

Saraswati
LAB MANUAL
BIOLOGY

Strictly in accordance with the latest core syllabus

Saraswati
LAB MANUAL
BIOLOGY

For Class XI

By
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SYLLABUS

Evaluation Scheme	Maximum Marks: 30
One Major Experiment	5 Marks
One Minor Experiment	4 Marks
Slide Preparation	5 Marks
Spotting	7 Marks
Practical Record + Viva Voce	4 Marks
Project Record + Viva Voce	5 Marks
Total	30 Marks

A. List of Experiments

60 Periods

1. Study and describe three locally available common flowering plants, one from each of the families Solanaceae, Fabaceae and Liliaceae including dissection and display of floral whorls, anther and ovary to show number of chambers (floral formulae and floral diagrams). Types of root (tap and adventitious), stem (herbaceous and woody), leaf (arrangement, shapes, venation, simple and compound).
2. Preparation and study of T.S. of dicot and monocot roots and stems (primary).
3. Study of osmosis by potato osmometer.
4. Study of plasmolysis in epidermal peels (*e.g.*, *Rhoeo* leaves).
5. Study of distribution of stomata in the upper and lower surface of leaves.
6. Comparative study of the rates of transpiration in the upper and lower surface of leaves.
7. Test for the presence of sugar, starch, proteins and fats. To detect them in suitable plant and animal materials.
8. Separation of plant pigments through paper chromatography.
9. To study the rate of respiration in flower buds/leaf tissue and germinating seeds.
10. To test the presence of urea in urine.
11. To detect the presence of sugar in urine.
12. To detect the presence of albumin in urine.
13. To detect the presence of bile salts in urine.

B. Study/observation of the following (spotting)

1. Study parts of a compound microscope.
2. Study of the specimens /slides/models and identification with reasons—Bacteria, *Oscillatoria*, *Spirogyra*, *Rhizopus*, Mushroom, Yeast, Liverwort, Moss, Fern, Pines, one monocotyledonous plant and one dicotyledonous plant and one lichen.
3. Study of virtual specimens/slides/models and identification with reasons—*Amoeba*, *Hydra*, Liver fluke, *Ascaris*, leech, earthworm, prawn, silkworm, honeybee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit.
4. Study of tissues and diversity in shapes and sizes of plant and animal cells (palisade cells, guard cells, parenchyma, collenchyma, sclerenchyma, xylem, phloem, squamous epithelium, muscle fibres and mammalian blood smear) through temporary/permanent slides.
5. Study of mitosis in onion root tip cells and animal cells (grasshopper) from permanent slides.
6. Study of different modifications in root, stem and leaves.
7. Study and identification of different types of inflorescences (cymose and racemose).
8. Study of imbibition in seeds/raisins.
9. Observation and comments of the experimental set-up for showing:
 - (a) Anaerobic respiration
 - (b) Phototropism
 - (c) Effect of apical bud removal
 - (d) Suction due to transpiration
10. Study of human skeleton and different types of joints with the help of virtual images/models only.
11. Study of external morphology of cockroach through models.

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INTRODUCTION

YOUR BIOLOGY LABORATORY

Laboratory is a place where the necessary equipments, chemicals and required facilities are available needed by a science student and teacher to perform the experiments.

It is the place where one tests his theoretical knowledge practically for its validity or truthfulness. One gets opportunity to learn the science by performing practicals. A science student cannot do or learn without a laboratory. It is a very significant place as many discoveries, inventions, theories have emerged out of this place.

WHAT YOU NEED

Before going into laboratory you need certain things that will help you to study or perform the experiment.

1. A *laboratory note book* for taking down instructions given by the teacher for an experiment. For noting the observations made by you and for sketching the rough diagrams.
2. *Practical book* for comparing the information, observation, sketches and it guides you how to proceed with the experiment.
3. *Pen, pencils (HB), eraser, razor blade, scale* etc.
4. During section cuttings or slide making you need *various instruments*, such as—scissors, a bone cutter, forceps (00), big forceps, scalpel, dissecting needles, brush, dropper, a piece of cloth etc.
Always you can carry along with you in for geometry box a set of forceps, blade, brush, dropper and a piece of cloth.
5. A *practical record file*. (To be submitted for signature of teacher and later to examiner during final practical exams. It carries 3 marks + 2 marks for Viva Voce = 5 marks).

Always reach to the laboratory in time. You should carry the above listed materials along with you, whenever you go to lab for work. Enquire from the teacher in advance what is to be done or which experiment is to be performed. Read it from the practical book and ask questions to remove the doubts if any, you have.

Take your allotted seat.

Do not waste time in roaming around in laboratory, disturbing classmates and avoiding teacher's instructions.

Remember a well behaved and sincere (science) student is always benefitted and liked by the teacher.

1. WHILE WORKING IN LABORATORY

1. Occupy your seat.
2. Carefully listen or note down the instruction given by the teacher. Always be attentive.
3. Read the experiment to be done before you start the work/experiment.
4. Ask or collect the materials from the laboratory attendant or rack.
5. Carry on the work without disturbing others. However, you should take guidance from the teacher and at the end of experiment show your result or work whether it is correct or not.
6. Take care of instruments, glasswares and chemicals. Use them carefully.
7. Keep your table clean.

