اسم المادة	باللغة العربية	تقنيات الأجهزة الطبية	السنة الدراسية	عدد الساعات الأسبوعية			
	باللغة الانكليزية	Techniques for Medical Device					
لغة التدريس للمادة	اللغة الانكليزية		الأولى	نظرية	عملي	مجموع	عدد الوحدات
				2	4	6	4

أهداف المادة:

الهدف العام:

يتعرف الطالب على الأجهزة الطبية المختبرية التي يتعامل فيها الطالب أثناء حياته العملية مثل المجهر بانواعة والمطياف والطاردة المركزية والحاضنة أو الفرن وغيرها من الأجهزة الأخرى.

الهدف الخاص:

1. يتعرف على المجهر الضوئي بأنواعه ومتى يعمل أي نوع من الاعتماد على القيمة التي يراد فحصها كما يتعرف على المجهر ا لالكتروني ومميزاته.
2. يتعرف على المطياف وأنواعه وما هو الفرق بين الفوميتر واليكزوفوتومير وماهي فائدة هذا الجهاز وماهي مكوناته .
3. يتعرف على الأجهزة المسيطرة عليها بالحرارة مثل الحاضنة والفرن ومكوناتها وفائدة كل منها .

Details	Title of lecture	Week
Definition; structural parts of microscope-head, base, and arm; classification of microscope; methods of uses; microscope electric lamp.	**Microscope**	**One**
Mechanical; optical; and light parts.		
Definition; defect; care; classification; single vision lens; bio-focal lens and veri-focal lens.	**Lens**	**Two**
Characteristic; limitation; magnification; optical tube length; focal length of the objective.	**Microscope**	**Three**
Dark field; phase contrast; fluorescent; electron and polarizing microscope: include (definition; principle structure; uses and care of microscope for each one).	**Types of micro-scope**	**Four**
Definition, Theory; History; and predecessors; isolating suspensions, isotope separation	**Centrifuge and Types of centrifuge**	**Five and Six**

Ordinary laboratory centrifuge; micro- hematocrit centrifuge;		
Classification tube; of centrifuge; uses of the laboratory centrifuge	**Centrifuge tubes**	**Seven**
1.Introduction of sterilization;	**Sterilization equipment's**	**Eight & Nine**
2. Sterilization methods in diagram.		
a. physical method (heat, radiation, filtration sterilization);		
b. chemical method-disinfection, antiseptic; 3. Mechanism of sterilization.		
Include-water bath; dry oven; incubator and autoclave; definition of temperature control instruments.	**Temperature control instruments-**	**Ten**
Definition; application; control of-temp., safety, and shaking for each instrument; types of water bath.	**Water bath and dry oven**	**Eleven**
Definition; parts; and uses for each instrument.	**Incubator and autoclave**	**Twelev**
Definition; parts of the colorimeter;	**Colorimeter and photometer**	**Thirteen**
Filters; Definition; principle of working; photon counting; photography.		
Definition; types of device; method of working; spectroradiometer; visible light reflectance photometry.	**spectrophotometer**	**Fourteen and Fifteen**

المفردات العمليه

تفاصيل المفردات	الأسبوع
Microscope; Type of the microscope; Type of lenses ,uses	**First & Second**
- Dark field- microscope; Polarizing microscope	**Third & Fourth**
Electron microscope ;microscope Fluorescent -	
- Centrifuge; Types of the centrifuge; Uses of each type	Fifth & Sixth
- Design of the centrifuge.	Seventh
- Design of the centrifuge.	**Eighth**
- Sterilization equipment's. Hot air oven.	**Ninth**
- Incubator	**Tenth**
- Water bath	**Eleventh**
- Colorimeter; Photometer	**Twelfth**
Spectrophotometer	**Thirteenth**
The uses and the purpose for each	**Fourteenth and Fifteenth**

Microscope

Microscope:

Is the instrument that produces enlarged images of small objects, allowing the observer an exceedingly close view of minute structures at a scale convenient for examination and analysis.

kinds of microscope:

1- Simple Microscope
2- Compound Microscope
3- Stereo Microscope (dissecting)
4- Confocal Microscope
5- Electron Microscope

parts of compound (light) microscope:

1- **Eyepiece:** The lens the viewer looks through to see the specimen. The eyepiece usually contains a 10X or 15X power lens.
2- **Diopter Adjustment:** Useful as a means to change focus on one eyepiece so as to correct for any difference in vision between your two eyes.
3- **Body tube (Head):**
4- **Arm:** The arm connects the body tube to the base of the microscope.
5- **Coarse adjustment**: Brings the specimen into general focus.
6- **Fine adjustment:** Fine tunes the focus and increases the detail of the specimen.
7- **Objective lenses:** One of the most important parts of a compound microscope, as they are the lenses closest to the specimen.A standard microscope has three, four, or five objective lenses that range in power from 4X to 100X. When focusing the microscope, be careful that the objective lens doesn't touch the slide, as it could break the slide and destroy the specimen.
8- **Specimen or slide:** The specimen is the object being examined. Most specimens are mounted on slides, flat rectangles of thin glass.
9- **Stage:** The flat platform where the slide is placed.
10- **Stage clips:** Metal clips that hold the slide in place.
11- **Stage height adjustment (Stage Control):** These knobs move the stage left and right or up and down.
12- **Aperture:** The hole in the middle of the stage that allows light from the illuminator to reach the specimen.
13- **On/off switch:** This switch on the base of the microscope turns the illuminator off and on.
14- **Illumination:** The light source for a microscope. most microscopes now use a low-voltage bulb.

15- **Iris diaphragm:** Adjusts the amount of light that reaches the specimen.

16- **Condenser:** Gathers and focuses light from the illuminator onto the specimen being viewed.

17- **Base:** The base supports the microscope and it's where illuminator is located.

How Does a Microscope Work?

All of the parts of a microscope work together - The light from the illuminator passes through the aperture, through the slide, and through the objective lens, where the image of the specimen is magnified. The then magnified image continues up through the body tube of the microscope to the eyepiece, which further magnifies the image the viewer then sees.

