

Ecological Adaptations in Hydrophytes

Hydrophytes are the plants which grow in habitats where water is abundant. They are further divided into the following six groups.

1. **Free floating:** These plants float freely and independently on water surface; e.g., *Eichhornia*, *Lemna*, *Pistia* etc.
2. **Floating and possessing roots:** These plants float on the surface of water. These plants attach themselves to the bottom with the help of their roots; e.g., *Nymphaea*, *Trapa* etc.
3. **Submerged:** These plants occur below the water surface, but they do not attach themselves to the bottom; e.g., *Ceratophyllum*, *Najas* etc.
4. **Submerged and possessing roots:** These plants occur below the water surface and also remain attached to the bottom of water reservoir; e.g., *Hydrilla*, *Vallisneria* etc.
5. **Ambhibious and possessing roots:** These plants grow in waterlogged soils. Examples are, *Polygonum*, *Marsilea* etc.
6. **Emergent and possessing roots:** These plants grow in shallow waters and remain attached to the bottom. A part of the plant is below the water surface and a part above it. Examples are, *Cyperus*, *Typha* etc.

Morphology of Hydrophytes

Hydrophytes have some special adaptations. Following are some of the external features.

Roots:

In hydrophytes roots do not play an important role in water absorption.

1. Roots are either completely absent (e.g., *Ceratophyllum*) or poorly developed (e.g., *Hydrilla*).
2. Root pockets are present instead of root caps (e.g., *Eichhornia*, *Lemna*, *Pistia* etc.).
3. Some plants develop floating roots in addition to normal adventitious roots (e.g., *Jussiaea repens*)

Stems:

The stem of hydrophytes shows the following adaptations.

1. In most of the hydrophytes the stem is long, slender, spongy and flexible; e.g., *Hydrilla*, *Potamogeton* etc.

2. The stem may float horizontally on water surface (e.g., *Azolla*) or may be thick, short and stoloniferous; e.g., *Eichhornia*. It may be attached to the bottom of the pond by a rhizome (e.g., *Nymphaea*).

Petiole

The petioles have special modifications to suit the aquatic environment. Following are some of the modifications.

1. Long, slender and delicate petioles are present in hydrophytes with their leaves floating on water surface (e.g., *Nymphaea*).
2. In some plants petiole is swollen to form a bulb like structure to help the plants to float on water (e.g., *Eichhornia*).

Leaves

The leaves of hydrophytes show the following characteristics:

1. In submerged hydrophytes the leaves are thin, long and in the shape of a ribbon, (e.g., *Vallisneria*) or finely dissected (e.g., *Ceratophyllum*).
2. Floating leaves are large, entire and flat (e.g., *Nymphaea*). These leaves have a coat of wax. The leaves may also have hairs (e.g., *Salvinia*).
3. The leaves of emergent and amphibious hydrophytes are heterophyllous, i.e., the leaves below the water are long, narrow and dissected while those outside the water are entire and broad. This is also termed as dimorphism of leaves. Heterophylly is shown in plants such as *Ranunculus*, *Limnophila heterophylla*, *Sagittaria*, *Sagittifolia* etc.

Anatomy of Hydrophytes

Following anatomical characters are common to all hydrophytes.

1. All hydrophytes show presence of large air chambers. The tissue that forms air chambers is termed as **aerenchyma**.
2. Mechanical tissue, i.e., sclerenchyma is either poorly developed or absent.
3. Vascular tissue, particularly xylem is poorly developed.
4. Cuticle is absent.
5. Stomata are absent in submerged hydrophytes.

Roots

Epiblema is not cuticularised. Cortex is mostly parenchymatous. Aerenchyma may also be present. Xylem is poorly developed in comparison to phloem. Amphibious hydrophytes show xerophytic characters in addition to hydrophytic characters. The roots of these plants have well developed mechanical and vascular tissues, besides aerenchyma.

Stem

Cuticle is absent in epidermis. Cortex is large and parenchymatous. It is largely made of aerenchyma. Xylem is poorly developed in comparison to phloem. The vascular tissues are so reduced that these form a single vascular bundle.

