9

Based on Latest CBSE Syllabus

LIVING SCIENCE
LAB MANUAL

With Practical Skills

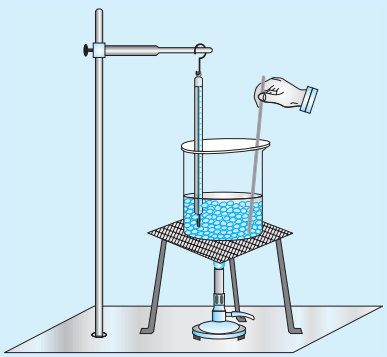
Ratna Sagar

Based on the latest CBSE syllabus and guidelines

LIVING SCIENCE LAB MANUAL

With Practical Skills

9



HITI MAHINDROO

Ratna Sagar

ABOUT THE AUTHOR

Hiti Mahindroo completed BSc (Physics Hons) and MSc (Physics) from the Physics Honours School, Panjab University, Chandigarh in 1972. She has taught Physics for many years, both at college and high school levels, and Science at middle school level.

First published 2012
Eighth reprint 2017 (March)

ISBN 978-93-5036-151-1

Ratna Sagar P. Ltd.

an ISO 9001:2015 and 14001:2015 company

Virat Bhavan, Commercial Complex, Mukherjee Nagar, Delhi 110009
PHONE: (011) 47038000 ◆ Fax: (011) 47038099
rsagar@ratnasagar.com ◆ ratnasagar.com ◆ ratnasagar.co.in
SHOWROOM: 4808/24 Bharat Ram Road, Darya Ganj, New Delhi 110002
PHONE: (011) 43028000 ◆ Fax: (011) 45166099

BRANCHES: Chennai ◆ Lucknow
OFFICES: Agra ◆ Ahmadabad ◆ Bengaluru ◆ Bhopal ◆ Coimbatore ◆ Dehradun
Guwahati ◆ Hyderabad ◆ Jaipur ◆ Jalandhar ◆ Kanpur ◆ Kochi ◆ Kolkata
Madurai ◆ Mumbai ◆ Patna ◆ Ranchi ◆ Varanasi

Contents

In the Lab 5

1. **Food Adulteration** 15

Experiment 1A: To test the presence of starch in the given food sample.

Experiment 1B: To test the presence of the adulterant metanil yellow in *dal*.

2. **True Solutions, Suspensions and Colloids** 21

Experiment 2A: To5 prepare a true solution of common salt, sugar and alum in water.

Experiment 2B: To prepare suspensions of soil, chalk powder and fine sand separately in water.

Experiment 2C: To prepare a colloidal of starch in water and egg albumin in water.

Experiment 2D: To distinguish between a true solution, a suspension and a colloidal solution on the basis of transparency.

Experiment 2E: To distinguish between a true solution, a suspension and a colloidal solution on the basis of filtration criterion.

Experiment 2F: To distinguish between a true solution, a suspension and a colloidal solution on the basis of stability.

3. **Mixtures and Compounds** 32

Experiment 3: 1. To prepare a. a mixture and b. a compound, using iron filings and sulphur powder. 2. To distinguish between the mixture and the compound on the basis of a. appearance, i.e. homogeneity and heterogeneity. b. behaviour towards a magnet. c. behaviour towards carbon disulphide as a solvent. d. effect of heat.

4. **Physical and Chemical Changes** 40

Experiment 4A: To study the reaction that takes place between iron and copper sulphate solution in water and to identify the type of change.

Experiment 4B: To study the reaction when magnesium ribbon is burnt in air and to identify the type of change.

Experiment 4C: To study the reaction between zinc and dilute sulphuric acid and to classify the type of change.

Experiment 4D: To study the changes when copper sulphate pentahydrate crystals are heated, and to identify the types of changes that occur.

Experiment 4E: To study the reaction between the aqueous solutions of sodium sulphate and barium chloride and to identify the type of change.

5. **Temporary Mounts Preparation** 55

Experiment 5A: To prepare a stained temporary mount of an onion peel and to record observations and draw labelled diagrams.

Experiment 5B: To prepare a stained temporary mount of human cheek cells and to record observations and draw labelled diagrams.

6. **Tissues in Plants and Animals** 63

Experiment 6A: To identify parenchyma and sclerenchyma tissues in plants from prepared slides and draw their labelled diagrams.

Experiment 6B: To identify striped muscle fibres and nerve cells in animals from prepared slides and draw their diagrams.

7. **Separation of Components of a Mixture** 73

Experiment 7: To separate the components of a mixture of sand, common salt and ammonium chloride (or camphor) by sublimation.

8. **Melting Point and Boiling Point of a Substance** 81
Experiment 8A: To determine the melting point of ice.
Experiment 8B: To determine the boiling point of water.

9. **Frictional Force** 90
Experiment 9: To establish relationship between weight of a rectangular wooden block lying on a horizontal table and the minimum force required to just move it using a spring balance.

10. **Absorption of Water by Plants** 97
Experiment 10: To determine the percentage of water imbibed by raisins.