(Types of microscopes)

Microscopes come in a variety of sizes, styles and types in order to suit all of the many uses we have for them. Different technologies, quality levels, viewing results, and physical setups are required depending on what is being viewed, and for what reason.

kinds of microscopes:

1- Simple Microscope

2- Compound Microscope

3- Stereo Microscope (dissecting)
4- Confocal Microscope
5- Electron Microscope

6- Fluorescence microscopy

7-Bright-field microscopy
8. Dark-ground microscopy
9. Phase-contrast microscopy
10. Interference microscopy

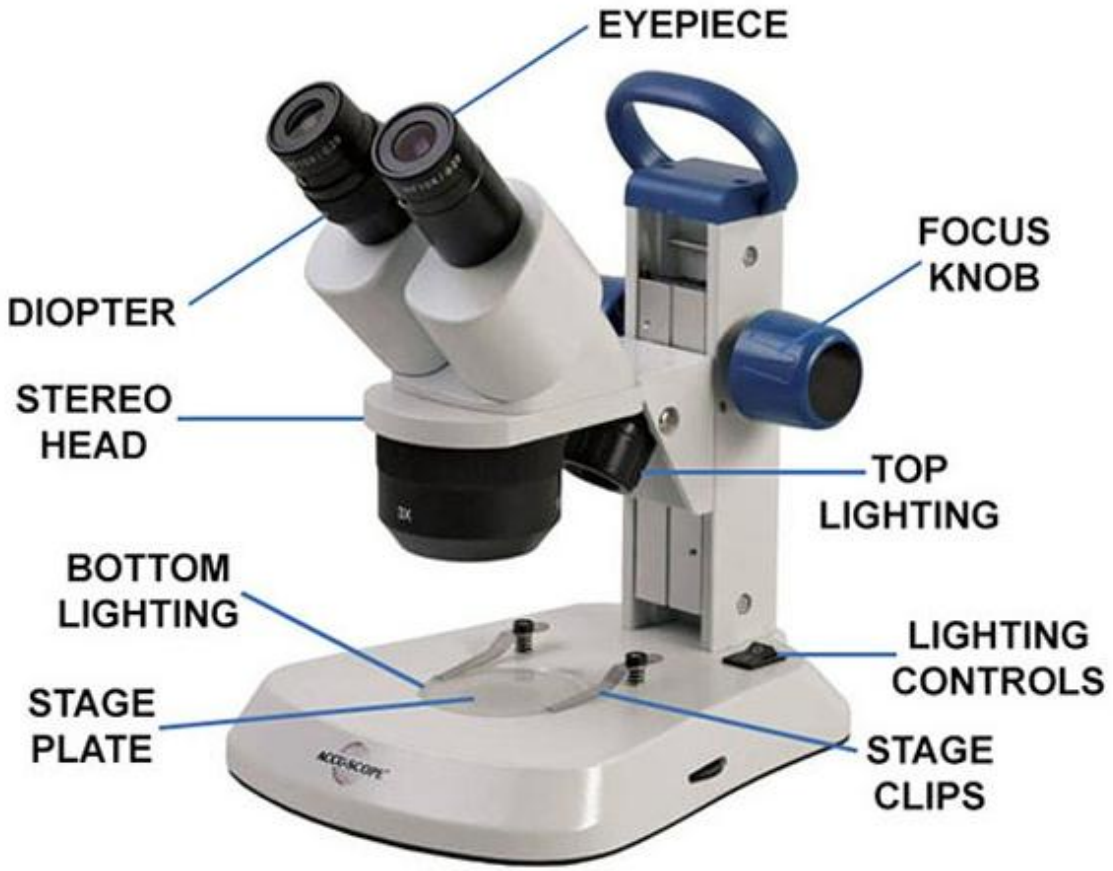
Stereo Microscopes

A stereo microscope is an optical microscope that provides a three-dimensional view of a specimen. It is also known by other names such as dissecting microscope and stereo zoom microscope. Dissecting microscope parts include separate objective lenses and eyepieces. As a result, you have two separate optical paths for each eye. The slightly different angling views to the left and right eyes produce a three-dimensional visual. Because it gives the three-dimensional view it is also called as the dissecting microscope.

The Characteristics of a Stereo Microscope

- Two separate objectives
- Two separate optical paths
- Uses the light reflected from the object
- Typical magnification range between 10x and 50x
- Three-dimensional images

stereo microscopes are often used for manufacturing things like circuit boards, and botanical observation and study. Excellent things to view under a stereo microscope include coins, flowers, insects and plant parts.



Polarizing Microscopes

Polarizing microscopes use light manipulation to increase the degree of contrast between different structures and densities under magnification. They use both transmitted and/or reflected light, filtered by a polarizer and controlled by the analyzer, to highlight differences in the texture, density and color of a sample surface. They are therefore excellent for viewing birefringent materials.

Polarizing microscopes are commonly used in geology, petrology, chemistry and many other similar industries.

A fluorescence microscope

A fluorescence microscope is an optical microscope that uses fluorescence instead of, or in addition to, scattering, reflection, and attenuation or absorption, to study the properties of organic or inorganic substances. "Fluorescence microscope" refers to any microscope that uses fluorescence to generate an image, whether it is a simple set up like an fluorescence microscope or a more complicated design such as a confocal microscope, which uses optical sectioning to get better resolution of the fluorescence image

