

Exercise 11

Aim: Study and describe flowering plants of families Solanaceae, Fabaceae and Liliaceae.

Principle: Taxonomy deals with identification, nomenclature and classification of organisms. Bentham and Hooker's system of classification is universally used for classification of plants. Field identification of plants is based primarily on morphological features particularly the floral characters.

Requirement: Locally available plant specimens of Solanaceae, Fabaceae and Liliaceae. (minimum 3 species for each family other than the ones described for reference in the manual); each specimen should have at least a small branch with a few inter nodes, leaves, flowers and fruits; glass slides, cover glass, water, 100 ml beakers, petridish, razor, blade, needles, brush, hand lens, dissecting microscope and compound microscope.

Procedure

Keep the twigs in beakers containing water. Make yourself familiar with the terms given to describe the habit of plant, its root system, stem and leaf, inflorescence and flowers. Describe the vegetative and floral features of the plant in the same sequence using terms described therein. Observe the flower bud under dissection microscope or a hand lens and note the aestivation patterns of calyx and corolla, number of sepals and petals (tri, tetra, pentamerous), number of stamens. Cut LS of the flower, place it on a slide and observe under the dissecting microscope to study:

- Position (attachment) of stamens – opposite/alternate to petals; free or epipetalous; extrorse/ introrse anthers (anther lobes in the bud face away from axis – extrorse; anther lobes in the bud face towards the main axis – introrse).
- Number of carpels (mono, bi, tri- carpellary); Position of the ovary (epigynous, perigynous, hypogynous).

Mount a stamen on a slide and study the attachment of filament to anther (basifixed, dorsifixed, versatile, adnate), dehiscence pattern of anther (porous, longitudinal), number of anther lobes (monothealous, dithealous). Mount the pistil and study the ovary, style and stigma. Also cut a TS of the ovary to study the number of locules and placentation. Write the floral formula and

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draw the floral diagram of each specimen based on the description. Identify features of the different parts of flower on the basis of descriptions given in Table 11.1.

Observations

Compare the characters with those given in the table and identify the family to which the plant belongs to.

Note: For ready reference some plants are described for each family. The students are required to study the plants other than one described here-under.

Questions

1. Draw the floral diagram and write the floral formula from the below given description of a flower-
Bisexual, actinomorphic, hypogynous, sepals 5, gamosepalous, petals 5, free, imbricate aestivation, stamens 6, arranged in 2 whorls, ovary superior, trilocular, axile placentation.
2. In which type of placentation would the ovary be always unilocular?
3. If a flower is epigynous what is the position of floral parts?
4. What in the fruit is equivalent to the ovule of the ovary?

**Table 11.1 Description of parts of flowers:
Calyx/Corolla**

Aestivation	Arrangement of sepals and petals with respect to one another
Aestivation (Fig 11.1 a–e)	<p>(i) Valvate: The sepals/petals close to each other without overlapping or may be in contact with each other.</p> <p>(ii) Twisted: Overlapping is regular, i.e., one margin of the sepal/petal overlap the next member and the other margin is overlapped by the previous.</p> <p>(iii) Imbricate: Out of five sepals/petals one is completely internal being overlapped on both margins and one is completely external with the rest of the members arranged as in twisted aestivation.</p> <p>(iv) Quincuncial: Out of five sepals/petals two are completely internal, two external and one has one margin external and the other margin internal.</p> <p>(v) Vexillary: Out of five sepals/petals the posterior one is the largest and external almost completely covering two lateral members which in turn overlap the two small anterior sepals/petals</p>
Number of stamens	The number of stamens may vary from a few to many in different flowers
Cohesion (Fig. 11.2 a-e)	<p>Stamens may be free or united. If united they can be of the following type:</p> <p>(i) Syngenesious: Filaments free and anthers united, e.g., Sunflower.</p> <p>(ii) Synandrous: Stamens fused all through their length. e.g., <i>Cucurbita</i>.</p> <p>(iii) Adelphous: Anthers remain free and filaments are united. Adelphous condition can be:-</p> <p>(a) Monadelphous - United to form 1 bundle. e.g., China rose.</p> <p>(b) Diadelphous - United to form 2 bundles. e.g., Pea.</p> <p>(c) Polyadelphous- United into more than two bundles. e.g., Lemon.</p>
Adhesion (Fig. 11.3)	<p>Fusion of stamens with other parts of the flower.</p> <p>(i) Epipetalous: Stamens fused with petals e.g., Sunflower, Datura.</p> <p>(ii) Epiphylloous: Stamens fused with perianth e.g., Lily.</p>
Attachment of filament to anther (Fig. 11.4 a-d)	<p>(i) Basifixed: Filament attached to the base of anther. e.g., Mustard.</p> <p>(ii) Adnate: Filament attached along the whole length of anther. e.g., <i>Michelia</i>, <i>Magnolia</i>.</p>