2. MAKING A PRACTICAL RECORD FILE

1. **Importance of Records.** There are two records to be submitted at the end of exams :
 - (a) A **practical record file** is important record. As it carries 3 marks for maintenance and 2 marks (Total 5 marks) for Viva Voce based on the contents or work recorded.
On the day of final practical examination, it has to be submitted to the examiner. Use a good file.
 - (b) Other record is maintained for project work. It is called **project file** or **report**. It also carries 5 marks. (3 for record + 2 for Viva Voce based on it).
2. **Maintenance of Record**
 - (a) After each work done in laboratory it is properly recorded. The details, observation, procedure, experiment etc. is written on the writing sheet. **Writing or recording of observations is done on left hand side only.** Write neatly and precisely with blue ink pen.

(b) Refer the practical book for it.

On the drawing sheet (right side) the diagram is made with the pencil without shading. Neat and well labelled diagrams carry weightage.

(c) Mention the day, date and get it checked when the work is complete. For keeping your record maintained neat and tidy, with permission of your teacher, keep the used and checked sheets at home, carry one or two blank sheets only.

3. Categories or Types of Work

There are various types of work to be done by you in laboratory. The recording of same is different for different work. They are of following types:

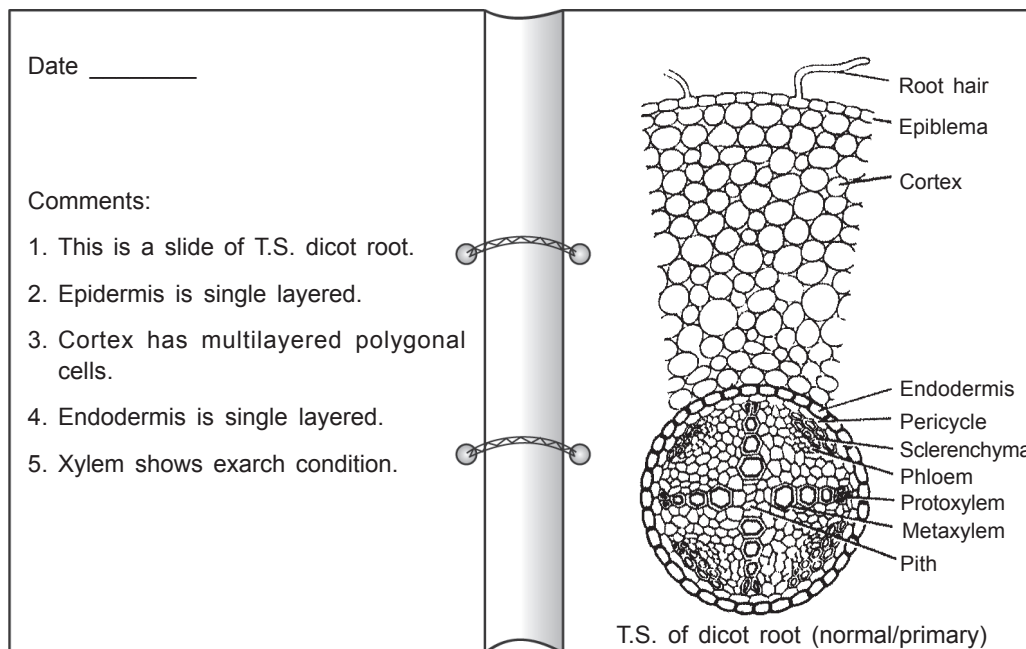
RECORDING OF OBSERVATIONS OF SLIDES (TEMPORARY OR PERMANENT SLIDES)

1. While writing the observations, write the brief description of the structure in small sentences under heading/comments.
2. Write in maximum 5 to 6 points.
3. Note: The procedure of making slides is not written.
4. A neat and well labelled diagram should be drawn.

RECORDING OF OBSERVATIONS OF SPECIMENS

1. While writing the observations write the brief description of the structure in small sentences under heading-comments.
2. Write in maximum 5-6 points.
3. A rough labelled diagram should be drawn.

These two categories are used for spotting during examinations. You will be given three spots and 1-1½ minutes to write about a spot. Hence, the comments should be brief, upto the mark, with one or two identification features. Your writing skill is seen by this.



RECORDING OF PHYSIOLOGICAL EXPERIMENTS

You are supposed to write—

Aim, materials required, procedure or setting of experiment, observations, recordings/readings, inference, result and precautions, and a labelled diagram.

Note:

1. All the work should be supplemented by good diagrams on the drawing sheet.
2. On one page 1 or 2 diagrams can be drawn depending upon the size of the diagrams.
3. Follow the instructions given by your teacher.

4. Take the help of practical book.
5. Keep your record clean and tidy.

3. MAGNIFYING INSTRUMENTS

There are many things, materials, specimens that cannot be seen clearly with our naked eyes. Therefore, we need the help of certain magnifying instruments in order to aid our naked eye for better vision and study. The common magnifying instruments are—

(a) Magnifying Glass (Hand Lens)

It is a very common magnifying instrument also known as hand lens. It is a biconvex lens mounted on a handle. It is of different sizes with magnifying powers 2X, 5X or 10X. It is commonly used to magnify an object.

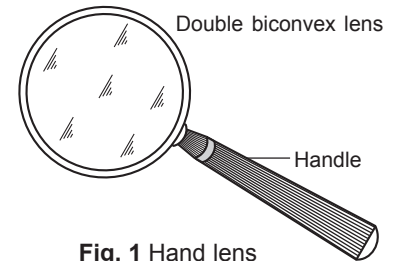


Fig. 1 Hand lens

(b) Dissecting Microscope

It is a simple microscope with better magnifying power than hand lens. The main parts are—

1. **Base.** It supports the other parts of the microscope. It is either horse shoe shaped or circular.
2. **Stand.** A vertical stand to hold the microscope.
3. **Vertical limb.** A short cylindrical rod that can be moved up and down with the help of adjustment screw.
4. **Arm.** It is a horizontal flat arm attached to the vertical limb. It can be folded. At the free end is a hole to which the lens is fitted. It is of various magnifications such as 5X, 10X, 20X. It can be changed for better magnification and through it the object is seen.
5. **Stage.** A rectangular glass plate attached to the lower end of the stand. It is used to keep the object over it for observation. Two clips are there to hold the slide in position.
6. **Mirror (concave).** A concave mirror is fitted to the lower end of the stand. It is used to reflect the light rays on the stage.