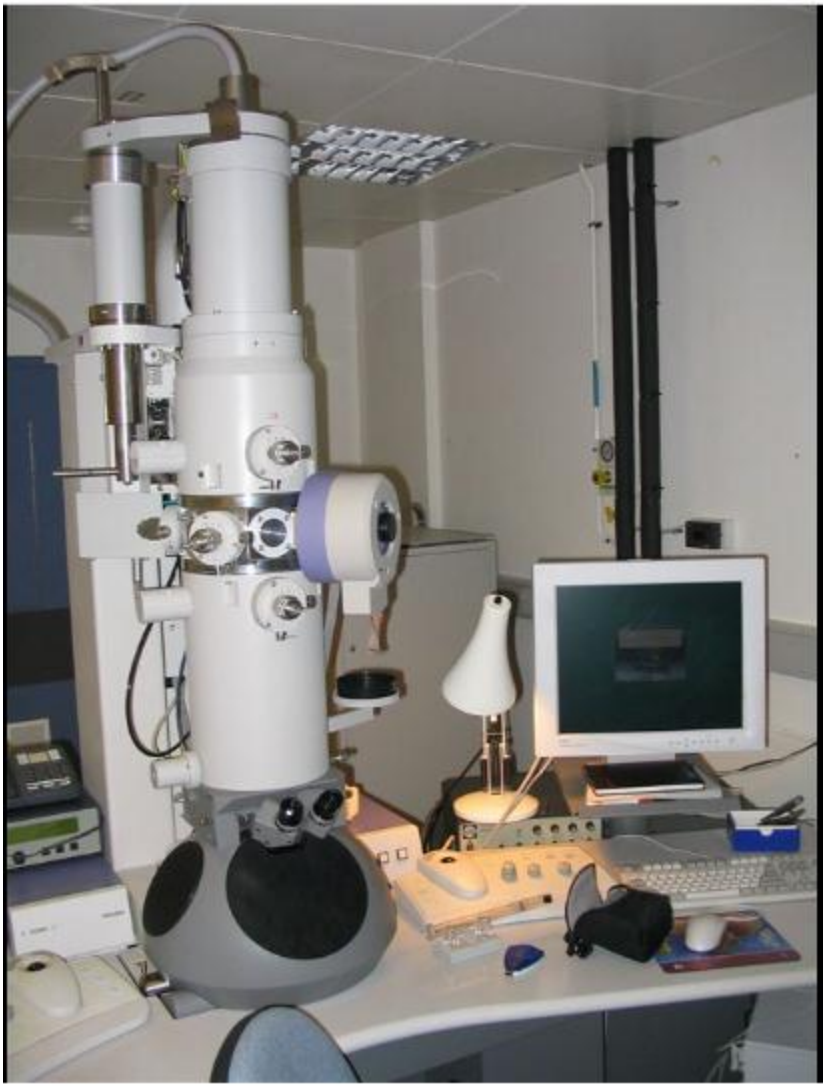
Principle

The specimen is illuminated with light of a specific wavelength (or wavelengths) which is absorbed by the fluorophores, causing them to emit light of longer wavelengths (i.e., of a different color than the absorbed light). The illumination light is separated from the much weaker emitted fluorescence through the use of a spectral emission filter.

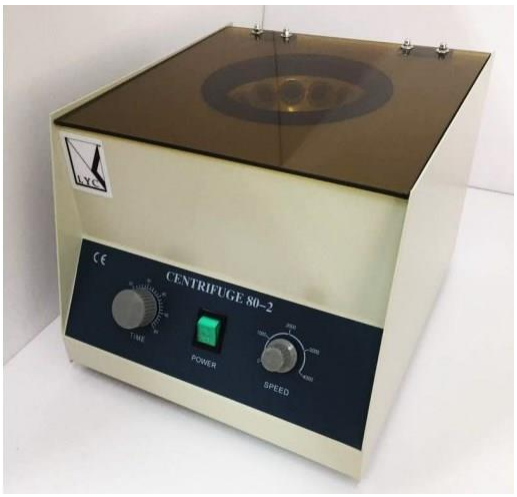
Electron Microscopes

An electron microscope doesn’t need light to create an image. Instead, this type of microscope sends accelerated electrons across or through a specimen to render a digital image. These microscopes have the highest power and highest resolution available and are used to see detailed structure at the cellular and macromolecular levels.

magnifications of up to about 10,000,000× whereas most light microscopes are limited by diffraction to about 200 nm resolution and useful magnifications below 2000×.



Centrifuge



It's a simple instrument used in the laboratory for separating solid components from liquid suspension by centrifugal action. It's used for plasma and serum separation of blood samples, urine particles sedimentation in microbiological laboratories and for similar experiments in other lab. It's also used in recovering solid material from suspension as in the microscopic examination of urine. The solid materials or sediment packed at the bottom of centrifuge is sometimes called the precipitate and the liquid or top portion is called the supernatant. Cell usually collect at the bottom of the centrifuge tube because the particles are heavier than the liquid.

Centrifugation: Is a process which involves the use of the centrifugal force for the sedimentation of heterogeneous mixtures with a centrifuge, used in industry and in laboratory settings. This process is used to separate two immiscible liquids.

More-dense components of the mixture migrate away from the axis of the centrifuge, while less-dense components of the mixture migrate towards the axis. Chemists and biologists may increase the effective gravitational force on a test tube so as to more rapidly and completely cause the precipitate ("pellet") to gather on the bottom of the tube. The remaining solution is properly called the "supernatant liquid".

The rate of centrifugation is specified by the angular velocity measured in revolutions per minute (RPM).

Types of centrifuge :

1. Microcentrifuges (capillary)

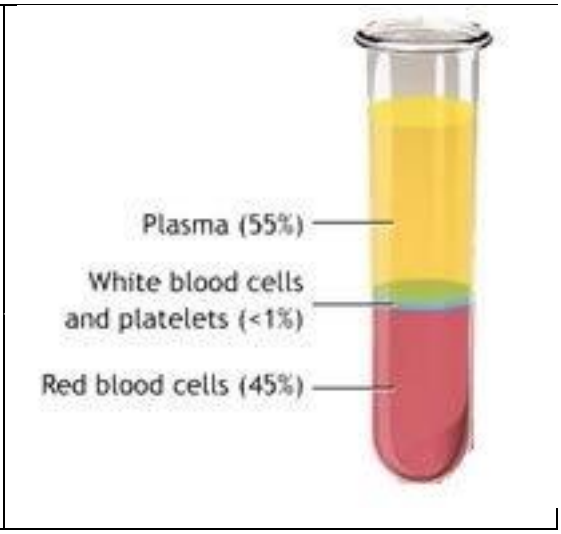
Are used to process small volumes of biological molecules, cells, or nuclei. Microcentrifuge tubes generally hold 0.5 - 2.0 mL of liquid, and are spun at maximum angular speeds of 12,000–13,000 rpm.

2. Clinical centrifuges

Moderate-speed devices used for clinical applications, like blood collection tubes. Clinical centrifuge tubes generally hold few of milliliters of liquid, and the range of speeds from 300-16.000 rpm.

3. High-speed or superspeed centrifuges

Can handle larger sample volumes, from a few tens of milliliters to several liters. Additionally, larger centrifuges can also reach higher angular velocities (around 30,000 rpm).

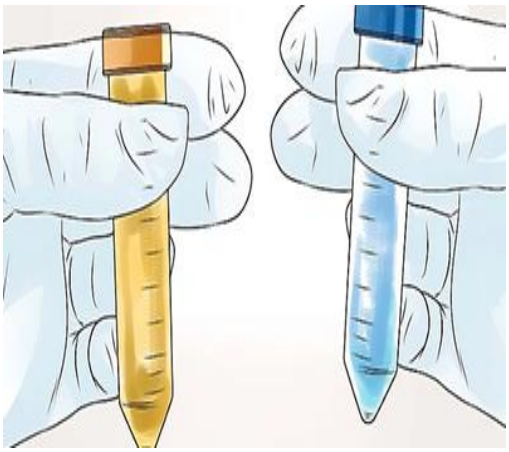


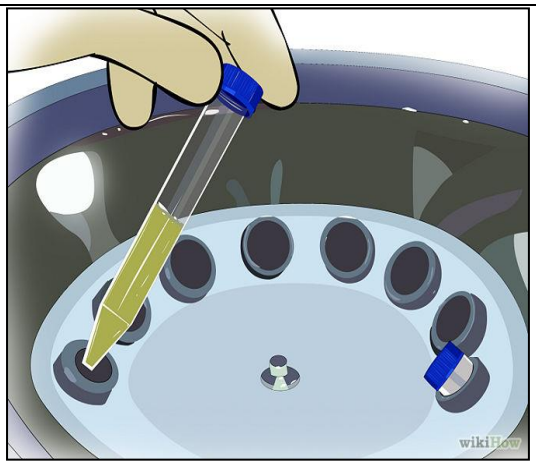
4. Ultracentrifugation

Use high centrifugal force for studying properties of biological particles. Ultracentrifuges can isolate much smaller particles, including ribosomes, proteins, and viruses. Ultracentrifuges can also be used in the study of membrane fractionation. This occurs because ultracentrifuges can reach maximum angular velocities in excess of 70,000 rpm.