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	<p>(iii) Dorsifixed: Filament attached to the back of anther, e.g., Passion flower.</p> <p>(iv) Versatile: Anther lobes attached with filament in the middle portion with both ends free. e.g., Gramineae family.</p>
Lobes of anther (Fig. 11.5 a,b)	<p>(i) Monothealous: Anther single lobed.</p> <p>(ii) Dithealous: Anther bi-lobed.</p>
Dehiscence pattern (Fig. 11.6 a,b)	<p>(i) Porous: Pollens released through pores, e.g., brinjal, potato.</p> <p>(ii) Longitudinal: Pollens released through the longitudinal slit of anther lobes, e.g., China rose, cotton.</p>

Gynoecium

Position of ovary (Fig. 11.7 a-d)	<p>(i) Epigynous: Position of ovary inferior to other floral parts. e.g., mustard, China rose.</p> <p>(ii) Perigynous: Other floral parts (organs) are attached around the ovary. e.g., apple, guava.</p> <p>(iii) Hypogynous: Position of ovary superior to other floral parts e.g., sunflower.</p>
Cohesion (Fig. 11.8 a-c)	<p>If number of carpels is more than one, they may be</p> <p>(i) Apocarpous: Carpels are free. Each carpel has its own style and stigma. e.g., rose.</p> <p>(ii) Syncarpous: Carpels are united, e.g., lady finger, tomato.</p>
Number of locules in ovary	<p>Vary from one to many</p> <p>(i) Unilocular: One locule, e.g., rose, pea.</p> <p>(ii) Bilocular: Two locules. e.g., datura.</p> <p>(iii) Multilocular: Many locules, e.g., lady's finger, China rose.</p>
Placentation (Fig. 11.9 a-e)	<p>(i) Marginal: The placenta forms a ridge along the ventral suture of the ovary and the ovules are borne on this ridge e.g., pea.</p> <p>(ii) Axile: The ovary is partitioned into several chambers or locules and the placentae are borne along the septa of the ovary. e.g., tomato, China rose.</p> <p>(iii) Parietal: The ovules develop on the inner wall of the ovary or on peripheral part. Ovary unilocular but in some cases becomes two chambered due to formation of a false septum. e.g., mustard.</p> <p>(iv) Free central: Ovules are borne on the central axis and septa are absent. e.g., carnation, chilly.</p> <p>(v) Basal: Placenta develops at the base of the ovary. e.g., sunflower.</p>

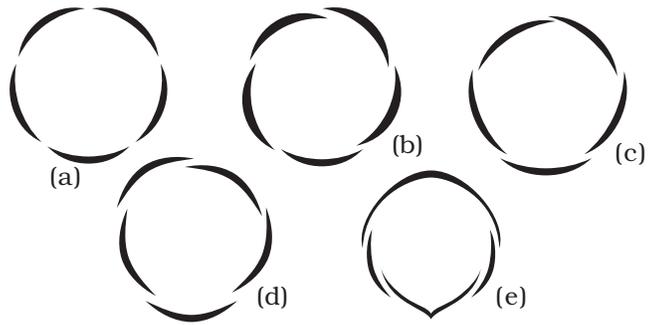


Fig. 11.1 Aestivation (a) Valvate (b) Twisted (c) Imbricate (d) Quincuncial (e) Vexillary

