

# *Equisetum* (Sphenopsida)



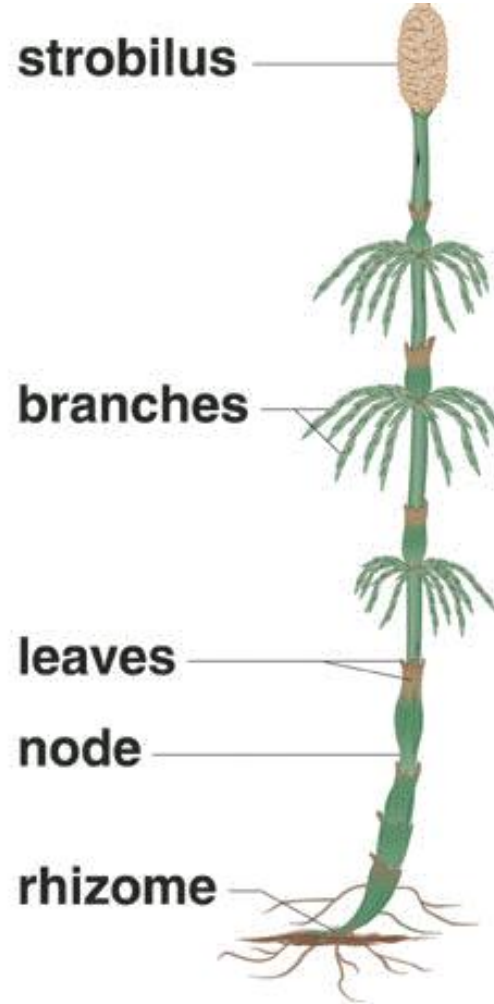
# General Characters

- Characteristic feature of these plants, is the hollow stem consisting of internodes fitting one on top of the other like links of a chain.
- At the level of the nodes (joints) a whorl of small scaly leaves forming a brush emerge.
- In some species "side-branches" arise from these nodes. The stem contains a single vascular trace and a central canal, surrounded by smaller cavities and bands of cells giving strength.
- At the top of the fertile stem a cone-shaped strobilus is formed from rings of sporangiophores.
- These consist of stalks covered with a scale that protects the sporangia. By dry weather ribbon-like appendages attached to the spore uncoil and enable a further dispersal through the wind.
- The spore germinates to form a prothallus.
- After fertilization a new sporophyte is formed.