5. Cold centrifuge

Cooling is important added feature to any laboratory centrifuge, temperature ranges as wide as (-20C° - 40C°), making them perfect for DNA, RNA, PCR or antibody analysis. Cold centrifuge can obtain rotational speeds of over 30,000 rpm, and a relative centrifugal force (RCF) of over $65000 \times g$. These centrifugation systems utilize centrifuge tips and tubes or well-plates for use in a number of applications.

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(Centrifuge tubes)

Centrifuge tubes are used to contain liquids during centrifugation, which separates the sample into its components by rapidly rotating it around a fixed axis.

Most centrifuge tubes have conical bottoms, which help collect any solid or heavier parts of the sample being centrifuged. Centrifuge tubes must also be able to withstand the centrifugal pressure created during their use, and their specifications may indicate the maximum speed at which they can be safely used.

Centrifuge tubes are available in various styles, sizes, and materials

- Capacities: Range from 0.1mL to more than 100mL; the most common sizes are 15mL and 50mL (centrifuge) and 1mL and 2mL (microcentrifuge)

- Closures: Screw-on plugged or flat caps; may be attached or separate
- Markings: May have writing areas, graduations, or other markings
- Shape: Conical- or round-bottomed; if conical, choose skirted free-standing versions
- Material: Glass or plastic resin; the latter include **polypropylene**, polystyrene, PET, and **PPCO**
- Sterility: Sterile or nonsterile; may be heat- or gas-sterilized
- Packaging: Bulk or racked tubes
- Color: Choose amber or black plastics for light-sensitive samples

Sterilization

Sterilization is defined as the process where all the living microorganisms, including bacterial spores are killed. Sterilization can be achieved by physical, chemical and physiochemical means. Chemicals used as sterilizing agents are called chemosterilants.

Sunlight: The microbicidal activity of sunlight is mainly due to the presence of ultra violet rays in it. It is responsible for spontaneous sterilization in natural conditions.

Heat: Heat is considered to be most reliable method of sterilization of articles that can withstand heat. Heat acts by oxidative effects as well as denaturation and coagulation of proteins.

- **DRY HEAT**

Dry oven: It is used for sterilization of glassware's, such as test tube, pipettes and petri dishes. Such dry sterilization is done only for glassware's. Liquid substance, such as prepared media and saline solutions cannot be sterilized in oven, as they lose water due to evaporation. They are dried inside the drying oven at 100˚C till the glassware's dry up completely.

Bunsen burner: A Bunsen burner is a common piece of laboratory equipment. It is commonly used for heating chemical substances, sterilization, and combustion. It works by burning flammable gas.

Red heat: Articles such as bacteriological loops, straight wires, tips of forceps and

searing spatulas are sterilized by holding them in Bunsen flame till they become red hot.

Flaming: This is a method of passing the article over a Bunsen flame, but not heating it to redness. Articles such as scalpels, mouth of test tubes, flasks, glass slides and cover slips are passed through the flame a few times.

❖ MOIST HEAT

Moist heat acts by coagulation and denaturation of proteins

Water bath: A laboratory water bath is used to heat samples in the lab. Some applications include maintaining cell lines or heating flammable chemicals that might combust if exposed to open flame. A water bath generally consists of a heating unit, a stainless steel chamber that holds the water and samples, and a control interface. Different types of water baths offer additional functionality such as a circulating water bath that keep a more even temperature or a shaking water bath that keeps the samples in motion while they are heated.

Boiling: Boiling water (100°C) kills most vegetative bacteria and viruses immediately. Certain bacterial toxins are heat resistant. Some bacterial spores are resistant to boiling and survive.

Autoclave: (pressure –steam sterilizer) is the essence of a microbiology laboratory. It is used not only to sterilize liquid substance such as prepared media and saline (diluents) solution, but also to sterilize glassware's, when required.

Sterilization can be effectively achieved at a temperature above 100^{o}C using an autoclave. Water boils at 100^{o}C at atmospheric pressure, but if pressure is raised, the temperature at which the water boils also increases.

Autoclave device

Glucometer

Need of Glucose

Glucose is essential for cell respiration, used as a source of energy in cells through aerobic and anaerobic respiration. Glucose plays important role in various metabolic functions in the body. So Glucose level must be maintained periodically.

There are 3 types of Diabetes

Type 1 Diabetes: Is caused by an autoimmune reaction, where the body's defense system attacks the insulin- producing beta cells in the pancreas. As a result, the body can no longer produce the insulin it needs. Without insulin, a person with type 1 diabetes will die.

Type 2 Diabetes: The body is able to produce insulin but either this is not sufficient or the body is unable to respond to its effects (also known as insulin resistance), leading to a build-up of glucose in the blood.

Gestational Diabetes: Is when women develop a resistance to insulin and subsequent high blood glucose during pregnancy.

Glucometer

Glucose meter is a medical device for determining approximate concentration of glucose in the blood. Key Element of Home Based Glucose Monitoring.

Some key characteristics of the device

 The device is almost a palm sized one.
 It works on battery so that the device is a portable 0.3 to 1 microliter of blood is enough for the test. The test strips contain chemicals that react with the glucose in the blood.
 Result is displayed in mg/dl[US, France, Japan, India] & in mmol/dl [Canada, Australia, China, UK] Germany uses both units.

Blood Sugar Monitoring: When to Check

Steps of handle

 Requirements: Glucometer, Test Strips, Lancet
 Get the requirements in ready condition.
 Wash hands to prevent infection.
 Decide where you are getting the blood Fingers, Forearms, Less sensitive areas.
 Warm Hands for faster flow of blood.
 Fix the strip in the glucometer and when it is ready pierce the fingertip and a get a drop of hanging blood.
 The results are displayed in approx. 40 seconds.