Use or Working of Dissecting Microscope

1. The object is kept on the stage.
2. The objective lens is brought over the object and is focused by adjustment screw for better magnification or vision.
3. For better vision light rays are focused on the stage by adjusting the mirror.
4. It is used for low magnification of objects.
5. After use keep the dissecting microscope in the box and cover the lens.

(c) Compound Microscope

Details of compound microscope are given in Section B, Spotting no. 1, Page 54.

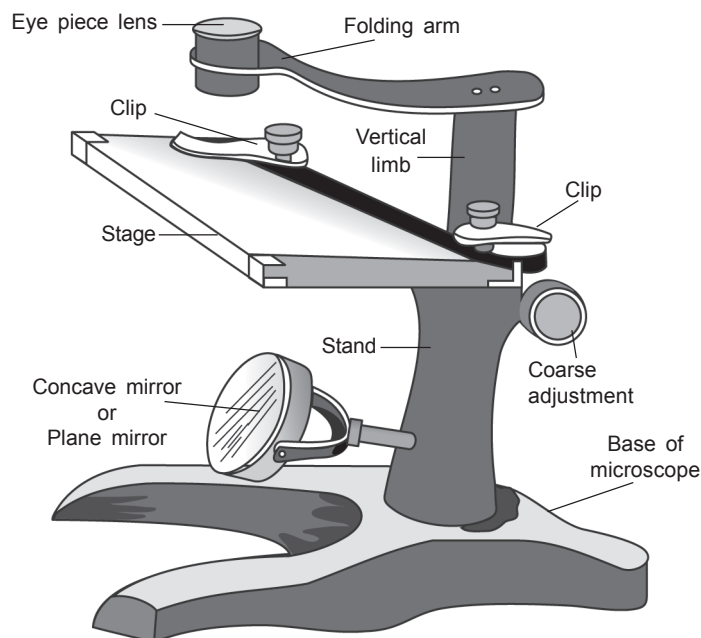
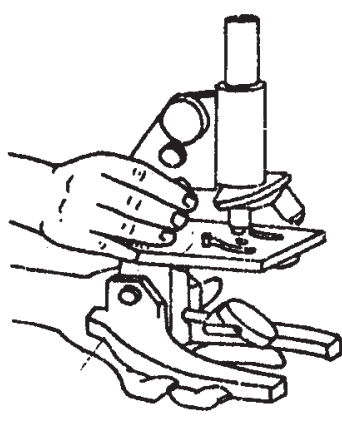
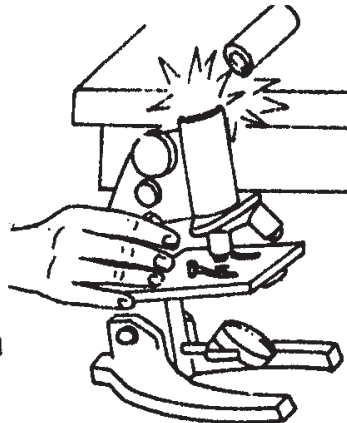