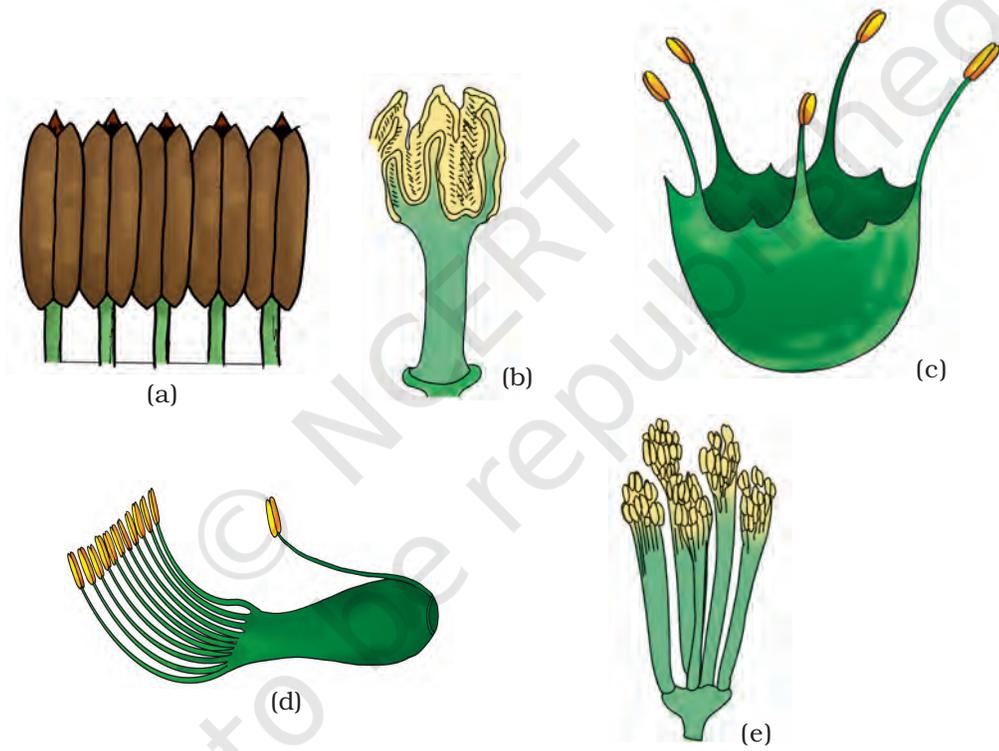


Fig. 11.2 Cohesion of stamens (a) Syngenesious (b) Synandrous (c) Monoadelphous (d) diadelphous (e) Polyadelphous

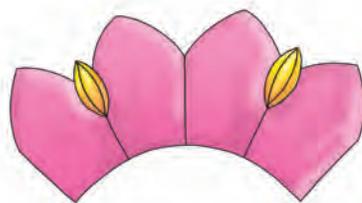


Fig. 11.3 Adhesion of Stamens-Epipetalous/Epiphyllous

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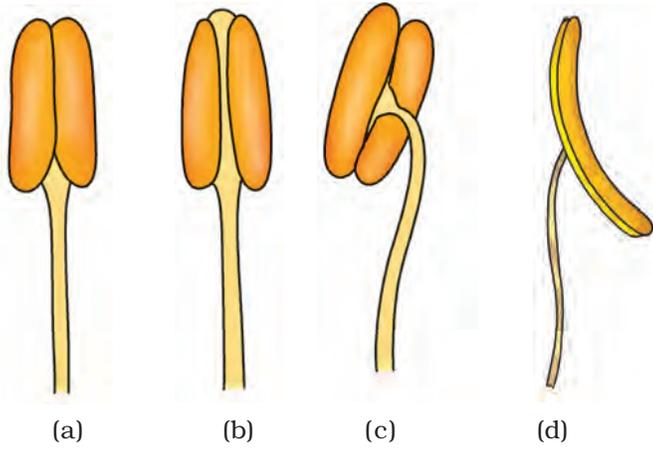


Fig. 11.4 Attachment of filament to anther (a) Basifixed (b) Adnate (c) Dorsifixed (d) Versatile