Benefits

 Patients with “Type 1” diabetes and “Type 2” diabetes are in a need to test their sugar level several times a day which is made simple using glucometer.
 Patients suffering immediate raise or sudden down of glucose level could check immediately their glucose level and consult a doctor.
 Memory chips in it store the details about each test done
 This device is more accurate in figuring the results compared to the Lab Tests results.

Incubator

In biology, incubator is a device used to grow and maintain microbiological or cell cultures. The incubator maintains optimal temperature, humidity and other conditions such as the carbon dioxide (CO_2) and oxygen.

Incubators are essential for a lot of experimental work in cell biology, microbiology and molecular biology and are used to culture both bacterial as well as eukaryotic cells.

Types and Size

Types and size abound, the sizes ranging from small incubator to room size.

The simplest incubators are isolate boxes, typically going up to (60 to 65 °C) but some can go slightly higher (generally to no more the 100 °C). Most commonly used temperature both for bacteria such as the frequently used E.coli as well as for mammalian cells is approximately (37°C), as these organisms grow well under such conditions. For other organisms used in biological experiments, such as the budding yeast *Saccharomyces cerevisiae*, a growth temperature of (30°C) is optimal.

Functions

Laboratory incubator provide a controlled contaminant-free environment for safe, reliable work with cell and tissue cultures by regulating conditions such as temperature, humidity, and CO_2. Microbiological incubators are used for the growth and storage of bacterial cultures. Laboratory incubators are essential for cell and tissue culture, biochemical and food analysis.

Incubators are also used in the poultry industry to act as a replace for hens. This often results in higher hatch rates due to the ability to control both temperature and humidity.

The incubators parts

Consist of a cub shaped body with a double wall containing isolating material to keep the temperature as long as possible.

1. The external structure: it takes one of the geometric shapes (mostly rectangular) and its function to carry and protect the internal parts.
2. The internal body: it is of metal, such as Stainless Steel and carries the internal parts of the incubator and within the dishes are placed bacteria farms and the possibility of laying metal shelves if necessary.
3. Door: it has two doors (the first internal) and is transparent glass, which is to see what is inside the incubator without opening the incubator each time. The second (external) is of the same type of metal made from the outer structure with a handle and a calf for sealing.
4. Temperature incubator: it is (a meter or thermometer) to show the temperature inside the incubator room.
5. Thermostat: it is the means of controlling the temperature inside the incubator.
6. Unplug switch: it is to open and close the circuit and connector directly.
7. Light bulb: a red light indicates the presence of current.

Biological Safety Cabinets

Biological safety cabinets or (BSCs) are an enclosed, ventilated hood or workspace that allow for the safe handling of pathogens, contaminants or other potentially hazardous materials.
This type of equipment is also referred to as biosafety cabinets or microbiological safety cabinets. When outfitted with glove systems (in the case of Class III biosafety cabinets), they are also called gloveboxes. There are various classes of biological safety cabinets, each defined by the required level of biosafety.

Functions of Microbiology Safety Cabinets

A biological safety cabinet (BSC) is a primary engineering control used to protect personnel against biohazards or infectious agents and to help maintain quality control of the material being worked with as it filters both the inflow and exhaust air

Purpose:

The primary purpose of a BSC is to serve as a means to protect the laboratory worker and the surrounding environment from pathogens. All exhaust air is HEPA-filtered as it exits the biosafety cabinet, removing harmful bacteria and viruses. This is in contrast to a laminar flow clean bench, which blows unfiltered exhaust air towards the user and is not safe for work with pathogenic agents.

Classes :

The U.S. Centers for Disease Control and Prevention (CDC) classifies BSCs into three classes. These classes and the types of BSCs within them are distinguished in two ways: the level of personnel and environmental protection provided and the level of product protection provided

Class I

provides personnel and environmental protection, but no product protection. It is similar in air movement to a chemical fume hood, but usually has a limited fixed work access opening and the exhaust air must be HEPA filtered, to protect the environment.(Airflow recirculated 0% , Airflow exhaust 100%)

Class II :

A Class II cabinet is defined as a ventilated cabinet for personnel, product and environmental protection for microbiological work or sterile pharmacy compounding.

Contain Four types of class III

1.A1 (Airflow recirculated 70% , Air flow exhaust 30%)
2. A2 (Air flow recirculated 70% , Air flow exhaust 30%).
3. B1 (Air flow recirculated 30% , Air flow exhaust 70%) .
4. B2 (Air flow recirculated 0% , Air flow exhaust 100%).

Class III :

Generally only installed in maximum containment laboratories, is specifically designed for work with BSL-4 pathogenic agents, providing maximum protection. The enclosure is gas-tight, and all materials enter and leave through a dunk tank or double-door autoclave. Gloves attached to the front prevent direct contact with hazardous materials (Class III cabinets are sometimes called glove boxes). These custom-built cabinets often attach into a line, and the lab equipment installed inside is usually custom-built as well.

Maintenance and service

Cabinets need to be maintained on a regular schedule. During this check, the airflow and the filter capacities are controlled. The filters have a limited lifespan. Depending on the laboratory environment and the type of samples used, the filter air flow-through is reduced over time. Newer cabinets measure the air flow-through constantly. If the flow-through is too low, there will be an audial and visual alarm. Changing the filter should be limited to trained persons as the filter is potentially contaminated and a "bag-in/bag-out" procedure needs to be followed. When an UV light is used, this lamp should be checked and changed as well. UV lights decrease in power over time, resulting in suboptimal disinfection of the working area.

Spectrophotometer

Device used to study how the chemical compounds interacts with different wave lengths in a given region of electromagnetic radiation.

Spectrophotometry: Quantitative measurement of the reflection or transmission properties of a material as a function of wavelength. Spectrophotometry deals with visible light, near- ultraviolet, and near-infrared.