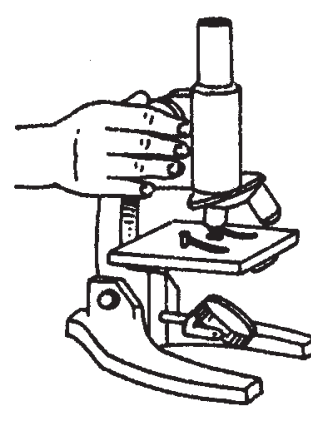
Fig. 2 A dissecting microscope



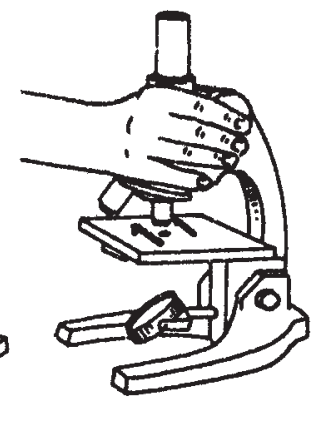
1. Correct Handling



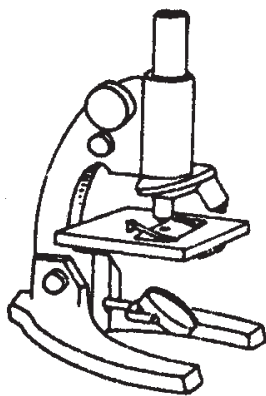
Wrong Handling



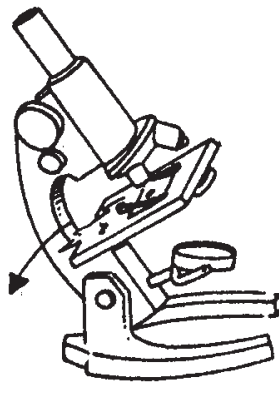
2. Correct



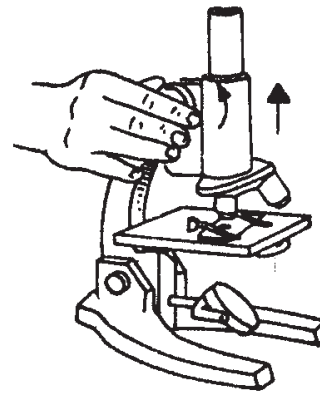
Wrong



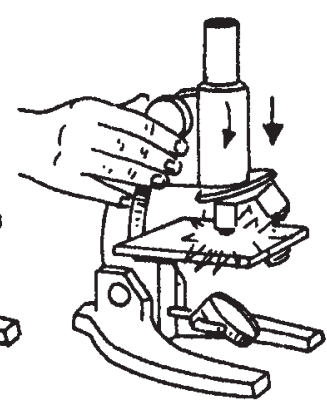
3. Correct Position



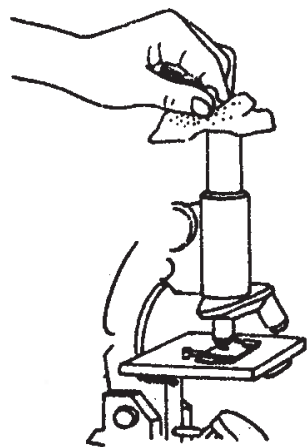
Wrong Position



4. Correct Use



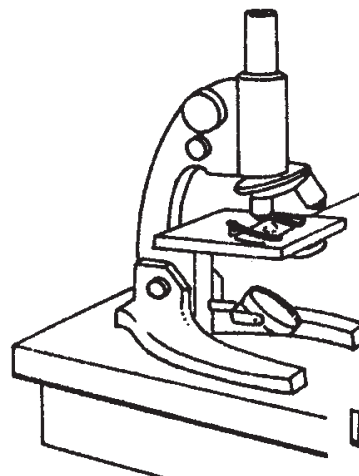
Careless Use



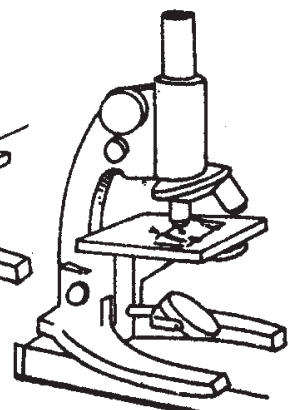
5. Clean Eye Piece



Don't Clean Like This



6. Do Keep Slide Properly



Don't Keep Slide Like This

Fig. 3 Handling of microscope

PRACTICAL RECORD BOOK

[This section is regarding your practical record book or file. This is an important record to be possessed by each biology student. Five marks are allotted for this file. And it is evaluated as following.]

1. Completeness of Practical Work

- All the practicals done in the practical classes during the session are recorded in this record or file. You have to record all the practicals, related diagrams/figures, observations, result etc., performed by you in the practical classes.
- These records are written on the left hand side on the writing (ruled) sheets. The labelled figures are drawn on the right hand side on the drawing (white) sheets.
- The experiments performed and noted should be complete in all respects—*viz.*, date, experiment number, aim, requirements, procedure, observation table, inference, conclusion, diagram and precautions.

2. Regular Submission of Record

- The record file should be submitted to the concerned teacher. After, completing the assignment or practical, as said above, on the next day or the proposed date given by the teacher.
- See that your work is checked by the concerned teacher. Regular submission for checking is very important. It means student is sincere and regular in work. Irregularly checked work compels the examiner in board examination to draw wrong conclusion against you.

3. Neatness and Accuracy of Record

- A neat and tidy record file is liked by everyone. This shows that the student is good and takes interest in studying his subject. Good labelled diagrams, observation tables, written work, properly kept sheets, file etc., all adds to your personality. It is an advantage over careless and untidy work. Take care of your record file.

4. Viva voce on Record

- A general Viva voce is there based on your record. Prepare yourself accordingly from the viva voce given after each experiment. This is to judge weather the student has merely copied the experiments from the book or he/she has actually, performed it in the laboratory. Also, this helps the examiner to know that how much the student knows about or remembers about the experiments he/she had done in the class. Keep revising the work done at intervals.

A GOOD RECORD FILE

1. It is properly covered with brown or any coloured chart paper. With your name, class, section, session and your board roll no., on a label.
2. A complete index page with details and teacher's signature.
3. Practical sheets properly tagged/fastened with lace to the file. (No loose sheets please.)
4. All experiments/records completely checked and in a sequence.
5. The edges/corners of file not worn/damaged.

Some Instruments used in Biology Laboratory

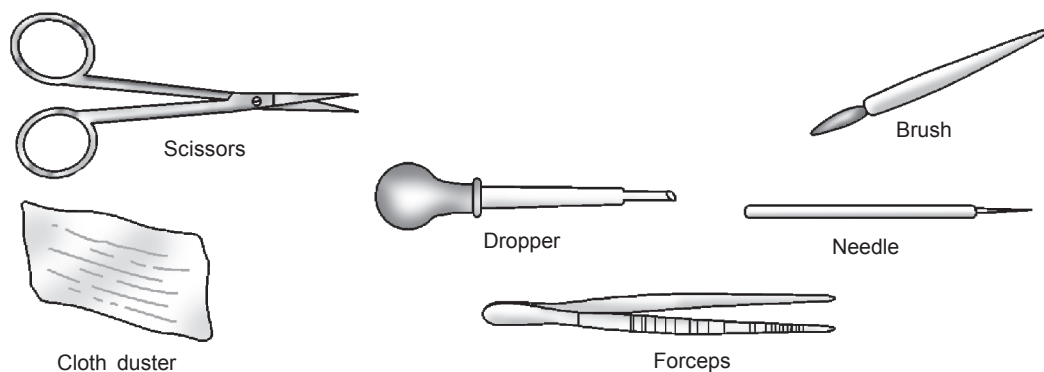


Fig. 4 Some instruments used in biology lab

SECTION - A

EXPERIMENT 1

Study and Description* of Three Locally Available Common Flowering Plants

(Families 1. Solanaceae, 2. Fabaceae and 3. Liliaceae)

AIM

To study and describe three common flowering plants.