11. **Sound** 104
Experiment 11: To verify the laws of reflection of sound.

12. **Mass and Density** 112
Experiment 12: To determine the density of a solid (denser than water) by using a spring balance and measuring cylinder.

13. **Buoyancy and Archimedes' Principle** 121
Experiment 13: To establish the relation between the loss in weight of a solid when fully immersed in a. tap water b. strongly salty water with the weight of the water displaced by it, by taking at least two different solids.

14. **Thrust and Pressure** 130
Experiment 14: 1. To observe and compare the pressure exerted by a solid iron cuboid on fine sand/ wheat flour while resting on its three different faces. 2. To calculate the pressure exerted in the three different cases.

15. **Velocity of a Pulse** 137
Experiment 15A: To determine the speed of a transverse pulse propagated through a stretched string.
Experiment 15B: To determine the speed of a longitudinal pulse propagated through a stretched slinky.

16. **Kingdom Plantae** 147
Experiment 16: To study the characteristics of *Spirogyra/Agaricus*, moss/fern, *Pinus* (either with male or female cone) and an angiospermic plant. Draw and give two identifying features of groups they belong to.

17. **Adaptation in Animals** 160
Experiment 17: To observe the given pictures/charts/models of earthworm, cockroach, bony fish and bird. For each organism, draw their picture and record: 1. one specific feature of its phylum. 2. one adaptative feature with reference to its habitat.

18. **Conservation of Mass in a Chemical Reaction** 170
Experiment 18: To verify law of conservation of mass during a chemical reaction.

19. **Monocots and Dicots** 176
Experiment 19A: To study the features of seeds of monocot and dicot plants.
Experiment 19B: To compare the external features of root, stem, leaf and flower of monocot and dicot plants.

20. **Life Cycle of a Mosquito** 185
Experiment 20: To study the life cycle of a mosquito.

Test Papers 190

In the Lab

GENERAL LABORATORY FACILITIES

A science laboratory is equipped with working tables, items of common utility and space for storing equipment, chemicals and glassware.

1. The working tables in a science laboratory are usually fitted with the following:
   - Sinks with water taps for washing purposes and liquid waste disposal. Students are expected to use taps only when required and will not waste water.
   - Heating facilities provided in the form of gas taps fitted with a burner. Leakage, if any, should be immediately brought to the notice of the teacher. Also, spirit lamps can be provided.
   - Shelves for keeping bottles of chemicals and reagents of frequent use. These reagent bottles should be arranged in a definite order.
2. Equipment and glassware of common use are stored separately in a cupboard. They are generally issued to the students at the time of performing experiments.
3. Usually, instruments which are not used quite frequently, like balances and microscopes are kept permanently in a place. The type of balance used depends on how much accuracy is required of the weighing. At secondary stage, a physical balance is a good choice.

   The microscopes must be placed near the window to ensure the availability of sufficient sunlight needed.

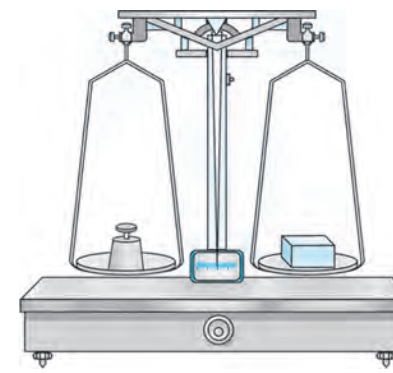


Fig. 1 A physical balance

4. Electrical connections must be provided with all working tables for performing electricity and magnetism experiments.
5. A demonstration table is necessary for teacher's demonstration.
6. For the purpose of disposal of solid waste, a dustbin may be provided either near each working table or at a common place in the laboratory.

General Laboratory Rules

The following rules should be observed by all users in a science laboratory:

1. Students must prepare in advance for the experiment they would perform in the laboratory.

2. Students must carry their practical notebook, laboratory manual, geometry box, pencil, sharpener, and eraser to the practical class regularly. They should also wear laboratory coats while working in the laboratory.
3. All equipment such as microscope, physical balance, measuring items and glassware must be handled with care after understanding their functions.
4. The labels on the reagent bottles should be read carefully to identify the reagents needed. To prevent contamination of reagents, do not dip glass rods, filter papers, droppers, etc. into the reagent bottles. Partially used materials should not be poured back into the reagent bottles. The cap/stopper should be put back on the bottle immediately after using the chemical reagent.
5. Windows and doors should be kept open.
6. Students should keep working tables clean and replace all laboratory equipment to their assigned place in the laboratory once the practical work is over.
7. Students should always wash their hands after the laboratory class.
8. Students should be acquainted with the handling of first-aid kit and fire extinguisher.
9. In case of any accident or injury or breakage of apparatus, report to the teacher immediately.

SAFETY REQUIREMENTS IN A SCIENCE LABORATORY

The following safety requirements are necessary in a science laboratory.