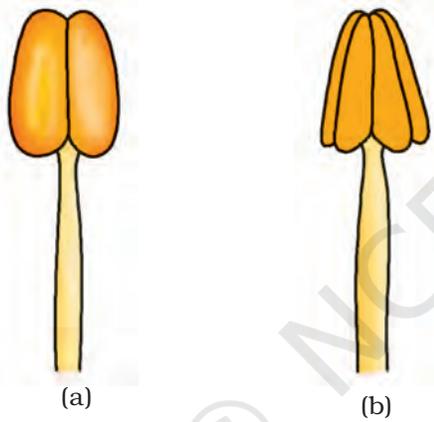


Fig. 11.5 Anther lobes (a) Dithecous (b) Monothealous

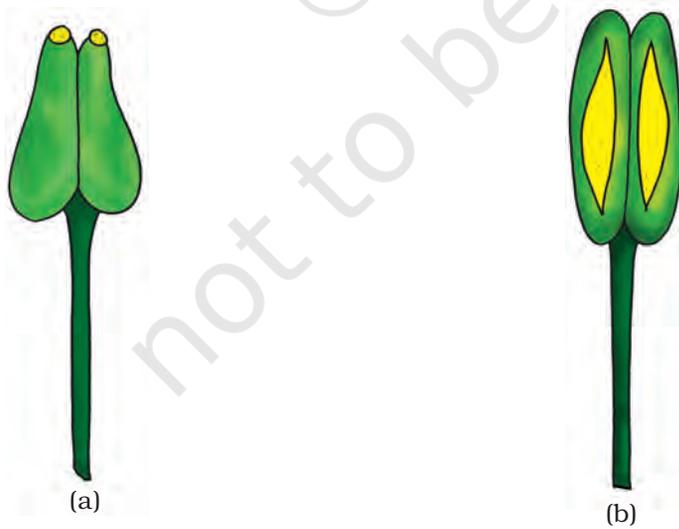


Fig. 11.6 Dehiscence pattern of anther (a) Porous (b) Longitudinal

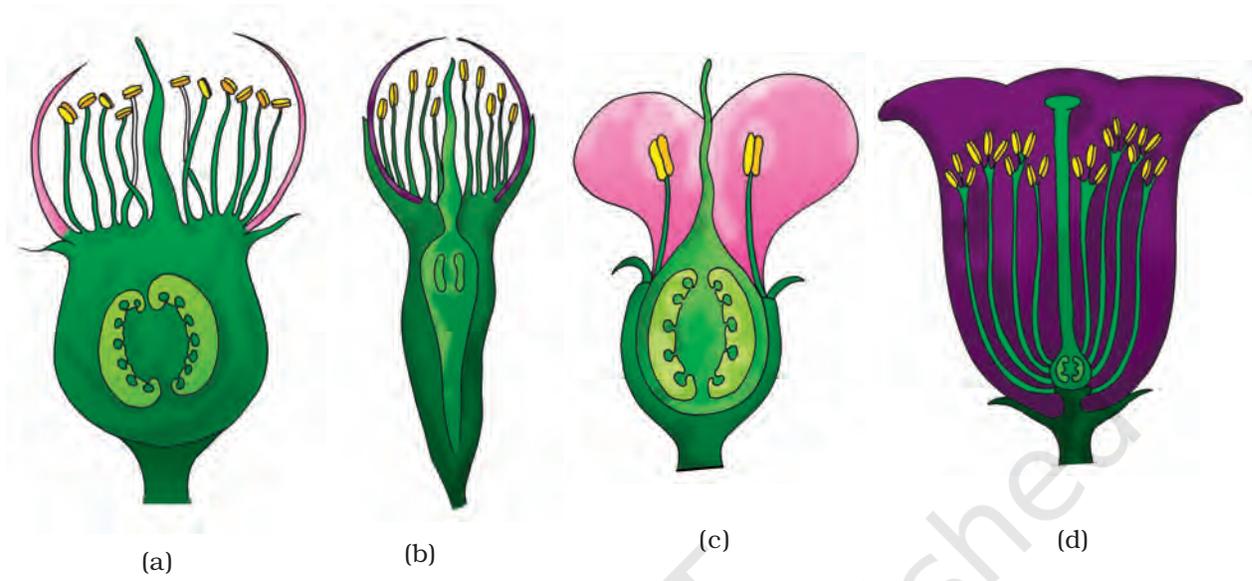


Fig. 11.7 Position of ovary (a) Epigynous (b-c) Perigynous (d) Hypogynous

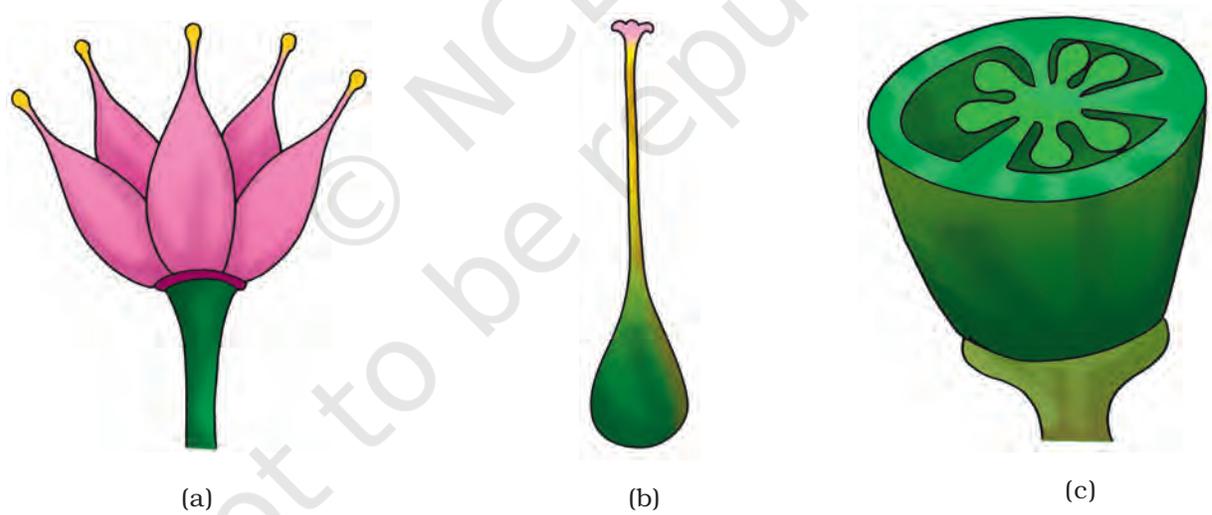


Fig. 11.8 Cohesion of carpels (a) Apocarpous (b-c) Syncarpous

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Fig. 11.9 Placentation (a) Marginal (b) Axile (c) Parietal (d) Free central (e) Basal

Annexure 1

Characteristics	<i>Solanum nigrum</i> (Makoi, Black night shade)	<i>Petunia alba</i>	<i>Lathyrus sp.</i>	<i>Pisum sativum</i>	<i>Asphodelus tenuifolius</i>
Habit	Herbaceous annual	Herbaceous annual	Herbaceous annual, climber	Herbaceous annual, climber	Herbaceous annual
Root	Tap root	Tap root	Taproot, the lateral roots may have nodules which contain nitrogen fixing <i>Rhizobium</i> bacteria	Taproot, the lateral roots may have nodules which contain nitrogen fixing <i>Rhizobium</i> bacteria	Fibrous root
Stem	Erect, herbaceous, branched, solid, cylindrical, green	Erect, herbaceous, branched, solid, cylindrical, green	Weak, cylindrical, branched, herbaceous, aerial, climbing with help of leaf tendrils, green	Weak, cylindrical, branched, herbaceous, aerial climbing with help of leaf tendrils, green	Very small but scape formed in reproductive phase
Leaf	Ex-stipulate, petiolate or sessile, simple, alternate, reticulate venation	Ex-stipulate, sessile, simple, alternate in the basal parts and opposite decussate in upper parts, reticulate venation	Stipulate (stipules foliaceous and in pairs), modified into a tendril, simple, alternate, reticulate venation	Stipulate (stipules large, ovate, foliaceous), petiolate, imparipinnately compound, (leaf lets 4 or 6) the common rachis ends in a branched tendril, terminal leaflet is always a tendril; alternate leaflets with reticulate venation	Fistular, slender