* Description of angiospermic plants in semitechnical language.

1. FAMILY—Solanaceae (Night shade Family)

Petunia nyctanginifolia

1. **Habit** - Annual, cultivated an ornamental herb.
2. **Root** - Tap root system and branched.
3. **Stem** - Erect, herbaceous, branched, cylindrical, aerial, solid, green and hairy.
4. **Leaf** - Alternate in basal part and opposite decussate in the upper part, cauline and ramal, simple, sessile, stipulate, ovate, hairy, acute, entire, unicostate, reticulate.
5. **Inflorescence** - Cymose, axillary dichasial cyme.
6. **Flower** - Bracteate, pedicellate, actinomorphic, regular, hermaphrodite, pentamerous, complete, cyclic, hypogynous, white or light violet in colour.
7. **Calyx** - 5 sepals, gamosepalous, deeply lobed, inferior, hairy, persistant, green.



Fig. 1.1 *Petunia* flower

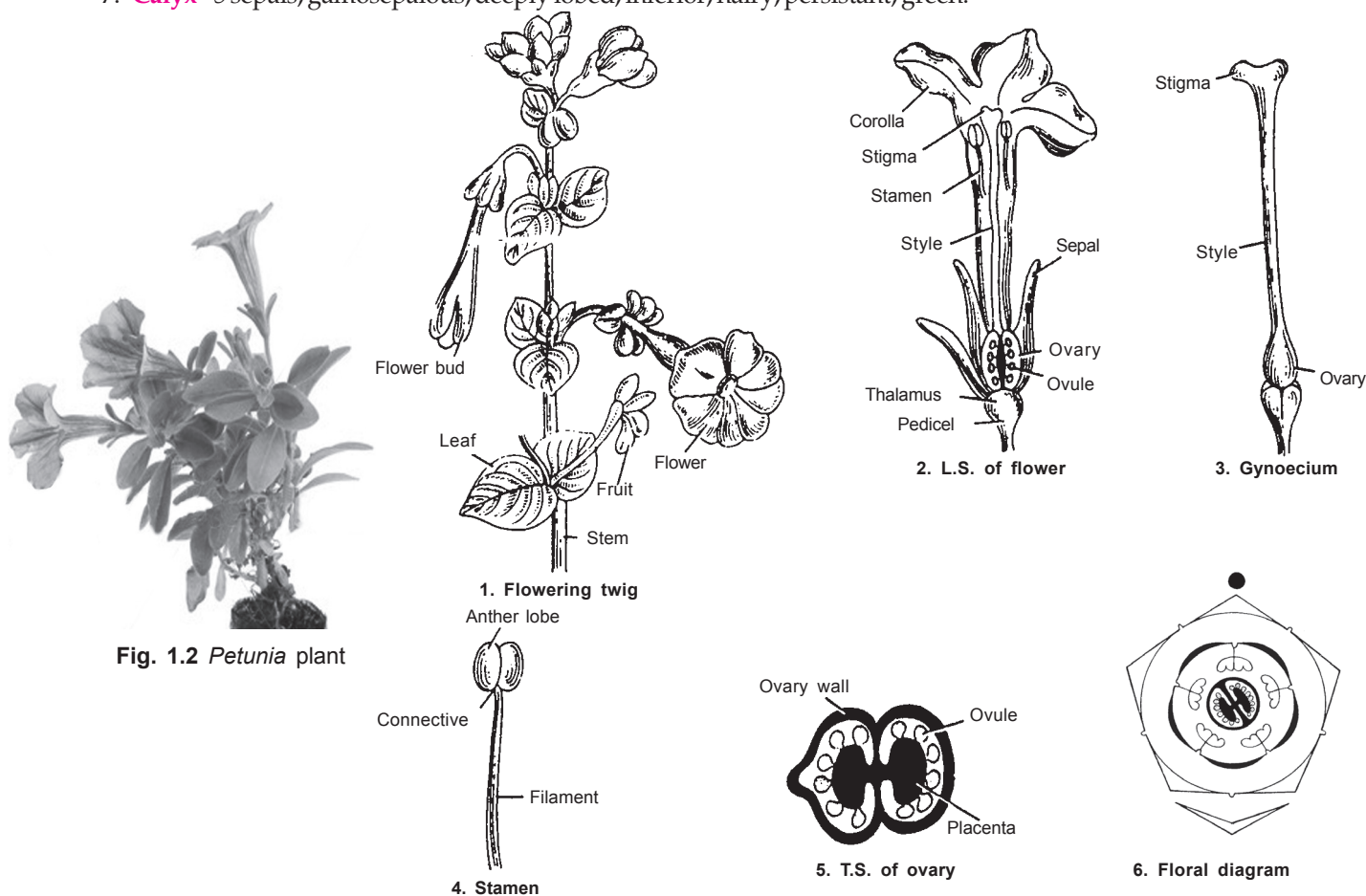


Fig. 1.2 *Petunia* plant

Fig. 1.3 *Petunia*

8. **Corolla** - 5 petals, gamopetalous, valvate, infundibuliform, induplicate, inferior, pentafid, white or light violet in colour.
9. **Androecium** - 5 stamens, epipetalous, polyandrous, filaments unequal, basifixed, introse.
10. **Gynoecium** - 2 carpels (bicarpellary), syncarpous, superior, bilocular, many ovules in each locule, style long, stigma capitate, placenta swollen.
11. **Fruit** - Capsule.
12. **Floral formula** - $\text{Br} \oplus \overset{\ominus}{\text{K}} (5), \overset{\ominus}{\text{C}} (\overline{5}) \overset{\ominus}{\text{A}} 5, \overset{\ominus}{\text{G}} (2)$

Some other plants

1. *Solanum nigrum* (medicinal), 2. *Solanum tuberosum* (potato) 3. *Solanum melongena* (Brinjal) 4. *Lycopersicon esculentum* (Tomato).