Techniques of Spectrophotometry include devices:

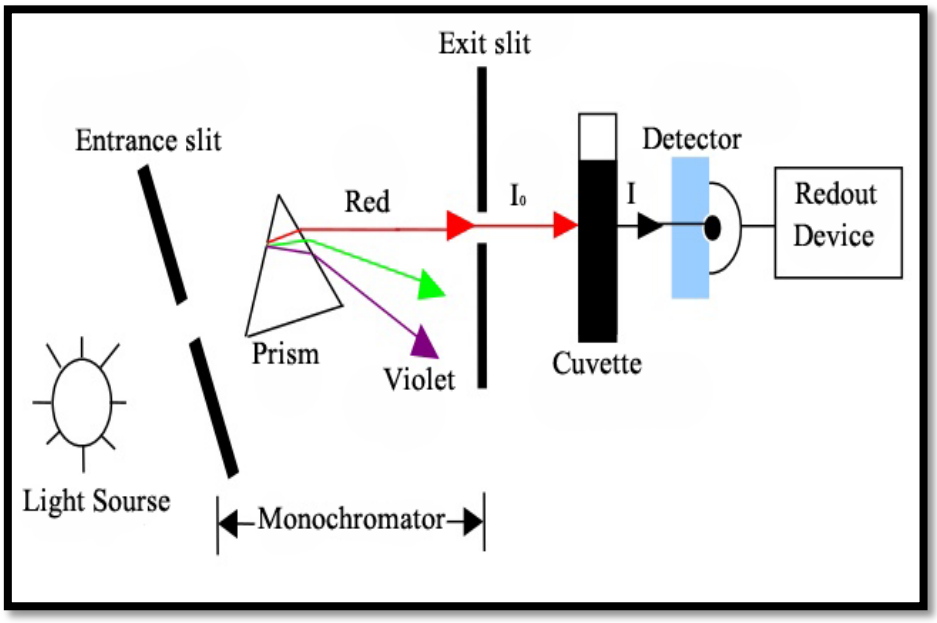
1. visible device
2. UV- visible device
3. Visible -near IR

Spectrophotometer: A device that is used to measure intensity of light as a function of the wavelength. It is include combination of two devices: *a spectrometer and a photometer*.

Spectrometer: for producing light of any selected wavelength or colour.

Photometer: used for measuring the intensity of light.

The two devices (Photometer & Spectrometer) are placed at the either side of a cuvette filled with a liquid.



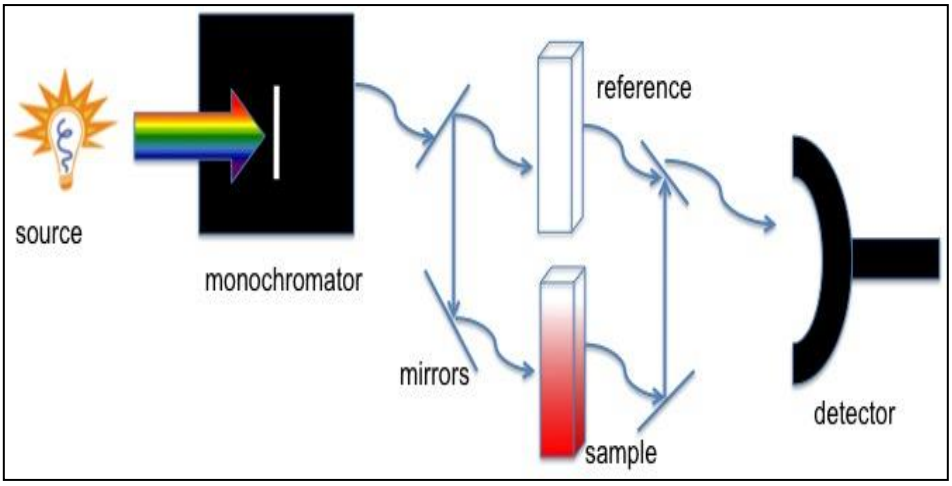
In a spectrophotometer device (visible), a light source gives off white light which strikes a prism, separating the light into its component wavelengths. Thus, light waves can be separated by frequency.

Types of spectrophotometer

There are two major classes of devices:

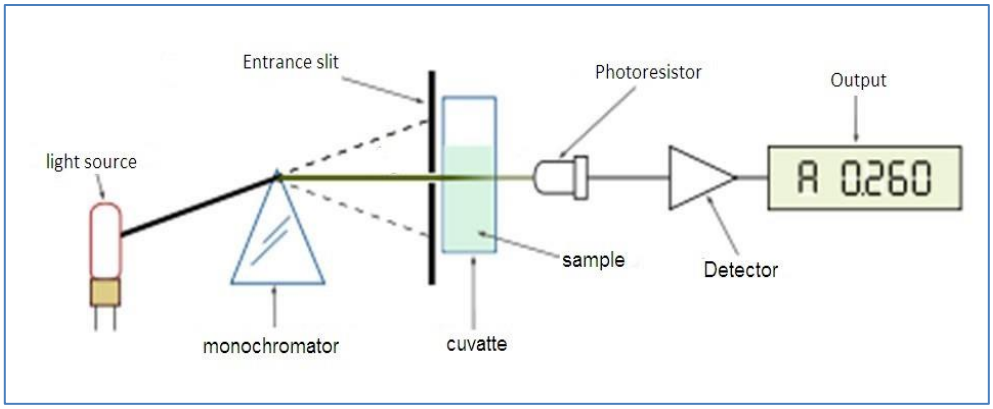
1. Double beam device

Compares the light intensity between two light paths, one path containing a reference sample and the other the test sample.



2. Single beam device

Measures the relative light beam intensity of the before and after a test sample is inserted.

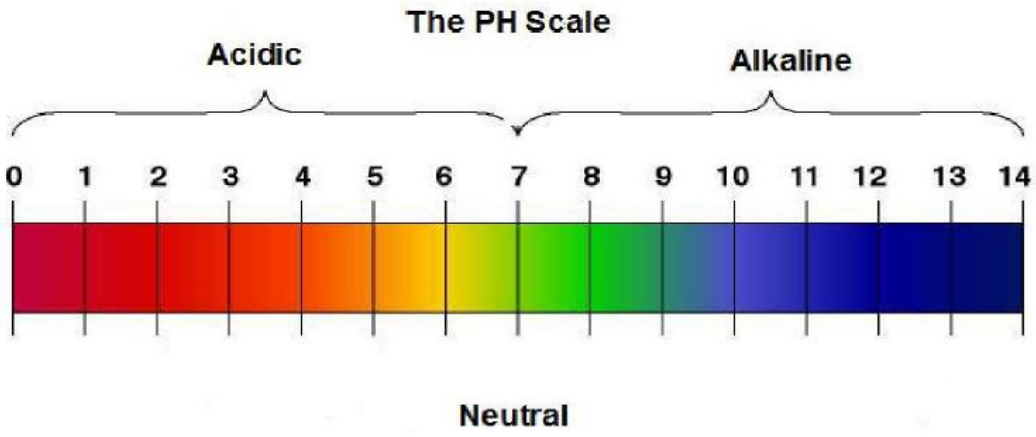


Components of Spectrophotometer

1. Light source
2. Monochromator
3. Sample containers (Cuvette)
4. Detector
5. Output : Signal processor and read out

pH meter

pH: is a unit of measure which describes the degree of acidity or alkalinity of a solution.



pH meter: An electronic device that measures the H+ ion concentration (pH: acidity or alkalinity) of a solution using an ion sensitive electrode.