Inflorescence	Cymose	Solitary	Racemose	Racemose	Racemose

Characteristics	<i>Solanum nigrum</i> (Makoi, Black night shade)	<i>Petunia alba</i>	<i>Lathyrus sp.</i>	<i>Pisum sativum</i>	<i>Asphodelus tenuifolius</i>
Flower	Ebracteate, ebracteolate, pedicellate, complete, actinomorphic, bisexual pentamerous, hypogynous	Bracteate, ebracteolate, pedicellate, complete, actinomorphic, bisexual, pentamerous, hypogynous	Bracteate, bracteolate, pedicellate, complete, zygomorphic, bisexual pentamerous, hypo-or perigynous, papilionaceous	Bracteate, bracteolate, pedicellate, complete, zygomorphic, bisexual pentamerous, hypo-or perigynous, papilionaceous	Bracteate, ebracteolate, pedicellate, actinomorphic, bisexual, trimerous, hypogynous
Calyx	Sepals 5, persistent, gamosepalous, green, valvate aestivation	Sepals 5, persistent, gamosepalous, green, valvate aestivation	Sepals 5, gamosepalous, ascending imbricate aestivation, odd sepal anterior, green	Sepals 5, gamosepalous, ascending imbricate aestivation, valvate aestivation, odd sepal anterior, green	
Corolla	Petals 5, gamopetalous, white, valvate aestivation	Petals 5, gamopetalous, white/purple, valvate aestivation	Petals 5, polypetalous papilionaceous (The 5 petals are unequal and have a bilateral symmetry. The posterior or outer most largest petal is called standard , the lateral pair of petals which are clawed are called the wings and the two anterior petals are united to form the keel i.e., 1+2+2 arrangement), which encloses the stamens and the carpel descending imbricate (vexillary) aestivation	Petals 5, polypetalous papilionaceous (The 5 petals are unequal and have a bilateral symmetry. The posterior or outer most largest petal is called standard , the lateral pair of petals which are clawed are called the wings and the two anterior petals are united to form the keel which encloses the stamens and the carpel, i.e., 1+2+2 arrangement), descending imbricate (vexillary) aestivation	Perianth tepaloid, tepals 6 in two whorls of 3 each (3+3), free, valvate aestivation