(a)



(b)



(c)

Fig. 1.4 (a) Potato, (b) Brinjal and (c) Tomato plants

Identification

- (i) Flowers hypogynous, often showy and large, petals (5), united, funnel shaped, imbricate sometimes, twisted in bud.
- (ii) Carpels (2), Syncarpous; ovary superior, with a disc at the base, 2 celled with 2 ovules in each, axile placentation fruit berry or capsule.

2. FAMILY—Papilionaceae (Fabaceae) Pea family.

Pisum sativum, Vern. *matar* (Hindi), Eng. Garden Pea.

1. **Habit** - Annual herb, cultivated.
2. **Root** - Tap, branched, root nodules present.
3. **Stem** - Weak, herbaceous, climbs with the help of leaf tendrils, smooth, branched, cylindrical, glaucous.
4. **Leaves** - Cauline and ramal, compound, alternate, stipulate, imparipinnate, leaflets 4 to 6, terminal leaflet forms a tendril.
5. **Inflorescence** - Racemose, axillary racemes or solitary arrangement of flowers.
6. **Flower** - Bracteate, pedicellate, Zygomorphic, irregular, hermaphrodite, papilionaceous, complete, hypogynous, white or pink.

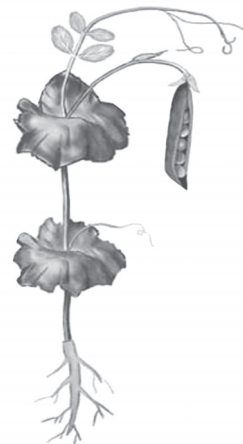


Fig. 1.5 Pea plant



Fig. 1.6 Pea flower

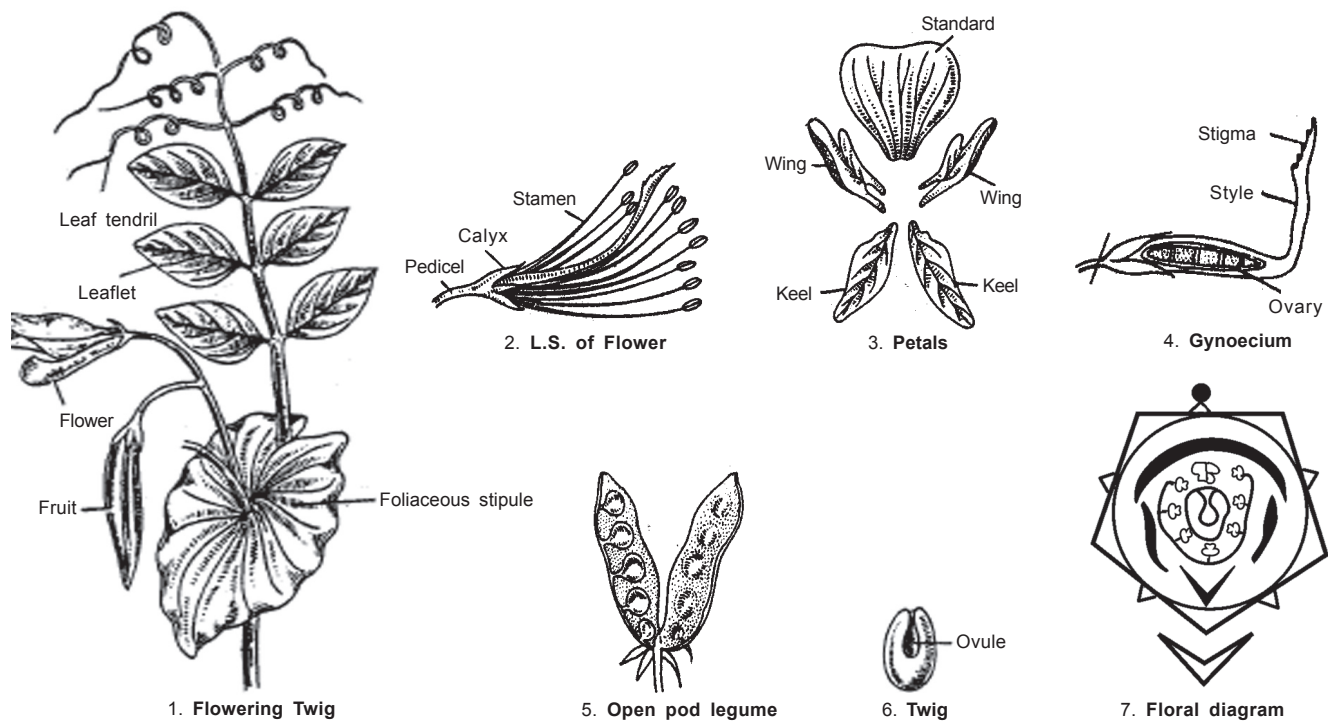


Fig. 1.7 *Pisum sativum*

7. **Calyx** - 5 sepals, gamosepalous, campanulate, Imbricate.
8. **Corolla** - 5 petals (1 standard, 2 wings, 2 keels united, keels shorter than wings) enclosed pistil and stamens, corolla papilionaceous, white/pink, imbricate.
9. **Androecium** - 10 stamens in 2 bundles (diadelphous-9+1-9 mixed at base and form a tube around ovary, 1 is free), anthers bilobed, basifixed, dehiscence by longitudinal splitting.
10. **Gynoecium** - 1 carpel, ovary superior, unilocular, marginal placentation, ovules many style bent and long, stigma simple, terminal, ovary hairy.
11. **Fruit** - A legume (pod).
12. **Seeds** - Uniform, ground.

