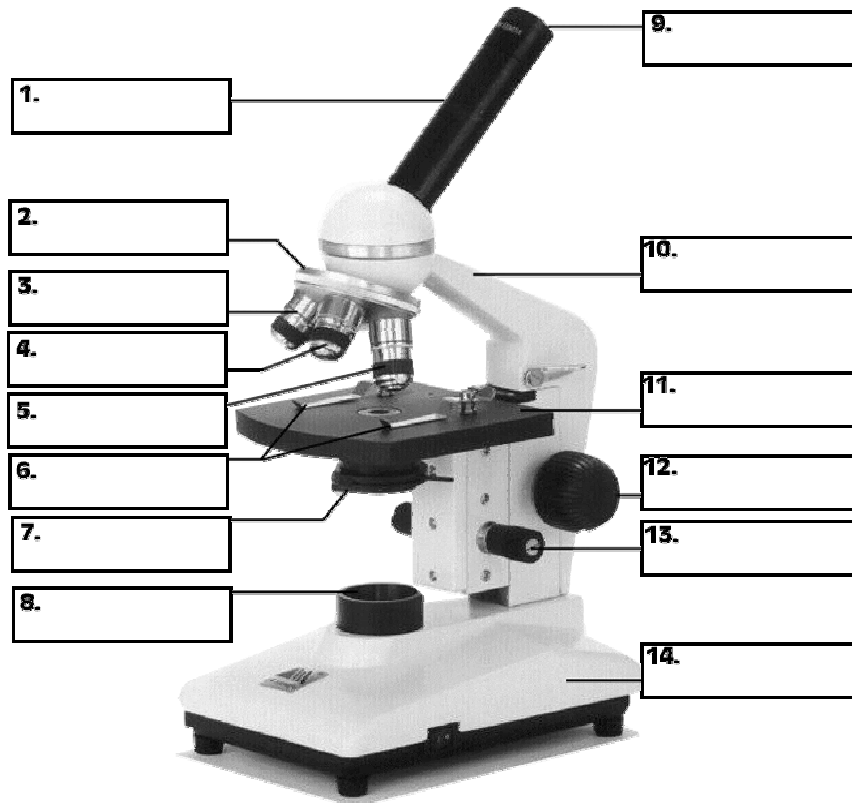
Two important features of a microscope are:

(1) magnification

(2) resolution

2. Light microscopes

Compound light microscopes allow \_\_\_\_\_ to pass through the \_\_\_\_\_ and enlarge the image using \_\_\_\_\_ lenses.



Techniques that make light microscopes more useful include  
Chemical stains

Fluorescent dyes

Video cameras and computer processing

3. Electron microscopes use beams of \_\_\_\_\_ rather than light to produce images. There are two main types of electron microscopes:  
 (1) TEMs

(2) SEMs

Electron microscopes require a \_\_\_\_\_ to operate so \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



Transmission Electron Microscope

#### 4. Laboratory Techniques

Two common lab techniques used to study cells are

(1) cell cultures

(2) cell fractionation

#### Science Safety Rules

1. Dress code:

Safety goggles are always worn when working with

Lab aprons are worn when

Tie back hair when

Remove or tie back clothing or jewelry

## 2. General Safety Rules and First Aid

Read all directions

Never do experiments that are not authorized by the teacher.

Never handle equipment unless you have permission.

Never pour chemicals into the

Never eat, drink, or bring food into the lab.

Immediately report all accidents to the teacher.

Learn the location of the first aid kit, emergency eye wash and shower, and the fire extinguisher.

## 3. Heating and Fire Safety

Never use a heat source without

Never heat a chemical you are not instructed to heat.

Never reach across a flame.

When heating a test tube or bottle point the opening away from yourself and others.

Never heat a closed container.

Use clamps, tongs, or heat-resistant gloves when handling heated containers.

## 4. Chemical Safety

Never touch, smell, or taste a chemical that you do not know for certain is harmless.

Dispose of all chemicals as instructed to by your teacher.

If any acids or bases get on your skin or clothing, rinse immediately with water. Notify the teacher of any acid or base spill.

#### 5. Glassware

Never heat glassware that is not thoroughly dry. Use a wire screen to protect glassware from any flame.

Hot glassware will not appear hot. Never pick up glassware without first checking to see if it is hot.

Never use broken or chipped glassware.

#### 6. Ending the experiment

Clean up your work area and return all equipment to its proper place.

Wash your hands before and after each experiment.