ECOLOGICAL ANATOMY

[T.Y.B.Sc. SEM-VI; PAPER-II; UNIT-II]

Hydrophytes

Ecological anatomy deals with the internal structures of plants with respect to the environment in which they live. The type of habitat in which the plants live determines their morphological as well as anatomical features. They are derived as a result of the adaptations developed by the plants in order to survive in the conditions present around. The adaptations can be seen generally in the roots, stems, petiole and the leaves according to the environmental conditions. Based on the different types of habitats in which plants live, they are classified into following types – Hydrophytes, Hygrophytes, Mesophytes, Xerophytes, Sciophytes, Halophytes, Epiphytes, etc.

HYDROPHYTES

"Plants growing in extremely wet soil or where there is abundance of water are called hydrophytes."

The general characteristics of hydrophytes are as follows:

1. Plants either rootless (*Utricularia*) or if **roots** are present, smaller in size and poorly branched (*Hydrilla*) or not branched at all. Root pockets often present giving buoyancy to young growing plants (*Lemna, Pistia*). Roots well developed in emergent plants like *Sagittaria* growing in mud.

2. **Stem** very delicate, may be stoloniferous (*Potamogeton*) or rhizomatous or cormous (*Nymphaea*) and spongy.

3. **Leaves** reduced in size and thickness. May be finely dissected (*Ceratophyllum*), linear or ribbon-like (*Vallisneria*) to resist water currents. Floating leaves large, entire and flat (*Nymphaea, Nelumbo*). Upper surface coated with wax or slimy mucilagenous substance to prevent wetting. Petioles swollen in T*rapa* and *Eichhornia* helping in floating. Heterophylly is of common occurrence (*Sagittaria*).

4. Humidity favours **vegetative propagation**. Takes place in hydrophytes by rapid fragmentation (*Elodea*), runners, offsets (*Eichhornia*) or by newly produced bud.

5. **Flowering** usually less freely than many land plants. Setting of **fruits** and **seeds** and their dispersal is uncertain.

In general, hydrophytes have following adaptations in order to render them suitable to lead a life in water:

1. **Development of aerenchyma tissue –** Helps in respiration as well as floating. Eg. *Jussieua*.
2. **Poor development of roots –** In some water plants like *Salvinia, Utricularia,* etc roots are absent. In others, roots are poorly developed. Root hairs are absent.
3. **Absence of cuticle –** This is not developed because there is no necessity to check transpiration.
4. **Poor functioning of stomata –** Stomata are either absent or they are functionless even if they are present.
5. **Poor development of mechanical tissue –** In all hydrophytes, mechanical tissues like xylem and sclerenchyma are poorly developed. Eg. *Hydrilla.* In some, sclereids can be seen in the leaves and petioles, eg. *Nymphaea*.
6. **Development of water-proofing devices –** To prevent decay and wetting, hydrophyte leaves develop a waxy coating, so that water will not be absorbed by them.
7. **Dimorphism of leaves –** Some water plants which are partly submerged have dimorphic leaves. The underwater leaves are thin and highly dissected whereas the leaves above are broad. This condition is called heterophylly. Eg. *Limnophila heterophylla, Sagittaria sagittifolia, Trapa, Nymphaea,* etc.
8. **Formation of coiled pedicels and petioles –** In plants like *Vallisneria* and *Nelumbo,* the pedicels and petioles are coiled so that the flowers and leaves will always be on the surface of water.

The major prominent features in the anatomy of hydrophytes are:

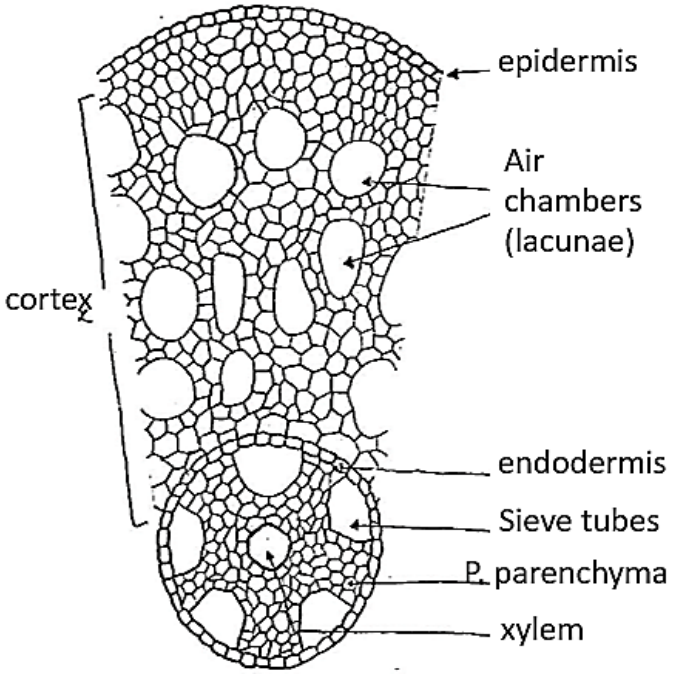
1. Anatomical structure of hydrophytes very simple.
2. Spongy plant body is caused by disintegration or separation of the cells forming large cavities.
3. These cavities found in roots, stems, rhizomes and leaves filled with air (hence called air-cavities).
4. These air spaces provide buoyancy and are helpful in respiration.

1.1. SUBMERGED HYDROPHYTES

These are the aquatic plants which are completely submerged under the water. They are of two types – submerged floating and submerged rooted ones. The submerged floating types are the plants in contact with only water, being completely submerged and not rooted in the mud. Their stems are long and leaves generally small. Some of the examples are *Ceratophyllum, Utricularia, Najas,* etc. The rooted submerged hydrophytes like *Hydrilla, Vallisneria, Potamogeton, Isoetes,* etc. remain completely submerged in water and rooted in the soil.

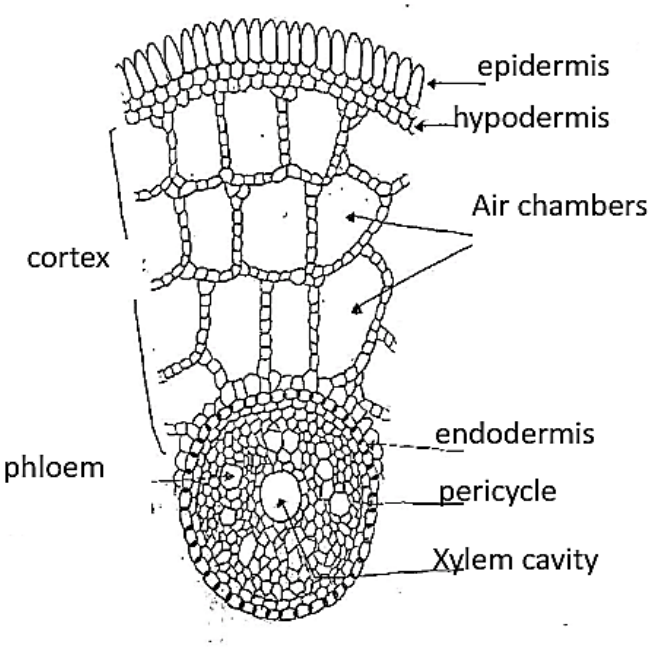
Ecological adaptations in the anatomy of Submerged Hydrophytes: -

(1) Internal structure of the roots:



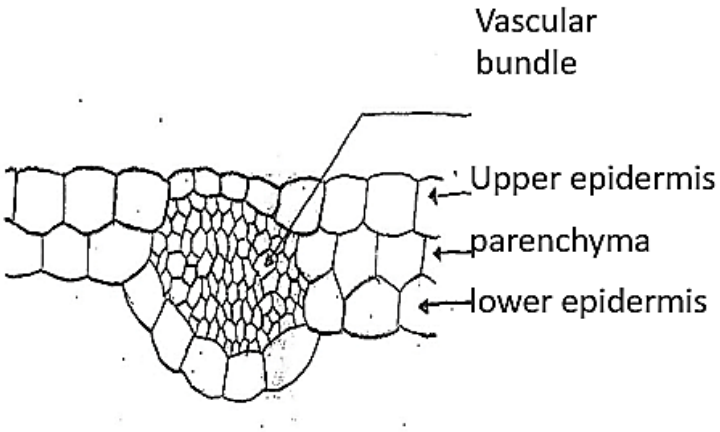
- Cuticle completely absent.
- Epidermis single-layered made up of thin-walled parenchymatous cells.
- Cortex well-developed, thin-walled and parenchymatous, major portion of which occupied by well-developed prominent air cavities – the 'aerenchyma', which offers resistance to bending stress, increases buoyancy and allows rapid gaseous exchange.
- Vascular tissues poorly developed and least differentiated in submerged forms, with thin-walled elements. Xylem vessels less common, tracheids being generally present.
- Mechanical tissues generally absent.