Characteristics	<i>Solanum nigrum</i> (Makoi, Black night shade)	<i>Petunia alba</i>	<i>Lathyrus Sp.</i>	<i>Pisum sativum</i>	<i>Asphodelus tenuifolius</i>
Androecium	Stamens 5, epipetalous, alternate with corolla lobes, polyandrous, anthers ditheous, introrse, dehiscence by apical pores	Stamens 5, epipetalous, alternate with corolla lobes, filaments unequal, polyandrous, anthers basifixed, ditheous, introrse, dehiscence by apical pore	Stamens 10 arranged in a single whorl, diadelphous, (9+1 arrangement, 9 unite at the base and form a tube around the ovary and the 10th posterior stamen is free) anthers basifixed, ditheous, introrse, longitudinal dehiscence	Stamens 10 arranged in a single whorl, diadelphous, (9+1 arrangement, 9 unite at the base and form a tube around the ovary and the 10th posterior stamen is free) anthers basifixed, ditheous, introrse, longitudinal dehiscence	Stamens 6 in 2 alternate whorls of 3 each, epiphyllous opposite to tepals, basifixed, ditheous, introrse, dehiscence by longitudinal slits
Gynoecium	Bicarpellary syncarpous, ovary superior, bilocular, ovary obliquely placed in the flower, ovules many per locule, axile placentation, placenta swollen,	Bicarpellary syncarpous, ovary superior, bilocular, ovary obliquely placed in the flower, ovules many per locule, obliquely transverse septum, axile placentation, placenta swollen,	Monocarpellary, ovary superior, unilocular, ovules many, placentation marginal,	Monocarpellary, ovary superior, unilocular, ovules many, placentation marginal	Tricarpellary syncarpous, ovary superior trilocular, two ovules in each locule, axile placentation,
Fruit	Berry	Capsule	Legume	Legume	Berry
Floral formula	Ebr, Eb1, ♂, Å, $K_{(5)} \overline{C_5 A_5} G_{\underline{2}}$	Ebr, Eb1, ♂, Å, $K_{(5)} \overline{C_5 A_5} G_{\underline{2}}$	Br, brl, ♂, %, $K_5 C_{1+2+2} A_{(9)+1} G_{\perp}$	Br, brl, ♂, %, $K_5 C_{1+2+2} A_{(9)+1} G_{\perp}$	Br, Eb1, ♂, Å, $\overline{P_{(3+3)} A_{3+3}} G_{\underline{3}}$

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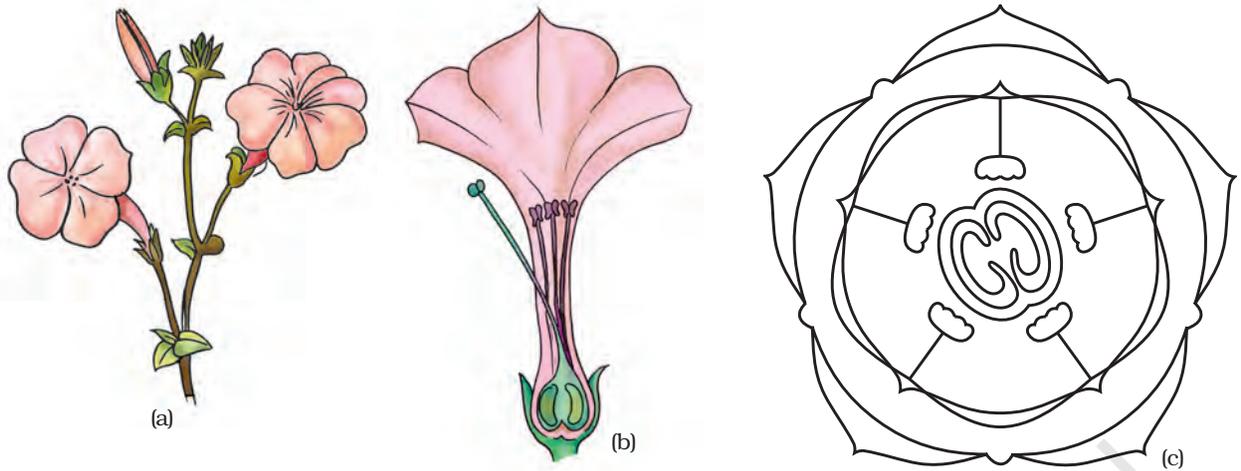