1. The laboratory should be well-ventilated. Provision for fuming hood or exhaust may be made in the laboratory to expel hazardous gases.
2. A first-aid box must be readily available, and the science teacher/lab assistant should be well versed with its use.
3. It is essential that every laboratory be equipped with a few fire extinguishers fixed at convenient places. Sand or dry mud should be available, (usually this is provided in buckets).
4. An *eye wash fountain* should be available in the laboratory. It is used in the case of irritation of eyes caused by chemicals and fumes.

First-Aid Treatment

A first-aid kit is an essential part of any science laboratory. In case of an accident, first-aid treatment must be provided immediately. The victim should be taken to the doctor, if required. Some common injuries caused due to accidents and their first-aid treatments are as follows:

Burns: In case of burns following treatment can be provided.

- For burns caused by steam or hot water, wash the affected part with cold running water. Do not use ice. Dry it gently with clean cloth and then apply an antiseptic ointment.
- For an acid burn, wash the wounded part with water and apply a dilute solution of sodium hydrogen carbonate. Dry gently with clean cloth and apply an antiseptic ointment.
- For an alkali burn, wash with a good amount of water to remove all the alkalis and then wash with dilute acetic acid. Dry the affected part with clean cloth and apply an antiseptic ointment.

Glass Cuts and Wounds: Carefully remove all the visible pieces of glass from the wound. Wash with cold water to remove smaller pieces of glass sticking to the wound, if any. Protect the wound from dirt and dust. Control the bleeding by pressing clean cotton or cloth on the wound. Apply an antiseptic solution/antiseptic cream. If required, take the victim to the doctor.

Eye Injuries: In case of injury to eyes, wash the eyes with cold water. Do not rub the eyes. Consult the doctor immediately.

Fires: Do not run around if clothes catch fire. Instead, lie down on the floor and roll. If a container with inflammable liquid catches fire while heating, turn off the gas burner immediately. Cover the mouth of the container with damp cloth and take it away from other reagents and chemicals. Fire extinguishers should be used if the fire goes out of control. In case of the short-circuit in electrical circuits, switch off the main switch of the electric supply and throw dry soil in the affected area. *Do not use water in case of electrical fire.*

Inhalation of Gases: If gases such as sulphur dioxide, chlorine or bromine are inhaled by anyone, take him/her into the open air immediately, and let the victim breathe deeply.

IN THE PHYSICS LABORATORY

General Precautions while doing Physics Experiments

Some special precautions should be followed while doing experiments in Physics.

1. *Percentage error* between 5% to 10% for recording observations and calculation of result is allowed. Percentage error is calculated by the formula:

   $$\text{Percentage error} = \frac{\text{Result} - \text{Standard Result}}{\text{Standard Result}} \times 100$$

2. *Error of parallax* should be avoided by placing your eye at right angle to the plane of the scale, and vertically above the point to be read.
3. *Error due to spilling* arises when a solid or liquid is added to another liquid in a hurry. To avoid this error, a solid or liquid is added to another liquid gently, so that spilling does not occur.
4. *Error due to friction* may arise if movement of an object over another surface is involved. Hence, the error due to friction should be minimised. For example, in a spring balance, the strip carrying the pointer should be lubricated, and tapped gently before use.
5. *Error due to suspension* can arise if the support from which an object is suspended moves during the oscillation of the suspended object, i.e. in the case of a simple pendulum. To avoid this error, the support should be rigid, so that time period can be measured accurately.
6. *Error due to loss of heat* may arise in heat experiments, if a hot object is not transferred quickly to a calorimeter. To avoid this error, the calorimeter should be well insulated, and its contents should be stirred well with the stirrer, and the hot object should be transferred quickly to it.
7. *Accuracy* of a measuring instrument is taken as half of its least count. *Least count* is the smallest distance that measuring instruments like scales, Vernier callipers, screw gauge, spring balance, thermometer, etc. are able to measure.
8. *Zero error* arises in a measuring instrument when its pointer, at its resting stage, does not coincide with the zero mark on the scale. To obtain the accurate value, the zero error has to be added or subtracted from the reading taken after measurement.

PLOTTING A GRAPH

A graph shows the interdependence of two physical quantities. The quantity which is made to vary at will is called an *independent variable,* whereas the quantity that varies as a result is called a *dependent variable.* A graph is either a straight line or a curve.

Uses of a graph

1. A straight line graph shows that both the variables are directly proportional to each other.
2. Elaborate mathematical calculations are not required to derive the mean value of the ratio of the two variables.
3. The probable value of the variables can be calculated from the graph, even beyond the range of observations taken.

Steps to plot a graph

1. *Choosing axes*: If all data to be plotted is positive, draw two straight lines starting from the bottom left-hand corner of the graph paper, one horizontal line (X-axis) and the other a vertical line (Y-axis). The point of intersection of the axes is called origin, and is labelled O. If data is partly negative, then the origin O is shifted towards the middle of the graph paper.
2. *Which variable on which axis:* The independent variable is plotted always on X-axis, whereas the dependent variable is plotted on Y-axis.
3. C*hoosing a suitable scale:* Choose any convenient scale to represent the variables, such that whole range of observations taken are well spread out on the whole graph paper as shown in Graph 2a). It is not necessary to take the origin from (0, 0), unless stated by the examiner.