Leaves

The leaf epidermis does not have cuticle. However, in floating leaves wax or hairs cover the upper epidermis. Stomata are present only in the upper epidermis. Stomata are absent in the submerged leaves. Large air chambers and spongy parenchyma are present in the leaves. Palisade parenchyma is generally absent.

In amphibious hydrophytes cuticle, stomata, palisade tissue and well developed tissue are present.

Anatomy of *Eichhornia* Root

Transverse section of the root shows the following characters:

1. **Epiblema:** It is the outermost single layer of cells. Cuticle is absent.
2. **Cortex:** It is divisible into three parts. The outer cortex consists of compactly arranged parenchyma. Middle cortex shows aerenchyma consisting of many air chambers. The inner cortex consists of compactly arranged isodiametric parenchyma.
3. **Endodermis and pericycle:** Both these layers are very distinct.
4. **Vascular tissue:** Vascular bundles are radial and exarch. The xylem elements are only a few.
5. **Hydrophytic characters:** The transverse section of the root shows the following hydrophytic characters.
 - a). Undifferentiated parenchymatous cortex.
 - b). Presence of aerenchyma.
 - c). Absence of mechanical tissue.
 - d). Poorly developed vascular tissue.
 - e). Parenchymatous pith.

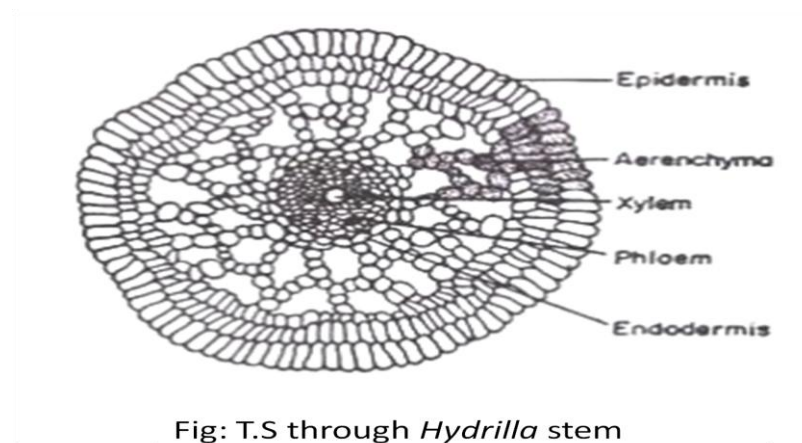
Anatomy of *Hydrilla* Stem

Transverse section of the stem shows the following characters:

1. **Epidermis:** This is the outermost single layer of cells. The cuticle is absent.
2. **Cortex:** It is mainly aerenchymatous and shows large number of air chambers. The air chambers towards the periphery are larger than those present in the middle of the cortex.
3. **Endodermis and pericycle:** The layers are not distinct.

4. **Vascular tissue:** The amount of phloem more. A large central cavity represents xylem.
5. **Hydrophytic characters:** The transverse section of the stem shows the following hydrophytic characters.

- a). Thin walled epidermis.
- b). Absence of cuticle.
- c). Presence of air chambers in the cortex.
- d). Vascular tissue poorly developed.
- e). The amount of phloem is more than that of xylem.



Anatomy of *Eichhornia* Petiole:

Transverse section of the petiole shows the following characters:

1. **Epidermis:** This is a single layer of cells where the cuticle is absent.
 2. **Hypodermis:** Parenchymatous tissue that is present below the epidermis forms the hypodermis.
 3. **Aerenchyma:** The remaining part of the petiole is termed as ground tissue. It has many air chambers or lacunae. The size of the air chambers gradually increases towards the centre.
 4. **Vascular tissues:** Numerous vascular bundles are present here and there between the air chambers. A distinct parenchymatous envelope surrounds each vascular bundle. Phloem occurs in the peripheral part of the bundle and a single element of xylem is present in the centre.
 5. **Hydrophytic characters:** The following hydrophytic characters are seen in the transverse section of the petiole.
- a). Thin walled epidermis.
 - b). Absence of cuticle.
 - c). Absence of mechanical tissue.

- d). Presence of aerenchyma and air chambers.
- e). The phloem is distinct in comparison to xylem.