Types of pH meter

Manual pH meter
Digital pH meter

Manual pH meter

Digital pH meter

Construction of a pH meter

A pH measurement system consists of two parts: an input meter and a probe, which itself is made up of two electrodes.
This probe passes electrical signals to a meter which displays the reading in pH units. The glass probe has two electrodes because one is a glass sensor electrode and the other is a reference electrode.

Calibrating a pH Meter

- 2 point calibration
- Multi point calibration

Make sure the meter is in pH mode. For a 3 point calibration, use high pH (10), pH 7.0 and low pH (4.0) solution. Before calibration, rinse probe thoroughly with deionized

water. Immerse the end of the probe completely in the calibration solution. Stir the probe gently to create a homogenous sample.

Measuring the pH of a Solution

Always rinse electrodes with de-ionized water prior to placing in a solution for pH measurement. Allow meter to stabilize for 30 seconds or a minute and then read. Remove electrodes and rinse with de-ionized solution.

Storage conditions

The pH bulb should always be stored wet preferably in pH 3.0 buffer solution. Other buffers or acidified tap water can be used for storage.

TYPES OF BLOOD SAMPLES

1. Whole Blood
A blood sample that is drawn and mixed immediately with an anticoagulant to maintain the integrity of the blood cells and prevent clotting, allowing whole blood analysis to be accurate. The blood remains in liquid state.

2. Serum
The liquid portion of blood that has been allowed to clot. The clotting factors are bound in the clot. (Blood collected in a tube with no additive will clot within 15-45 minutes. One 10 ml tube of whole blood will yield about 3-4 ml of serum. This is the only tube that should not be inverted).

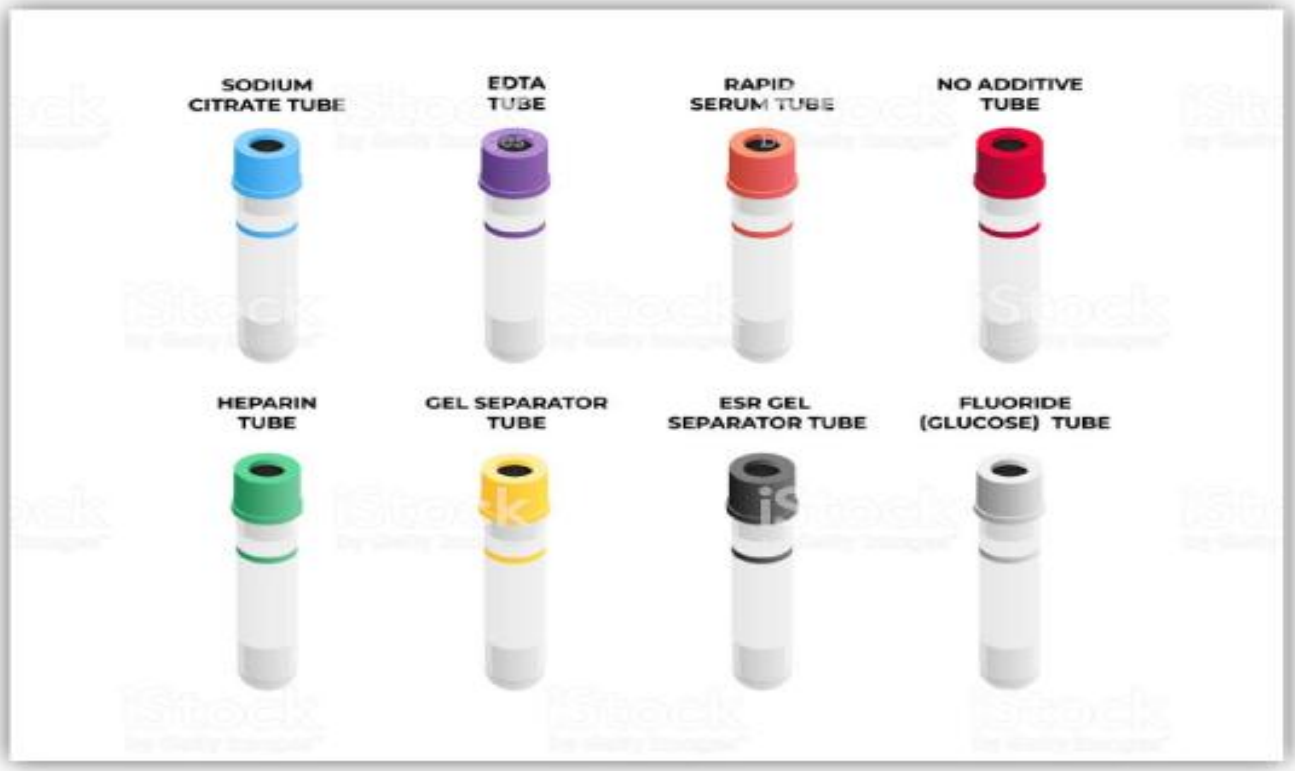
3. Plasma
The liquid portion of blood that has not been allowed to clot. Usually, formed when freshly drawn blood is mixed with anticoagulants. The clotting factors are present in the plasma. This sample is mixed 6-8 times and immediately centrifuged and plasma removed.

TYPES OF TEST TUBES

1. Red Stopper Tube
Additive: Clot Activator (powdered glass).
Specimen Type: Serum.
Laboratory Uses: For serum determinations in chemistry, serology and blood bank testing.