   It is not necessary that the scales on both X and Y axes should be same. Represent the axes by drawing thick lines at right angles to each other, beginning from the bottom left-hand corner of the graph paper. Mark each with an arrowhead.
4. *Denoting the scale chosen:* On top of graph paper, write down the scale chosen for X-axis and Y-axis. Mark the scale ratio (mentioning the proper units) taken along the X-axis and Y-axis.
5. *Marking the points:* Use a sharp pencil to mark the points of intersection. Encircle each point with a small circle (O).
6. *Plotting of graph:* It is not necessary that the graph line should pass through all the marked points. The line should pass though a maximum of marked points, or it should be plotted in such a way that it passes closest to maximum points on either side of it. To plot a curve, draw a smooth freehand curve which passes through maximum number of points.

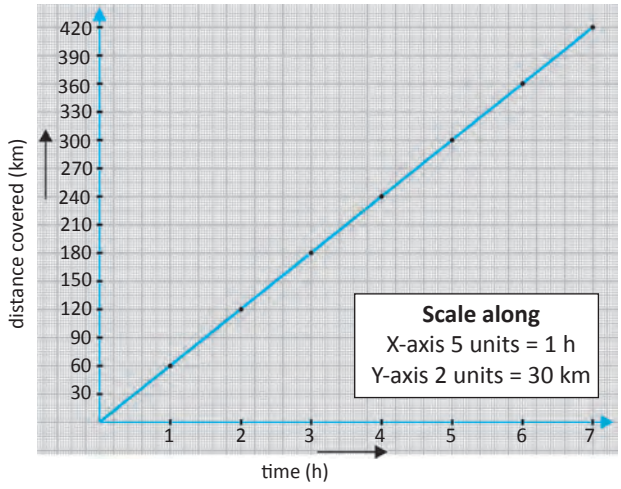


Fig. 2a Correct selection of scale for plotting the graph

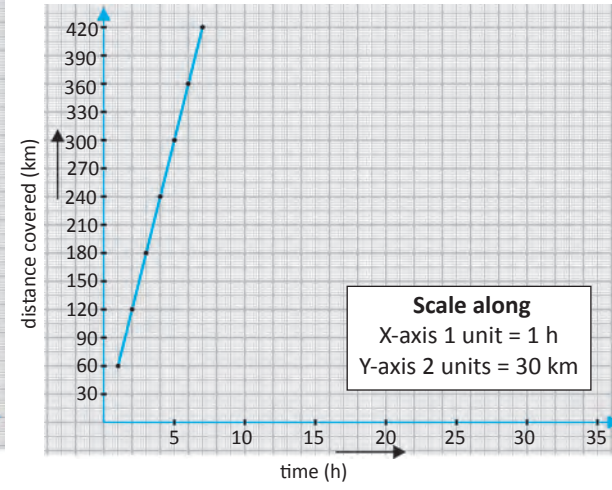


Fig. 2b Incorrect selection of scale for plotting the graph

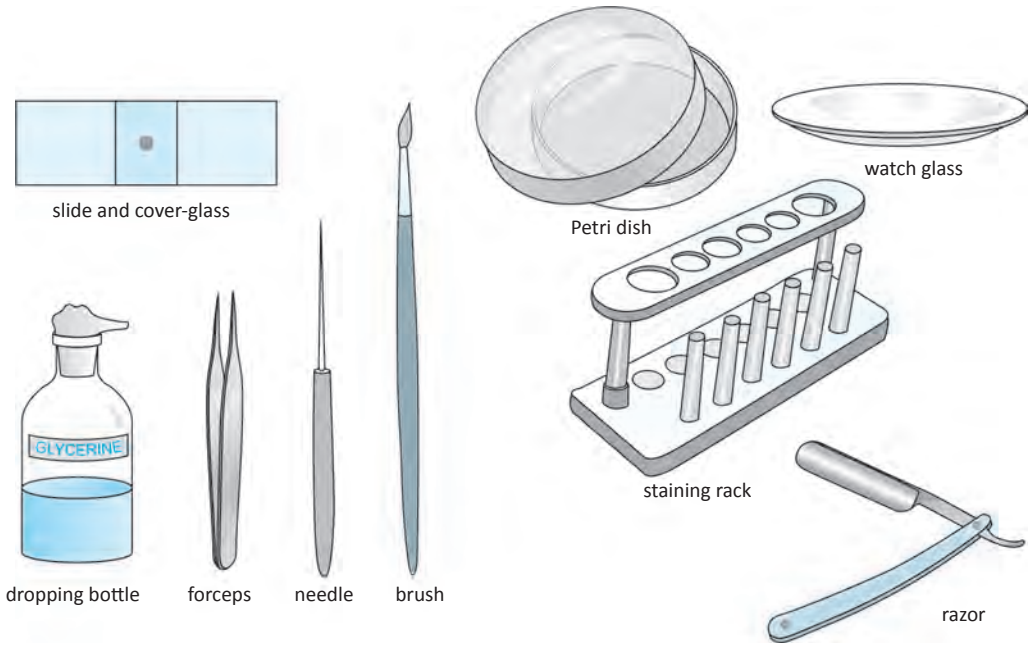


Fig. 3 Accessories used in Biology laboratory

IN THE BIOLOGY LABORATORY

A dissection box

A dissection box should always be carried by students to the Biology laboratory. It should contain a pair of small forceps, a pair of large forceps, a pair of small scissors, a pair of large scissors, a fine razor for section cutting, a scalpel, a fine needle, two fine mounted needles, a fine brush and a magnifying lens.

To Make a Temporary Wet Slide (Mount)

Steps to make a temporary wet slide are given below.

a. *Staining the specimen:* The specimen often requires staining, for better observation. Different stains such as safranin, iodine solution, methylene blue, cotton blue, etc. can be used for this purpose. Take a little stain in a watch glass. Transfer the specimen to be stained to it and allow to remain in the stain for a while. Remove the specimen from the stain and put it in another watch glass containing clean water in order to wash off extra stain.

b. *How to proceed:* Hold a clean glass slide by its edges. Find the mid-point of the slide by drawing its diagonals on a rough sketch of the slide. Point of intersection of diagonals gives the mid-point of the slide. Put a drop of a clean water in the middle of the slide. Using needle/brush/forceps, transfer the stained specimen to be mounted in the drop of water. Now, add a drop of glycerine (15% glycerine). Place the coverslip on the glass slide so that one