Floral formula - $\% \oplus \text{♀} K(5), C1 + 2 + (2), A(9) + 1, G1.$

Some other Plants

1. *Phaseolus mungo* (Urad), 2. *Cajanus cajan* (Arhar), 3. *Lythyrus odoratus* (Sweet pea), 4. *Dolicos lablab* (Sem)



Fig. 1.8 Arhar plant

Identification

Flowers are papilionaceous and zygomorphic. Descending imbricate aestivation of corolla. Arranged as 1 standard, 2 wings and 2 keels. Stamens 10 monoadelphous or diadelphous *i.e.* 5 + 5 or 9 + 1.

3. FAMILY—Liliaceae (Lily family)

Allium cepa

Allium cepa, Vern. Piyaz, Eng. : Onion

1. **Habit** - Herbs, cultivated.
2. **Root** - Fibrous.
3. **Stem** - Modified to disc like and found enclosed by scale leaves forming a bulb. Stem is underground.
4. **Leaves** - Simple.
5. **Inflorescence** - Terminal umbel or leaflets scape. (The young inflorescence may be enclosed by 2-3 membranous bract).
6. **Flower** - Pedicellate, bracteate, hermaphrodite, complete, actinomorphic, hypogynous, white in colour.



Fig. 1.9 Inflorescence of onion flowers

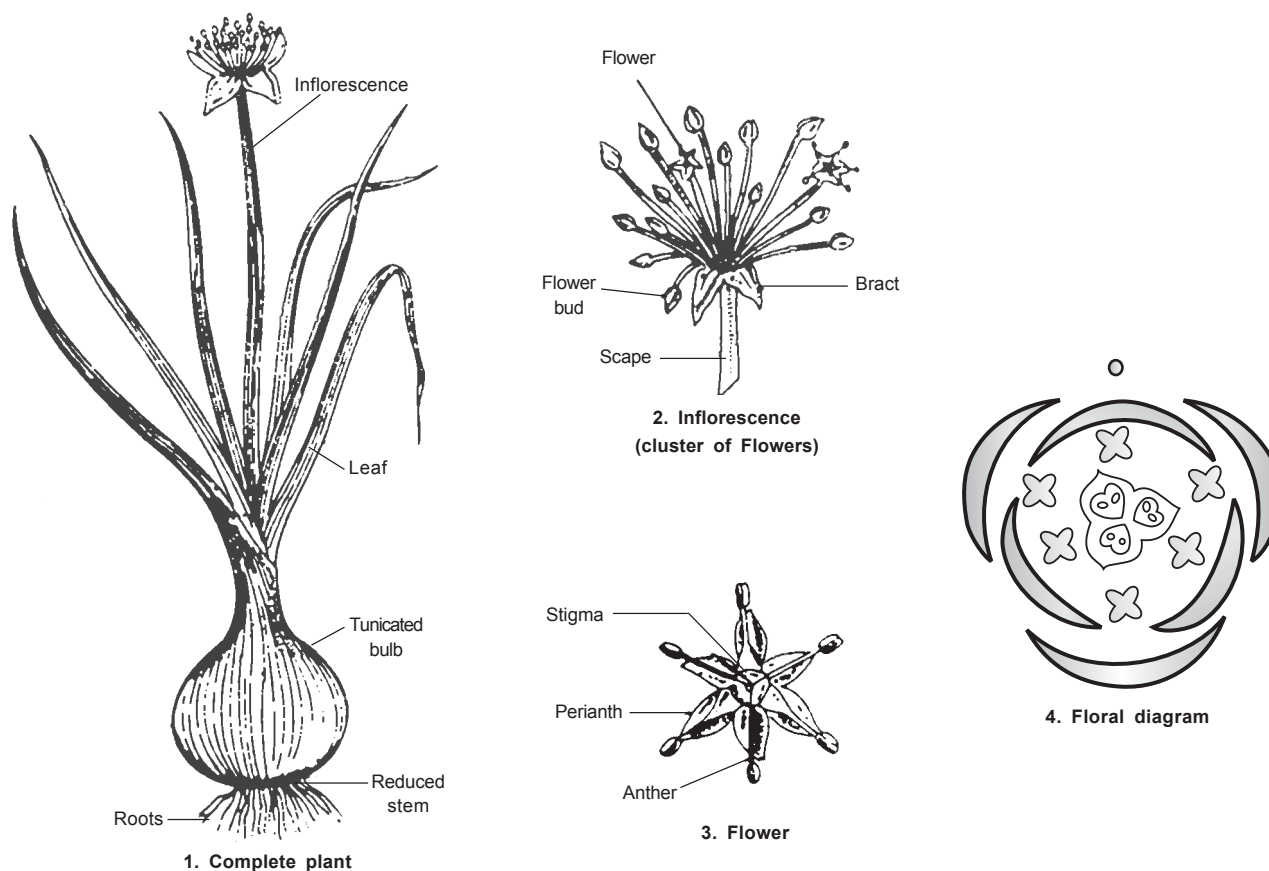


Fig. 1.10 *Allium cepa* – Onion

7. **Perianths** - 6 lobed, arranged in 2 whorls of 3 each, gamophyllous, imbricate.
8. **Androecium** - 6 stamens, arranged in 2 whorl of 3 each, polyandrous, epiphyllous, anthers, long, dorsifixed, introse.
9. **Gynoecium** - Tricarpellary, Syncarpous, Superior ovary, style short, stigma small, trilocular, axile placentation, 2 ovules/locule.
10. **Fruit** - Berry/capsule.
11. **Seeds** - Albuminous.