Fig. 11.10 *Petunia* (a) A twig (b) LS of flower (c) Floral diagram

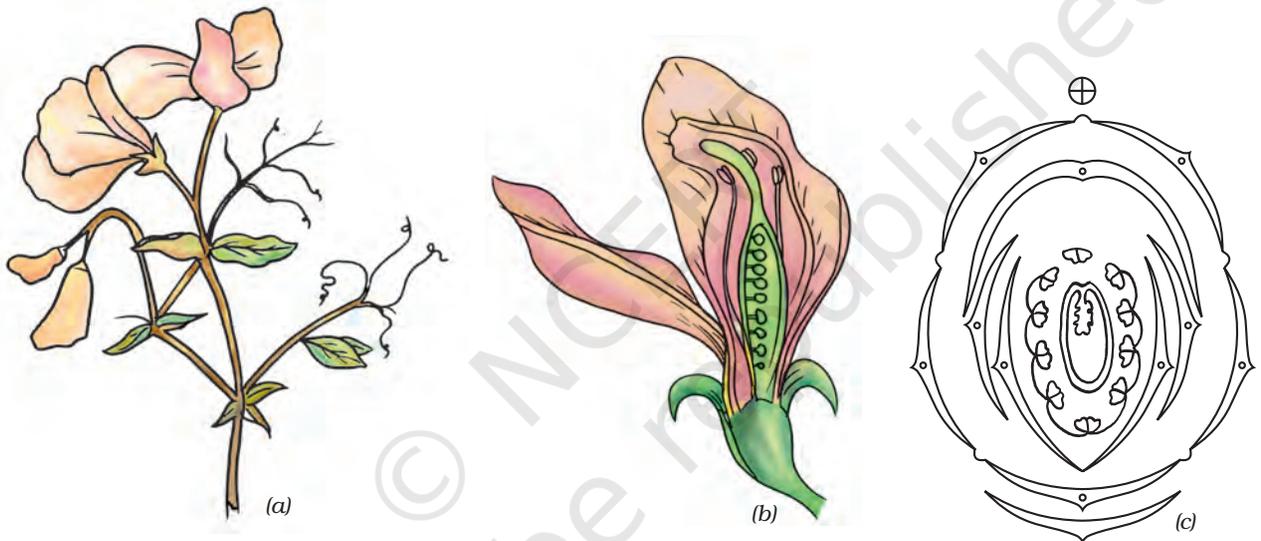


Fig. 11.11 *Lathyrus* (a) A twig (b) LS of flower (c) Floral diagram

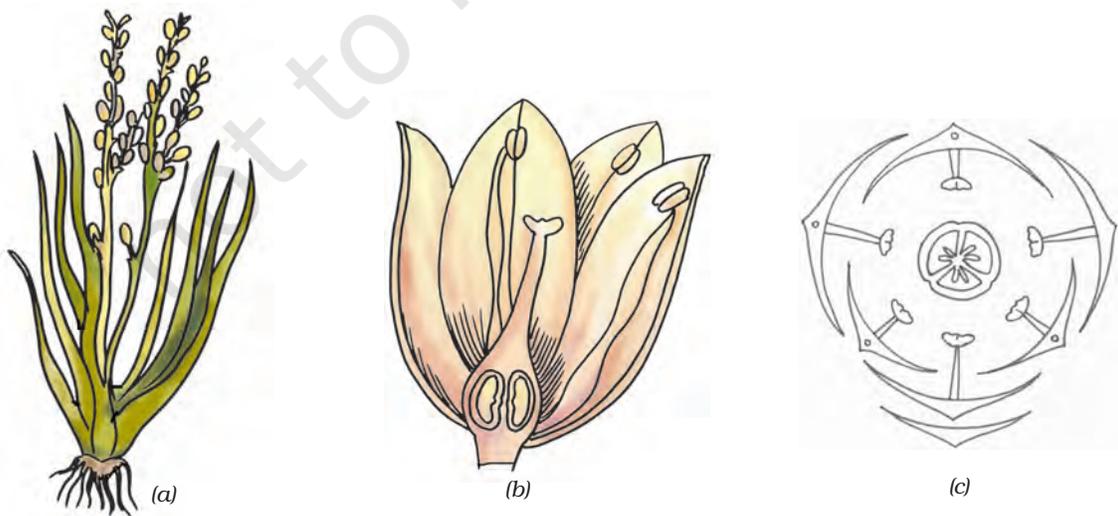


Fig. 11.12 *Asphodelus* (a) A twig (b) LS of flower (c) Floral diagram

Annexure 2

Other Examples

Family : Solanaceae	Family : Fabaceae	Family : Liliaceae
<i>Physalis</i> <i>Solanum xanthocarpum</i> <i>Solanum melongena</i> <i>Solanum tuberosum</i> <i>Nicotiana tabacum</i> <i>Hyocymus</i> <i>Atropa belladonna</i> <i>Withania somnifera</i> <i>Cestrum nocturnum</i> <i>Datura</i>	<i>Phaseolus moong</i> (Urad) <i>P. vulgaris</i> (Kidney bean, French bean) <i>P. aureus</i> (Moong) <i>Trigonella</i> (Fenugreek) <i>Cajanus cajan</i> (Arhar, pigeon pea) <i>Dolichos lablab</i> (Sem, Hyacinth bean) <i>Cicer arietinum</i> (chana, gram, chickpea) <i>Indigofera</i> (Indigo) <i>Abrus</i> (Ratti) <i>Arachis hypogea</i> (groundnut) <i>Medicago sativa</i> (Alfalfa)	<i>Allium cepa</i> (onion) <i>Gloriosa superba</i> <i>Aloe barbendesit</i> <i>Heterosmilax</i> <i>Asparagus officinale</i> <i>Yucca gloriosa</i> <i>Lilium candidum</i> <i>Smilax spp</i>

IDENTIFICATION AND SYSTEMATIC POSITION- Family : Solanaceae

1.	Leaves reticulate venation, flowers tetra or pentamerous, tap root system.	Dicotyledons
2.	Petals fused,	Gamopetalae
3.	Ovary superior, carpels usually two, stamens alternate with the corolla lobes, number of stamens equal or fewer to the number of corolla lobes.	Bicarpellatae