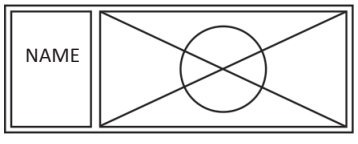


Fig. 4 How to find out the middle of the slide

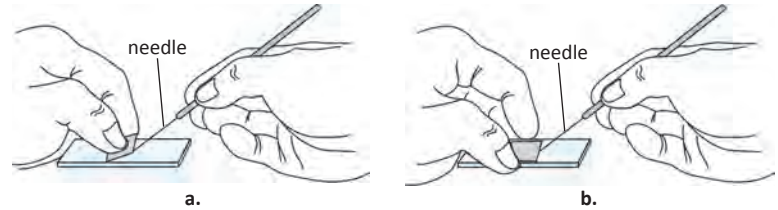


Fig. 5a and **b** How to put coverslip over the sample

of its side touches the liquid on the slide. Hold the other edge with the help of a needle held obliquely (see Fig. 5a). Now, gently lower the needle till the coverslip completely touches the slide. Cover the specimen. Remove the extra fluid from the sides of the coverslip with help of a dropper or a piece of filter paper. Now, the temporary wet mount is ready for observation under microscope.

c. *Important points for spotting*: Note the spot number and always write it down. The diagram of the spot should be correctly drawn and labelled and write important features of the specimen.

MICROSCOPE

Microscope is a sensitive instrument used to observe things in a laboratory, such as living/dead organism cells and tissues, which cannot be seen by the naked eye.

Magnifying Glass (hand lens)

The simplest type of microscope is the simple magnifying glass (hand lens). It consists of a double convex lens, fitted in a plastic/metal frame, with a handle. It is based on the principle that when an object is placed between a convex lens and its principal focus, an enlarged virtual image is formed. Ordinarily, it magnifies specimens up to 4–5 times depending upon magnification of the lens (3X, 4X, 5X, etc). *It is used to observe specimens, such as an ant, housefly, etc. which do not require higher magnification*.

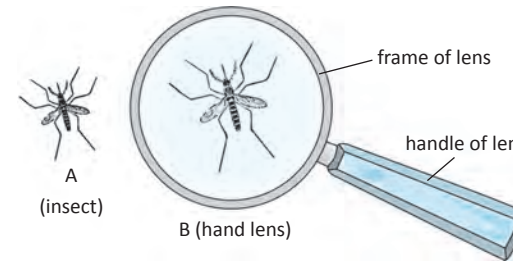


Fig. 6 Parts of a hand lens

Dissecting Microscope

A dissecting microscope has the following parts:

1. A metallic heavy *base t*o support other parts.
2. The s*tand* is a short, hollow, cylindrical metallic rod, fixed at one end with the base. It is used for holding the dissecting microscope.
3. *Vertical limb* is a short hollow cylindrical rod which fits into the hollow tube of the stand. An adjustment screw allows it to move up and down to focus an object.
4. The folded arm is a horizontal flat arm attached to the end of the vertical limb, and is used to focus an object by moving it sideways, or up and down. It has a lens fitted at the other end, which may be of magnification 5X, 10X or 20X.
5. *Stage* is a rectangular glass plate attached to the stand. It is used to place the specimen/temporary/permanent slide. It is fitted with two clips to hold the object in place.
6. *A concave mirror* is attached at the lower end of the stand, which helps in reflecting light towards the stage in order to illuminate the object.