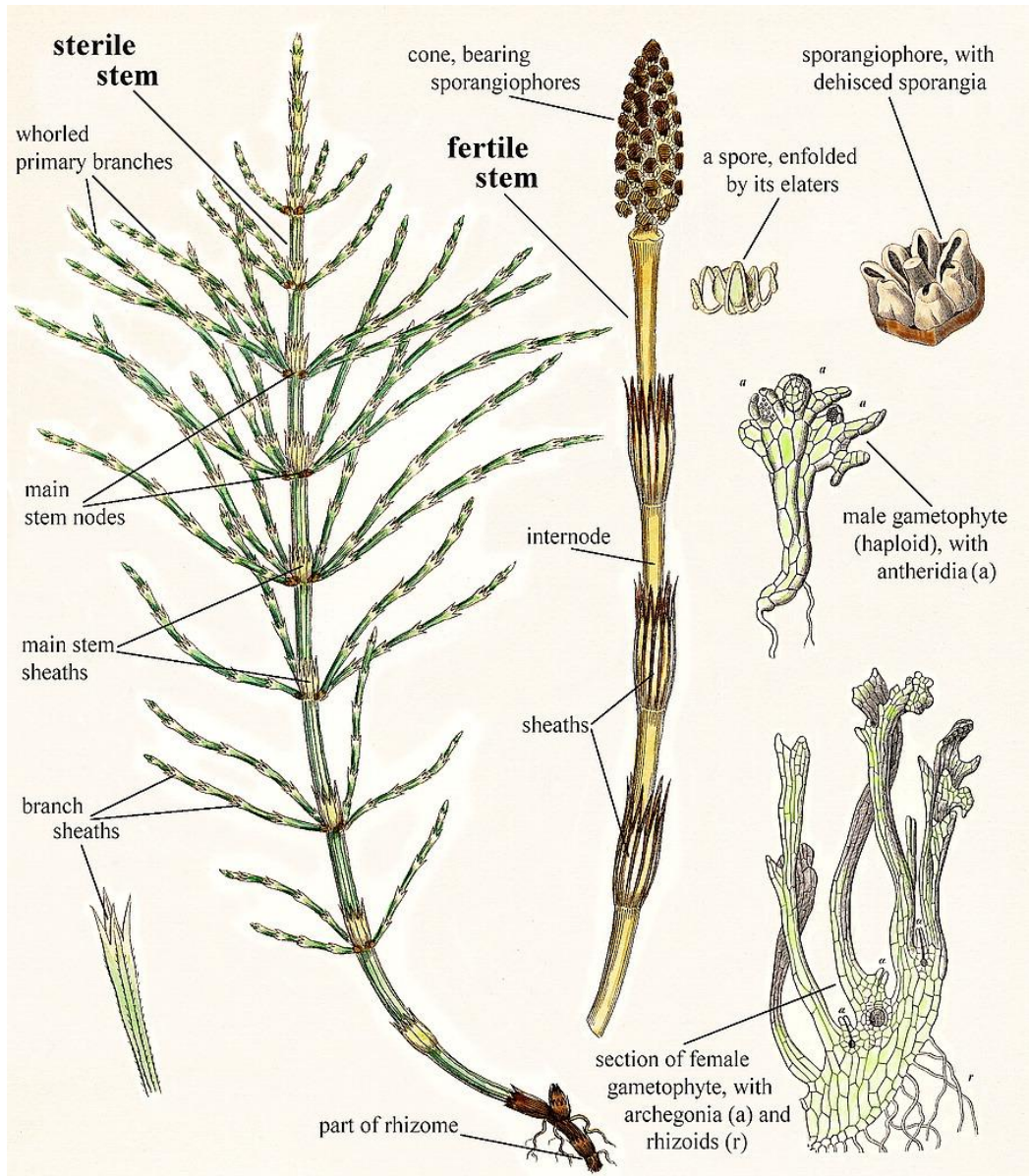
# Morphology

- *Equisetum* has a perennial, branched and creeping underground rhizome, which gives annual erect aerial branches.
- The aerial branches are herbaceous and usually grow to a height of 10-60 cm, but they can attain more height in some species.
- *E. giganteum*, the largest species of *Equisetum*, which grows in the tropics of South America, has stem up to 13 meters long, but since the stem is relatively thin (1.5 to 2.0 cm in diameter), it is vine-like in habit and climbs with adjacent trees.
- Stems are hollow, segmented and rough surfaced.
- Leaves are reduced to scales at the internodes.
- The fertile and sterile stems are similar, with the fertile stems topped with a spore-producing cone.

# Morphology



# Morphology





# Sporophyte

The sporophyte of *Equisetum* is differentiated into stem, root and leaves.

## **Stem:**

- The underground, creeping and perennial rhizome gives off aerial as well as subterranean branches.
- Aerial branches are rough (due to deposition of silica), jointed and green, differentiated into nodes and internodes.
- There is a whorl of small scaly leaves at each node. The leaves of a whorl are joined at their bases, forming sheath around the node.
- A branch bud is formed alternate to each scale leaf at the node, and these buds develop into erect aerial branches.



# Sporophyte

- The rhizome bears two types of aerial shoots, vegetative shoots and fertile shoots.
- Both these types of shoots are differentiated into nodes and internodes.
- The vegetative shoots are usually branched, green and photosynthetic.
- The fertile shoots are unbranched and achlorophyllous, each terminating into a cone or strobilus.
- In some species (e.g. *E. debile* and *E. diffusum*) there is no distinction between sterile and fertile shoots, and all the aerial shoots bear strobili.



# Sporophyte

## Leaves:

- The leaves are minute, scaly and isophyllous.
- They arise in whorls at the nodes of both the underground rhizome and aerial branch.
- They are fused at their bases to form a distinct sheath, and their distal free ends give a frill-like appearance.
- The leaves of *Equisetum* are non-photosynthetic, and their main function is to protect the branch buds at the node.





# Sporophyte

## Roots:

- The *Equisetum* sporophyte develops an underground rhizome system.
- The rhizome produces true roots along its length.
- The sporophyte is also competitive in fairly moist soils, though some species are specialized for desiccating environments.