(2) Internal Structure of the stem:



- Cuticle mostly absent.
- Epidermis usually single-layered made up of thin-walled parenchymatous cells.
- Hypodermis sometimes absent. In some like *Hydrilla*, it may be present as thin-walled parenchyma.
- Cortex undifferentiated, thin-walled parenchymatous. It is extensively traversed by air cavities as in roots. Cells of cortex generally contain chloroplasts and are photosynthetic.
- Endodermis generally distinct.
- Vascular bundles generally lack bundle sheaths. Thin-walled vascular elements, lignified elements being absent. Xylem represented by only a cavity in the centre; mostly phloem present.
- Mechanical tissues usually absent.

(3) Internal Structure of leaves:



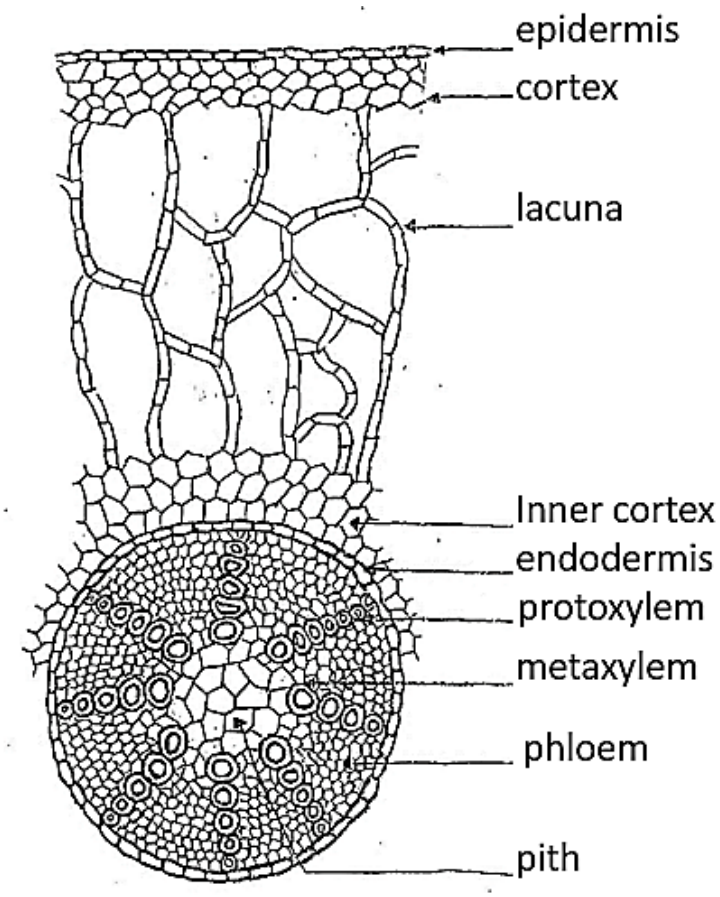
- Cuticle usually absent in submerged forms.
- Epidermis single-layered, with thin-walled cells having abundance of chloroplasts.
- Stomata completely absent in submerged leaves.
- Mesophyll is undifferentiated in submerged forms, where it is generally single-layered as in *Potamogeton*.
- Vascular tissues very much reduced and sometimes difficult to be differentiated into xylem and phloem in submerged forms like *Anachris*.
- Mechanical tissues are absent.

1.2. FREE FLOATING HYDROPHYTES:

These are the plants that remain in contact with water and air, but not soil. They float freely on the water surface. Leaves in some are very minute, while very large in some others. Some of the free floating hydrophytes are *Wolffia, Lemna, Spirodella, Azolla, Eichhornia, Salvinia, Pistia,* etc.