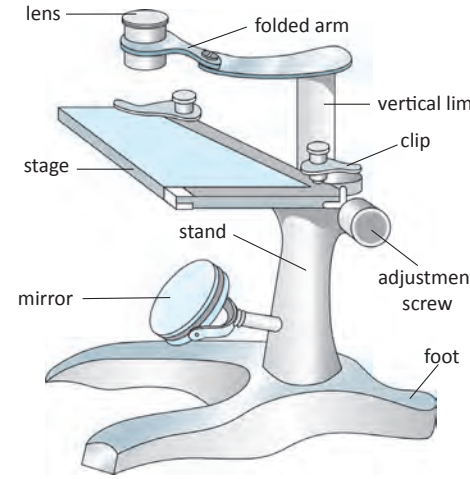


Fig. 7 Parts of a dissecting microscope

The magnification of dissecting microscope usually ranges from 5 to 50 times depending upon the power of

the lens, which is usually 5X, 10X or 20X. The dissecting microscope is used to observe small specimens such as mosquito, parts of a small flower, and small organs of specimens. You will also be able to observe different cells in a section of dicot stem.

Compound Microscope

A compound microscope consists of two lenses**,** called the objective lens and the eyepiece lens, which are placed at proper distances from each other. In a compound microscope, the object to be examined is placed in front of the objective lens, and forms a magnified image**.** This image is further magnified by the eyepiece lens and made visible to the eye.

Magnification power of a compound microscope depends upon power of objective lens and eyepiece lens. Power of a lens is expressed by the symbol X. It denotes number of times a lens magnifies an object. Generally, a compound microscope consists of eyepiece lens of 10X or 15X magnification. The objective lens are of 10X (*low power***)** and 45X (*high power*) magnification.

For *low power magnification* of compound microscope,

$$M = \text{Power of eyepiece lens} \times \text{Power of objective lens} = 10X \times 10X = 100X$$

Thus, under a low power microscope, which has eyepiece lens 10X and objective lens 10X, a specimen can be seen magnified 100 times its original size.

For *high power magnification* of compound microscope,

$$M = \text{Power of eyepiece lens} \times \text{Power of objective lens} = 10X \times 45X = 450X$$

Hence, under high power microscope, a specimen can be seen as magnified as 450 times its size.

A compound microscope consists of the following parts:

1. *Base or Foot* provides stability to the microscope and supports other parts.
2. *Limb or Pillar* is fixed to the foot with a hinge.
3. *Arm* is a curved metal piece which supports the body tube and coarse adjustment.
4. *Inclination joint,* where the arm is attached to the pillar, permits tilting of the microscope to adjust to eye level.
5. *Stage* is a rectangular flat metallic plate, fixed to the lower end of the arm. An opening in its centre admits light to illuminate the object. Two clips are provided over it to hold the slide.
6. *Diaphragm* is present below the stage of the microscope for regulating the amount of light. The diaphragm may be *disc* or *iris type.*
7. *Body tube* is a hollow tube, vertically mounted over the stage, and attached to the upper part of the arm. It can be moved up and down with the help of the screw. The body tube consists of an eyepiece, nose piece and objective lenses.
8. A *coarse adjustment screw* is provided, which can move the body tube up and down for coarse focussing of the object.
9. *Fine adjustment screw* is provided, which can move the body tube very slowly to achieve a fine and sharp focus.
10. A *mirror* is attached below the stage, at the lower end of the arm, to reflect light through the aperture/hole of the stage to the specimen slide.

Setting a Compound Microscope

1. Place the microscope gently on a working/lab table, so that the base is at least 10 cm inside the edge of the table. Keep the arms facing towards yourself.

2. Raise the body tube about 4–5 cm above the stage, by using the coarse adjustment screw.
3. Hold the nose piece and rotate it gently till the low power objective (10X) comes in line with body tube. You will hear a click when this happens. Do not rotate further after the click. Maintain this position even when changing from one objective to another.
4. Slowly, open the diaphragm of the condenser. With one eye, look through the eyepiece lens. Hold the edge of the mirror below the stage, and tilt it towards a light source. When the mirror is in proper position, the circular field in the microscope will be well illuminated.

Focussing the Compound Microscope

1. Turn the low power objective lens of the microscope into position.
2. Place the specimen on the stage, so that the specimen is directly below the objective lens.
3. By using the coarse adjustment screw, lower the body tube till the distance between the objective lens and the cover glass is about 1 mm.
4. Look through the eyepiece lens with one eye, keeping the other eye open. Using the coarse adjustment screw, raise the body tube slowly until the structure of the specimen comes into a clear view. Now, use the fine adjustment and focus to get a sharp image.