Floral Formula - $\oplus \overset{\sigma}{\underset{\sigma}{P}}_{3+3} A_{3+3} G(3)$ or $P(3+3)$.

Some other Plants - 1. Asparagus, 2. G. sativum (Garlic), 3. Tulipa (Tulip).

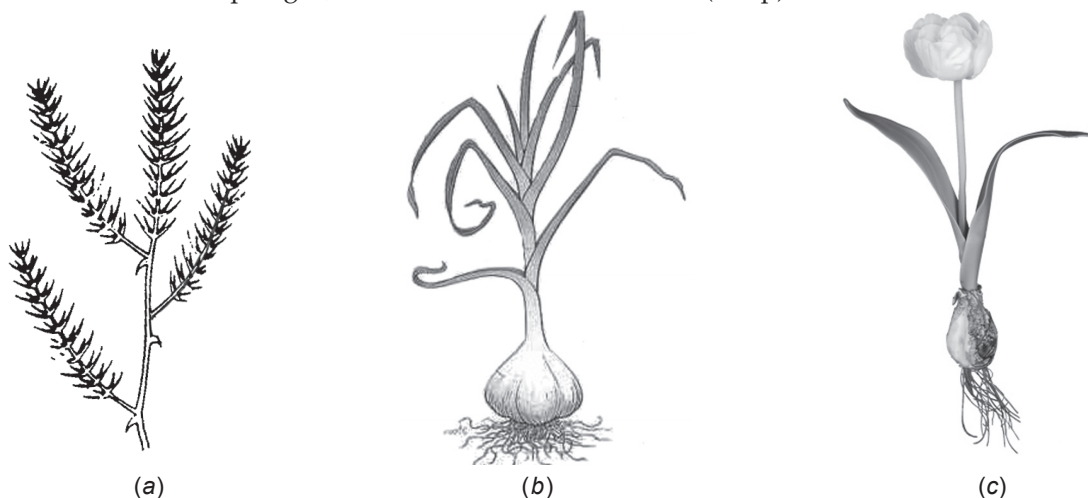


Fig. 1.11 (a) Asparagus, (b) Garlic and (c) Tulip plants

Identification

Flowers usually trimerous, 6 tepals in 2 whorls, petaloids.

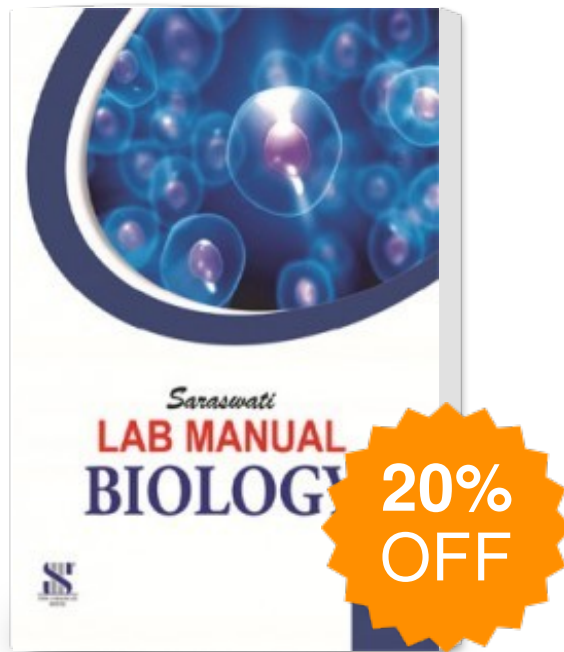
BE CAREFUL

1. Observe and describe the flower carefully.
2. Compare it with other flowers (of same and different kinds).
3. Do not throw away the floral members. Display them on the sheet.
4. Make a temporary mount slide of T.S. of ovary.
5. Observe it under dissecting microscope and count the chambers and ovules.

VIVA VOCE QUESTIONS

- Q1. What is flower?**
Ans. It is a modified shoot for sexual reproduction in flowering plants.
- Q2. How many whorls does a flower have?**
Ans. Four
- Q3. Mention the 4 whorls of a flower.**
Ans. (i) Calyx, (ii) Corolla, (iii) Androecium, (iv) Gynoecium.
- Q4. Which whorls of a flower are essential whorls?**
Ans. Androecium and Gynoecium.
- Q5. What is a complete flower?**
Ans. A flower with all 4 whorls is a complete flower.
- Q6. Which dicotyledonous flower have you studied?**
Ans. I had studied flower.
- Q7. What is the characteristics of pea flower?**
Ans. It is papilionaceous *i.e.*, it has 1 standard, 2 wings, 2 keels (united).
- Q8. Name any other two flowers of same kind as that of *Petunia*.**
Ans. *Solanum tuberosum* (Potato), *S. melongena* (brinjal).
- Q9. Mention the type of flower of *Allium*.**
Ans. Pedicellate, bracteate, hermaphrodite, complete, actinomorphic, hypogynous, white in colour.
- Q10. What does the symbol \bar{A} represent?**
Ans. Actinomorphic.
- Q11. Mention the inflorescence found in *Petunia*.**
Ans. Cymose.

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