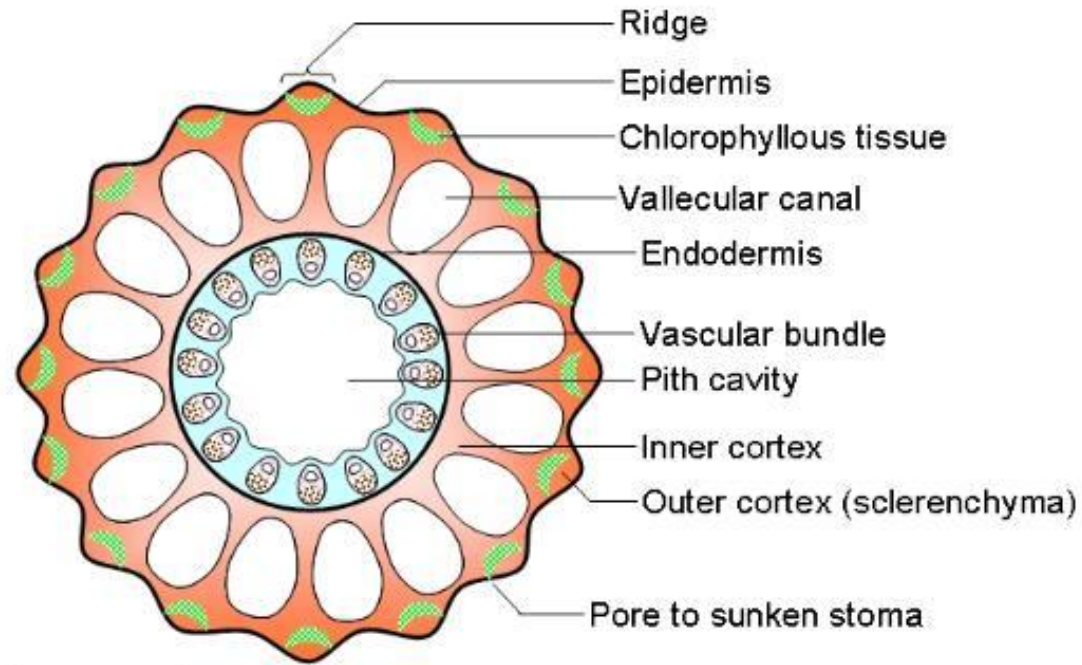
# Anatomy of stem

- The stem has 6-19 grooves producing **vertical ridges** running along its length. These ridges provide the main support for the plant as they are packed with **sclerenchyma**.
- The stems are hollow, with a central pith cavity surrounded by a ring of vascular bundles. There are as many vascular bundles as there are ridges and the vascular bundles are radially aligned with the ridges.
- Alternating with the vascular bundles, and situated in the cortex, are large longitudinal air spaces, called **vallecular canals**. These probably serve for both respiration (as the plant grows in damp soils which may be water-logged) and to reduce weight and increase stem strength.
- The **chlorophyllous tissue** is the main photosynthetic tissue and opens to the outside air via stomata which are sunken beneath pores flanked by subsidiary cells.

# Anatomy of stem

- The **hollow central pith** reduces the weight of the stem, and the chief supporting structures are concentrated towards the outside, increasing the strength of the stem and its resistance to buckling.
- The sclerenchyma cells are strengthened by **silica**, in both the stem and branches.
- The xylem consists of tracheids. The first formed **protoxylem** only persists as fragments.
- The later **metaxylem** develops from two groups, one on either side of the phloem. In the node, tracheids run horizontally, forming a ring which connects all the vascular bundles together.
- All the xylem is primary.