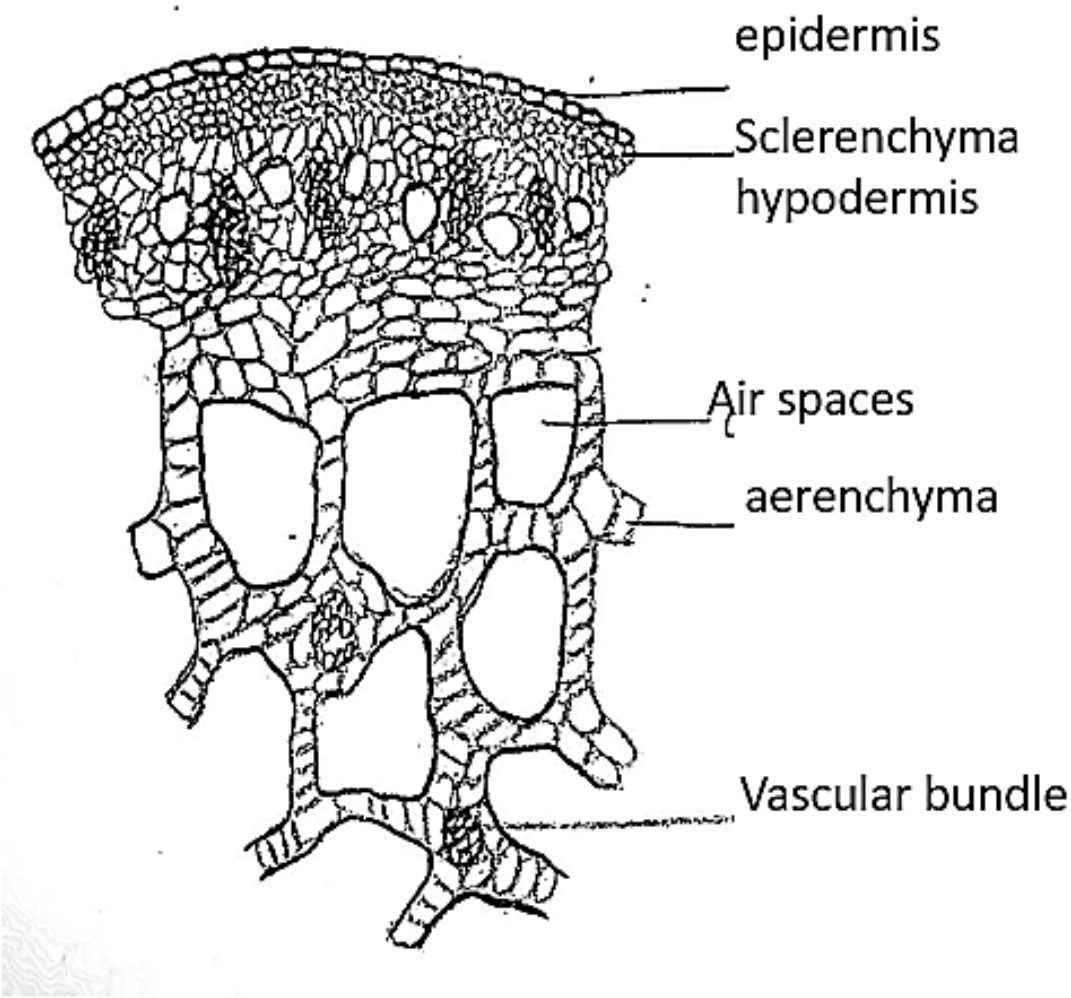
Ecological Anatomy of free-floating hydrophytes:

(1) Internal structure of roots:



- Cuticle thin and poorly developed.
- Epidermis single-layered made up of thin-walled parenchymatous cells.
- Cortex well-developed, thin-walled and parenchymatous, major portion of which occupied by well-developed prominent air cavities – the 'aerenchyma', which offers resistance to bending stress, increases buoyancy and allows rapid gaseous exchange.
- Vascular tissues comparatively differentiated to some extent.
- Mechanical tissues represented by only xylem elements.