4.	Herbs or twiners, leaves alternate, flowers actinomorphic, stamens epipetalous, ovary superior two carpels, bilocular, axile placentation, ovules few or many in each carpel.	Polemoniales
5.	Herbs and shrubs, leaves simple, alternate, gamosepalous, stamens 5, epipetalous, ovary superior, bicarpellary syncarpous, bilocular, sometimes four locules due to false septum, many ovules in each locule, swollen placenta, ovary obliquely placed in the flower, axile placentation, fruit a berry or a capsule.	Solanaceae

IDENTIFICATION AND SYSTEMATIC POSITION - Family : Fabaceae

1.	Leaves with reticulate venation, flowers tetra or pentamerous, tap root system.	Dicotyledons
2.	Petals free or not united.	Polypetalae
3.	Flowers hypo or perigynous; regular or irregular (vexillary).	Calyciflorae
4.	Flowers zygomorphic and <i>papilionaceous</i> , descending imbricate aestivation of corolla, 1 standard, 2 wings and 2 keels; stamens 10, mono or diadelphous (9+1) ovary superior, marginal placentation, ovules many.	Fabaceae

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IDENTIFICATION AND SYSTEMATIC POSITION - Family : Liliaceae

1.	Leaves usually with parallel venation, flowers trimerous, fibrous root system, embryo with one cotyledon	Monocotyledonous
2.	Ovary superior, trilocular, 6 tepals in 2 whorls of 3+3, petaloid	Coronariae
3.	Perianth petaloid, 6 tepals free or connate below. stamens 6 in two whorls of 3+3, opposite to tepals, epiphyllous, ovary tricarpeal, syncarpous, trilocular, 2 or more ovules per locule fruit 3 celled berry or capsule.	Liliaceae

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