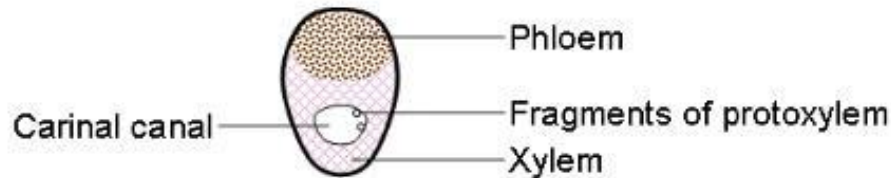
# Anatomy of stem



1.0 mm

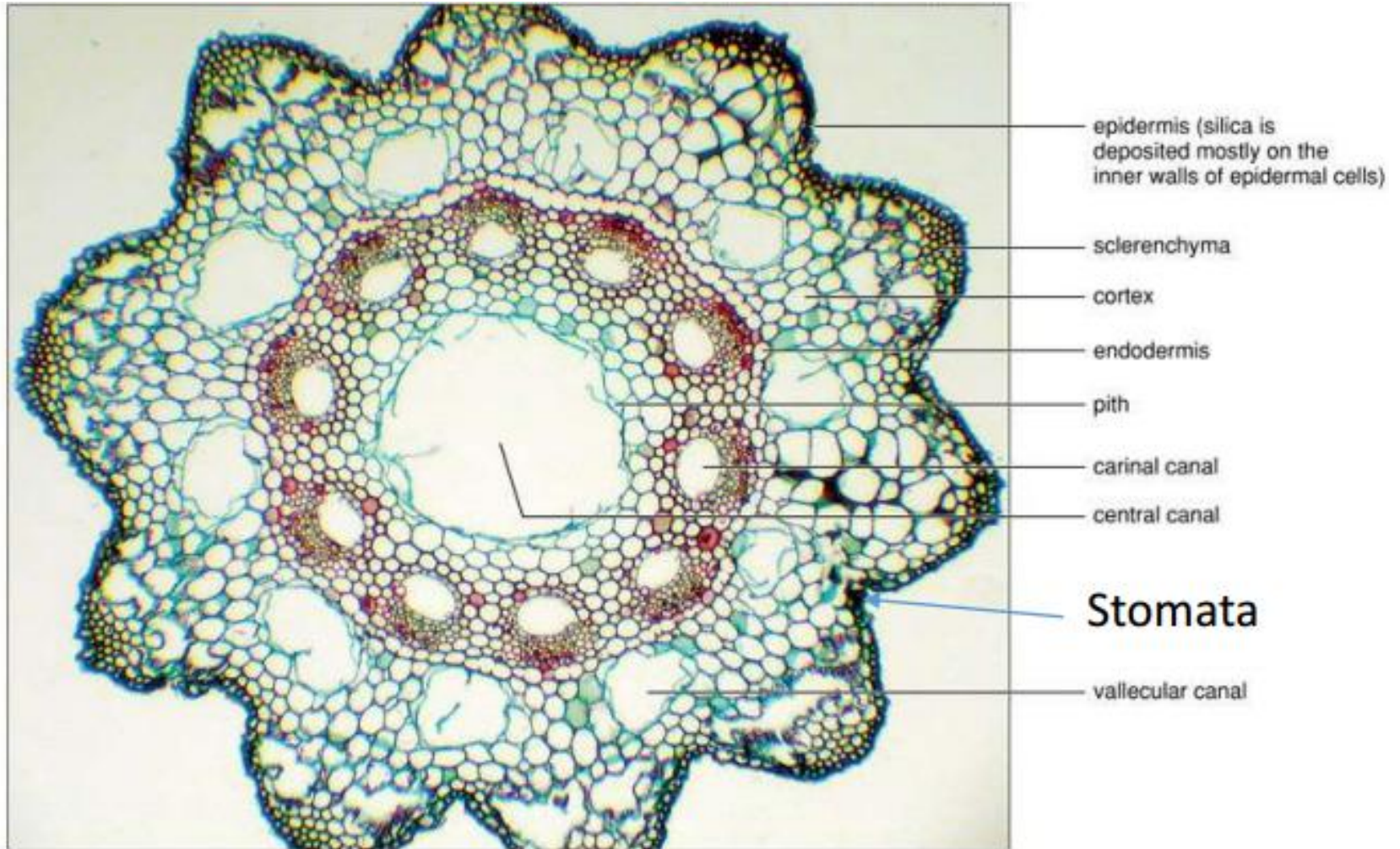
T.S. (young) stem of *Equisetum arvense*

## Detail of vascular bundle:





# Anatomy of stem



# Reproduction by Spores

## **Strobili:**

- In contrast to the strobilus of a clubmoss, which is composed of a series of reduced sporophylls (sporangia-bearing leaves), the terminal strobilus of *Equisetum* is composed of tightly packed whorls of very modified 6-sided structures, called sporangiophores.
- The sporangiophores are attached perpendicular to the axis of the strobilus. Attached to the bottom of each sporangiophore are 5-10 sporangia.
- When the spores are mature, the strobilus elongates slightly, separating the sporangiophores and allowing the spores to be released.
- The green, photosynthetic spores of *Equisetum* bear 4 elaters, which are long strap-like structures that aid in spore dispersal.