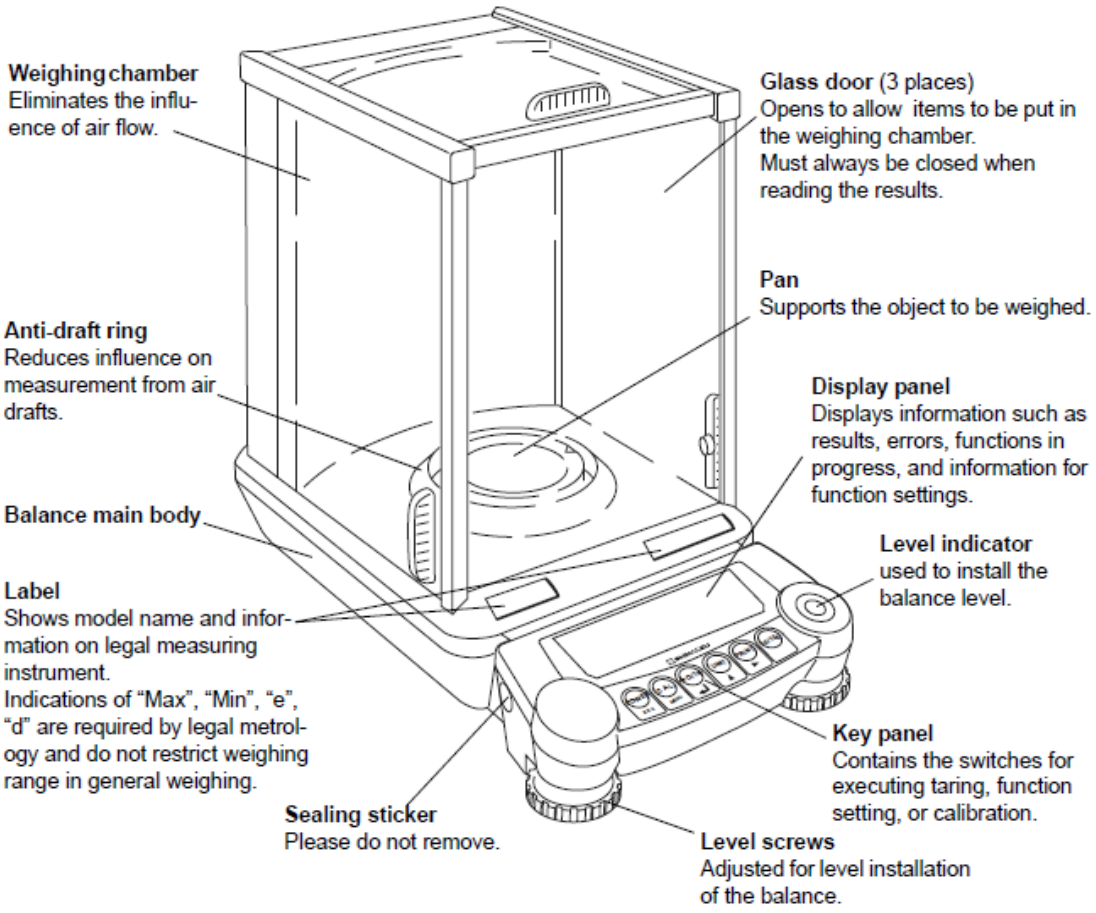
2. Yellow Stopper Tube
Additive: Polymer gel and clot activator.
Specimen Type: Serum.
Laboratory Uses: For chemical testing or infectious disease testing.
3. Green Stopper Tube
Additive: Sodium Heparin.
Specimen Type: Whole Blood, Plasma.
Laboratory Uses: For plasma determinations in chemistry, cytogenetic.
4. Lavender Stopper Tube
Additive: EDTA-K2.
Specimen Type: Whole Blood, Plasma.
Laboratory Uses: hematology, HbA1C, RNAquantization determinations and for blood
bank testing.
5. Light Blue Stopper Tube
Additive: Sodium Citrate (3.2%, 0.109M).
Specimen Type: Whole Blood, Plasma.
Laboratory Uses: For coagulation determinations of plasma specimens.
6. Gray Stopper Tube
Additive: Sodium fluoride/Potassium oxalate.
Specimen Type: Whole Blood, Plasma.
Laboratory Uses: For glucose, toxicology determinations.

7. Black Stopper Tube
Additive: Sodium citrate (buffered).
Specimen Type: Whole Blood, Plasma.
Laboratory Uses: Erythrocyte Sedimentation Rate (ESR) test.
Types of test tubes



Types of test tubes

Analytical balance



An **analytical balance** (often called a "lab balance") is a class of balance designed to measure small mass in the sub-milligram range. The measuring pan of an analytical balance (0.1 mg or better) is inside a transparent enclosure with doors so that dust does not collect and so any air currents in the room do not affect the balance's operation.

Steps of weighting samples

1. Open one of the glass doors of the weighting chamber. Place the weighing container on the pan, and close the glass door again.
2. Wait for the display to stabilize and press tare key. The appearance of the stability mark (➡) indicates a stable state. The display will read Zero.

3. Open the glass door. Place the item to be weighed in the weighing vessel and close the glass door.
4. After the display stabilizes, read the display.

Types of orders

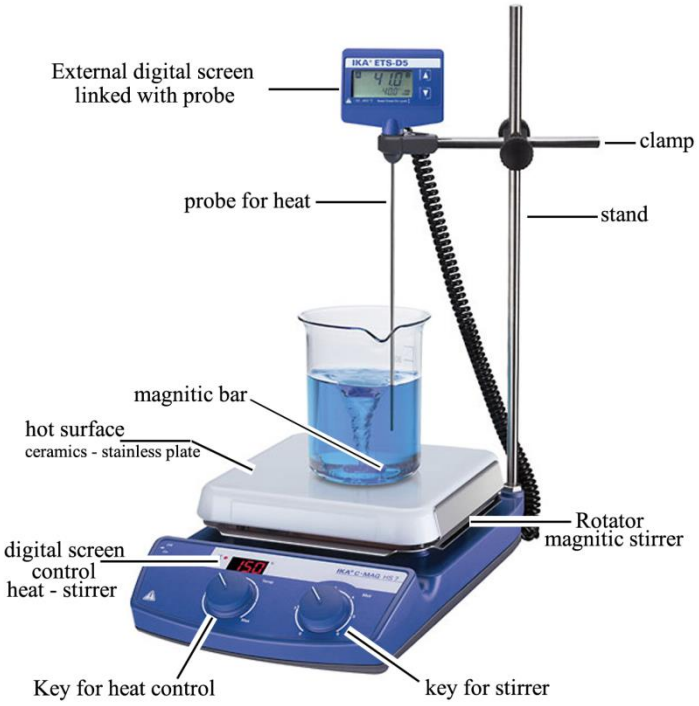
Numeric Decimal	Fractions
0.1 g	**1/10 g**
0.01 g	**1/100 g**
0.001 g	**1/1000 g**
0.0001 g	**1/10000 g (1/10 mg)**
0.00001 g	**1/100000 g (1/100 mg)**

Hotplate device

A hotplate: The variable-temperature hot plate is a very versatile heating unit. The main advantage of using a hot plate is that it provides a flameless variable-temperature heat from a flat surface, so no additional support is normally required when using a flat-bottomed flask.

Hotplate stirrer device

Magnetic stirring is the method of choice if an extended period of continuous agitation is required, since it is easy to set up the apparatus; particularly for small scale set-ups or closed systems.



Heating mantle device

A heating mantle: A heating mantle is a specialized kind of heating device designed to be used only with round-bottomed flasks when liquids are being heated under reflux or are being distilled. There are different heating mantles for each size of flask.