Precautions to be taken while using a microscope

1. Always keep the microscope in upright position by holding it with both the hands. Do not swing the microscope with one hand while carrying it, as the lens if loosely fitted, may fall.
2. Always clean the lens, mirror and stage of the microscope properly before use.
3. Do not touch the lens or mirror, as fingerprints may spoil the image.
4. Do not move the lens too low so that it touches the specimen or water.

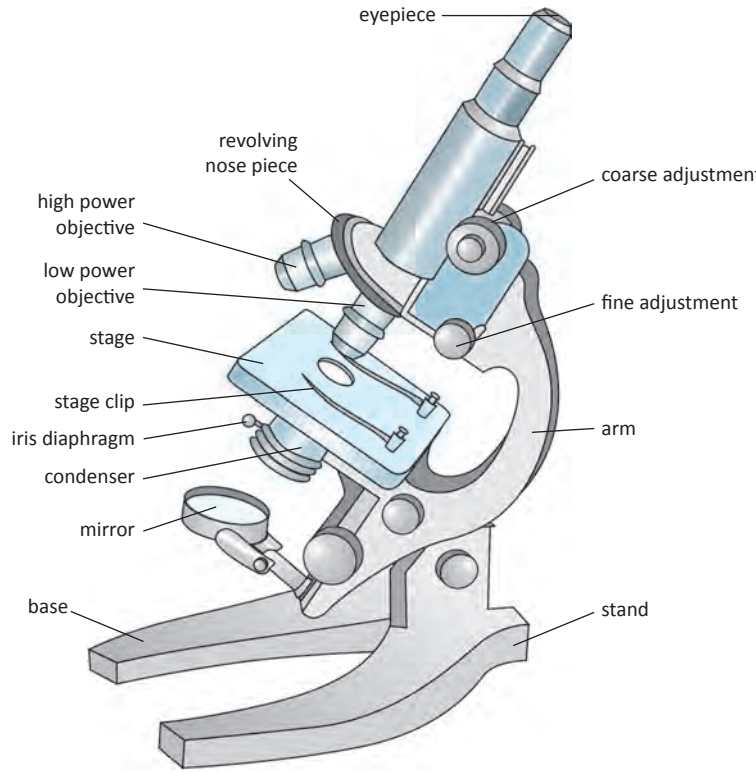


Fig. 8 Parts of a compound microscope

IN THE CHEMISTRY LABORATORY

How to clean the glass apparatus

Dirty apparatus can give wrong results in an experiment. All glass apparatus should be cleaned and dried well. Usually, a dilute solution of a common detergent is used to wash the apparatus. This should be done under running tap water. You may use bottle brushes if required. Put the apparatus upside-down to dry. Do not dry using a cloth, cotton wool, etc.

If the apparatus is very dirty, the lab assistant can prepare chromic acid solution, by dissolving 5 g of potassium dichromate in 5 mL of water, and adding to it 50 mL of sulphuric acid.

NOTE: This type of wash is done by lab assistant and not by students

Precautions to be taken in a chemistry lab

1. Keep all windows and doors open.
2. The mouth of the test tube should not be pointed towards any pupil including yourself while heating or adding a reagent.

Fig. 9 Correct method of heating a boiling tube

Fig. 10 Wafting technique to know the odour of gas

3. For smelling the vapours, fan the vapours gently with your hands towards the nose. Avoid direct smelling of chemicals or vapours.
4. Acid is diluted by adding water. Never add water to acid.
5. Do not handle chemicals with hands and do not taste any chemical.
6. Do not heat alcohol or any inflammable material directly on flame.
7. Never forcefully insert a thermometer or a glass tube through a cork.