(2) Internal structure of petiole:



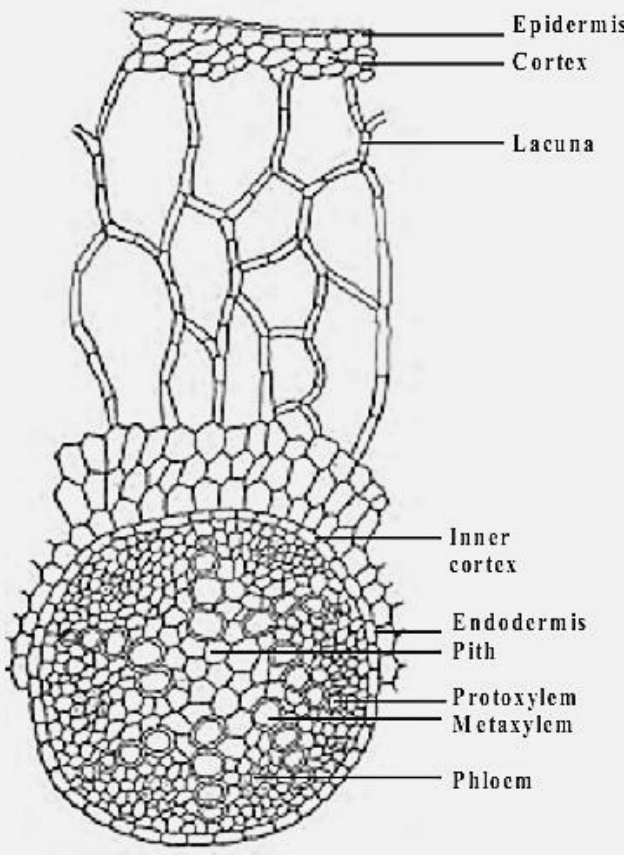
- Cuticle poorly developed, confined only to the upper side and is thin.
- Epidermis single-layered, with thin-walled cells having abundance of chloroplasts.
- Stomata confined only to the upper surface of the leaf.
- Mesophyll differentiated into spongy and palisade parenchyma, with well-developed air spaces.
- Vascular tissues differentiated, xylem elements are thin-walled, phloem being well developed.
- Mechanical tissues absent.
- There is absence of any lignified tissues.

1.3. ROOTED FLOATING HYDROPHYTES:

These are the plants that have their roots fixed in the mud, but leaves have long petioles which keep them floating on the water surface. The remaining plant, except the leaves, remains in water. Some of the rooted hydrophytes with floating leaves are *Trapa, Nelumbo, Nymphaea, Marsilea*, etc.

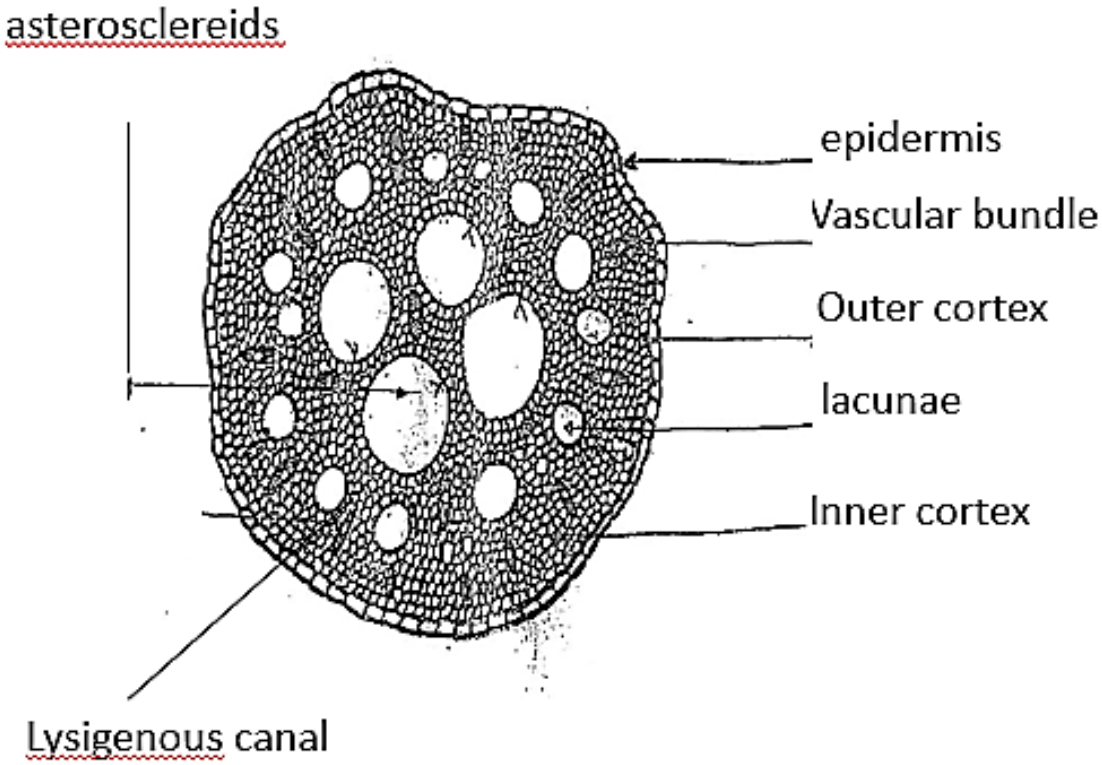
Ecological adaptations in the anatomy of rooted floating hydrophytes:

(1) Internal structure of roots:



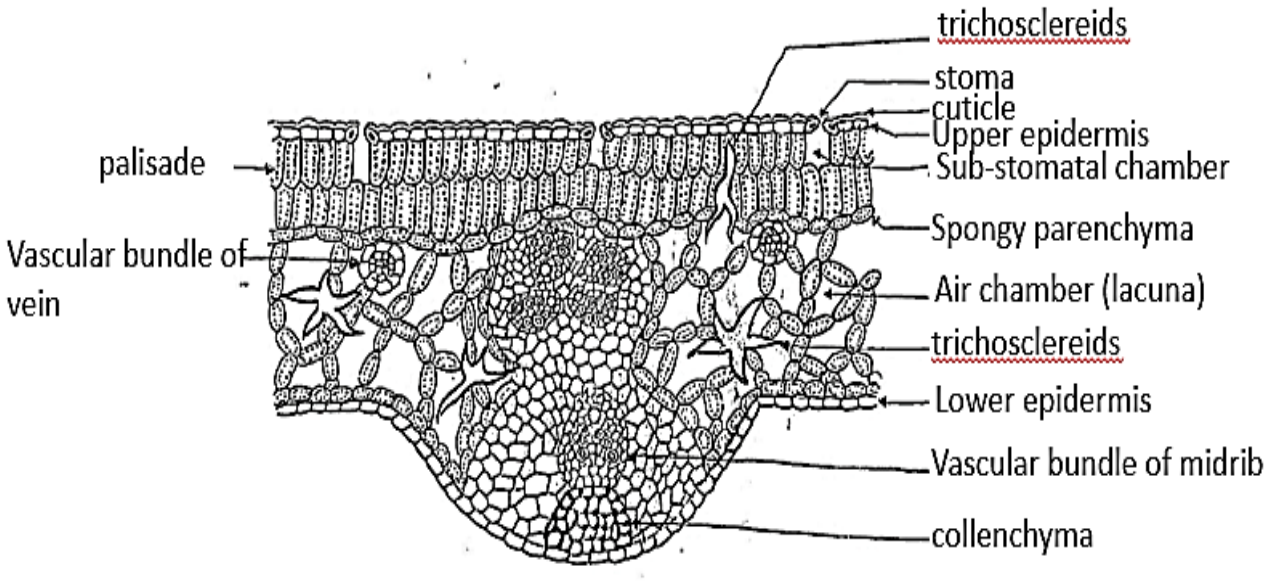
- Cuticle thin and poorly developed.
- Epidermis single-layered made up of thin-walled parenchymatous cells.
- Cortex well-developed, thin-walled and parenchymatous, outer major portion of which occupied by well-developed prominent air cavities – the 'aerenchyma', called lacunae, which offers resistance to bending stress, increases buoyancy and allows rapid gaseous exchange. Inner cortex also parenchymatous.
- Vascular tissues comparatively differentiated to some extent.
- Mechanical tissues represented by only xylem elements.

(2) Internal structure of stem:



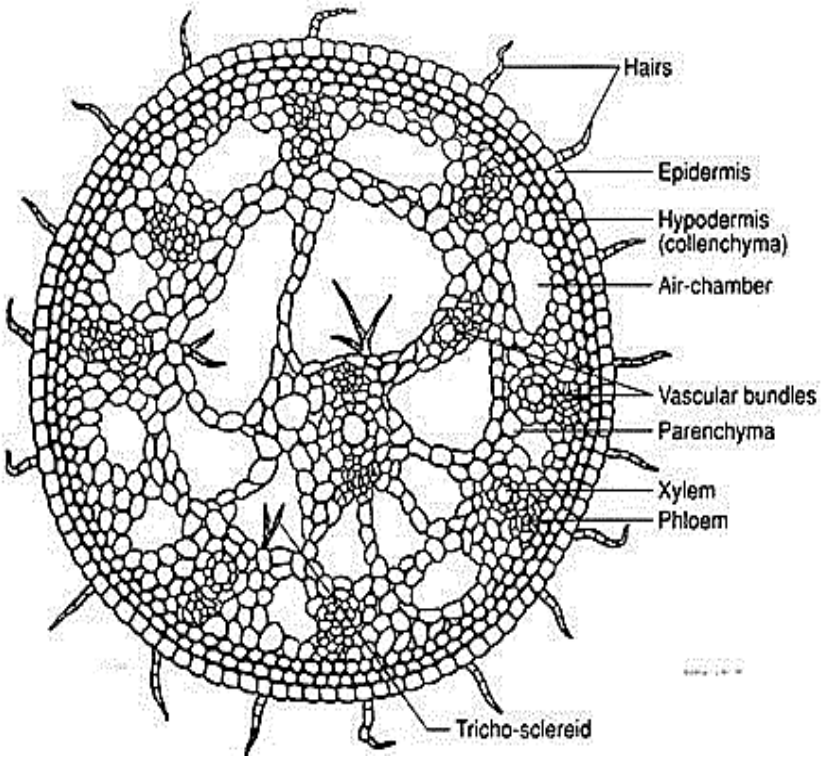
- Cuticle poorly developed and thin.
- Epidermis well-developed in rhizomes of *Nymphaea* and *Nelumbo*.
- Hypodermis present as thin-walled parenchyma and collenchyma.
- Cortex differentiated. Outer cortex consists of compact parenchymatous cells. Inner cortex with large number of lacunae as in roots. Large number of vascular bundles scattered in the cortex. Sclereids and lysigenous canals seen in the cortical region of stem of *Nymphaea*.
- Endodermis generally distinct, especially in rhizomes.
- Vascular bundles generally lack bundle sheaths. Thin-walled vascular elements, lignified elements being absent.
- Mechanical tissues usually absent.

(3) Internal structure of leaf:



- Cuticle poorly developed and confined only to the upper side and is thin, sometimes waxy that prevents wetting of leaf.
- Epidermis single-layered, made up of thin-walled cells with abundant chloroplasts.
- Stomata confined only to the upper surface of leaf, prominent sub-stomatal chambers visible in cross section.
- Mesophyll differentiated into palisade and spongy with well-developed air cavities.
- Vascular tissues differentiated, xylem elements much reduced and thin-walled, phloem well-developed.
- Tricho-sclereids visible in the cortical region that act as reduced mechanical tissue.
- Slime glands seen in the lower epidermis that prevents dessication.

(4) Internal structure of petiole:



- Outgrowth of hair from the epidermis. Cuticle absent.
- Epidermis single-layered.
- Hypodermis 2-3 layered made up of collenchyma. Reduced mechanical tissue.
- Cortex differentiated, outer parenchymatous, inner aerenchymatous with large air chambers, showing the presence of sclereids.
- Vascular bundle in the centre; phloem surrounded by xylem. Phloem abundant, xylem represented by lacunae.

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