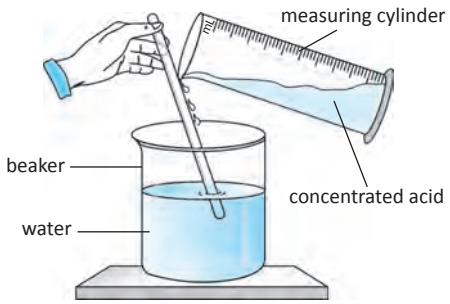


Fig. 11 Correct way of adding acid to water for dilution

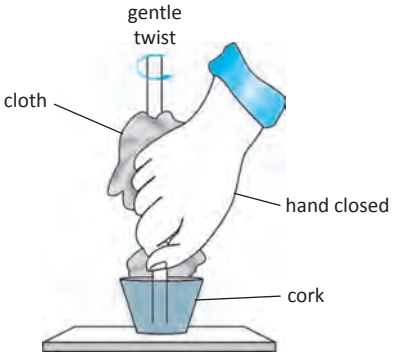


Fig. 12 Correct way of inserting a glass tube in a cork

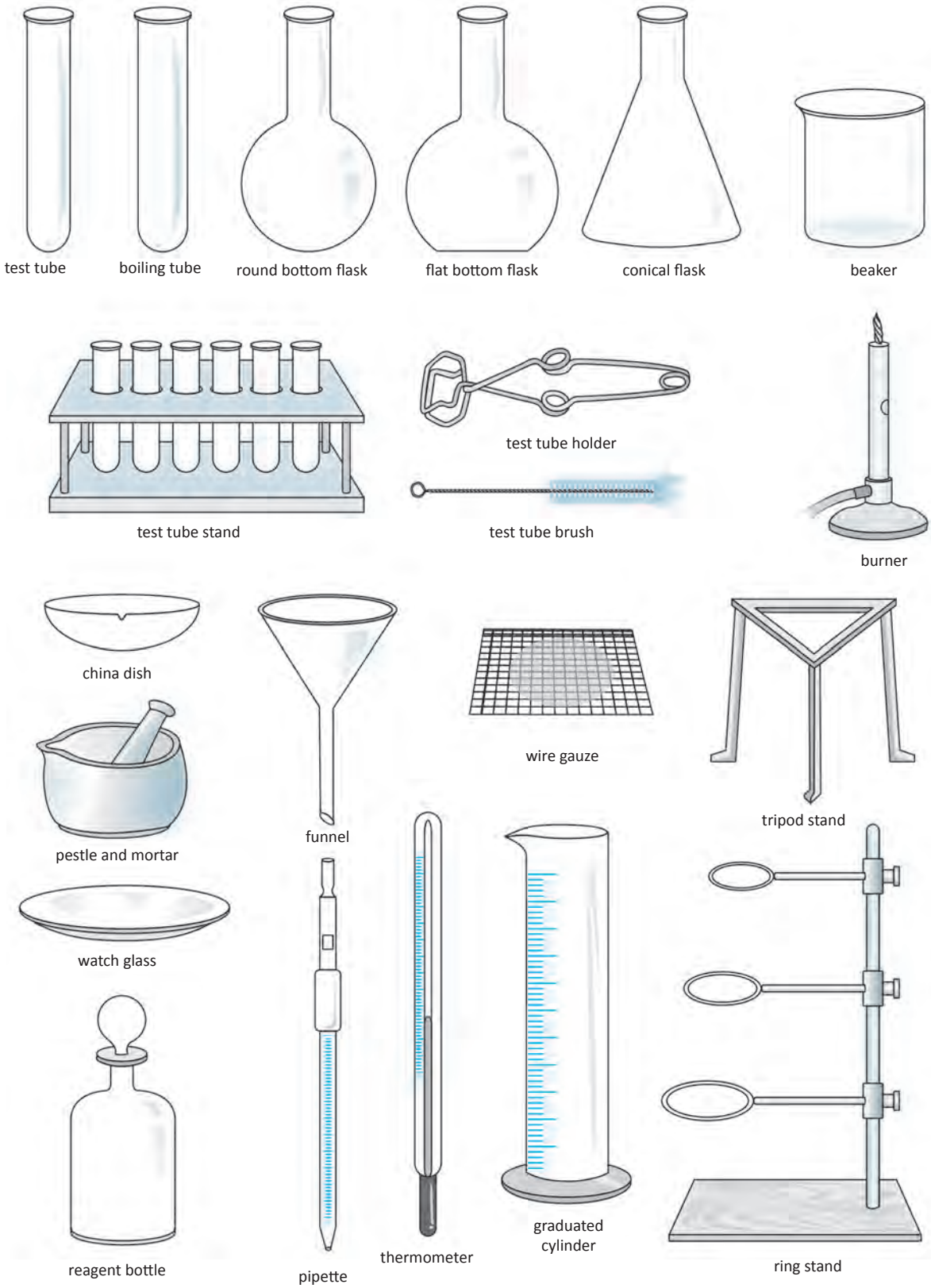
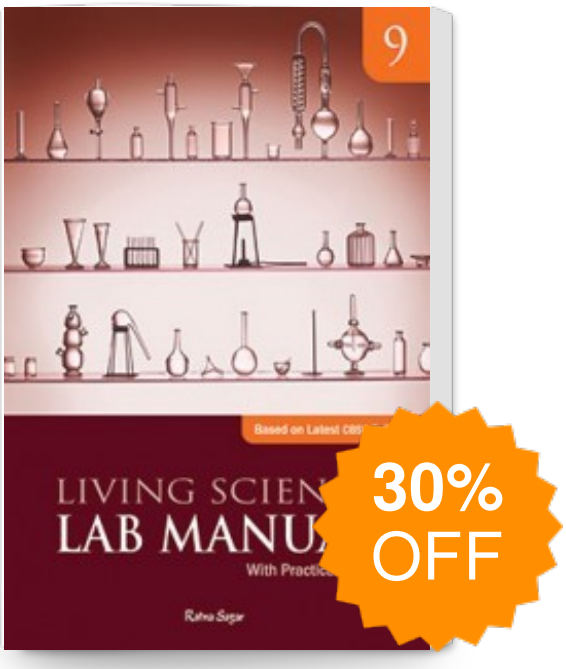


Fig. 13 Some of the common laboratory equipment and glassware

CBSE Living Science Lab Manual Class IX



Publisher : Ratna Sagar ISBN : 9789350361511 Author : Hiti Mahindroo