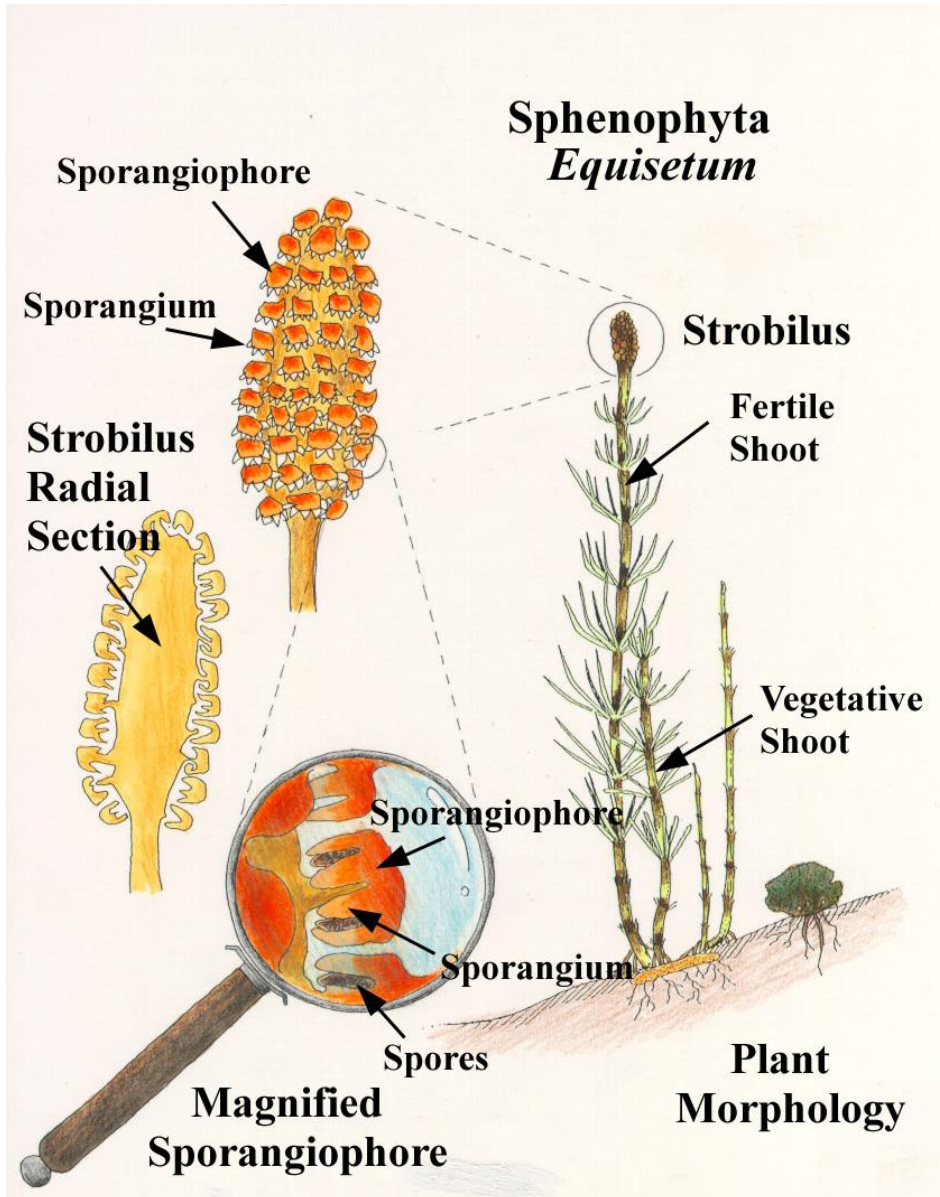
# Reproduction by Spores

**Strobili:**

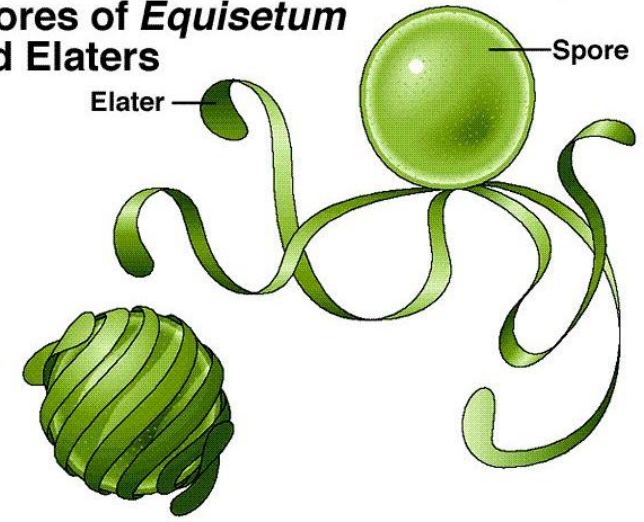




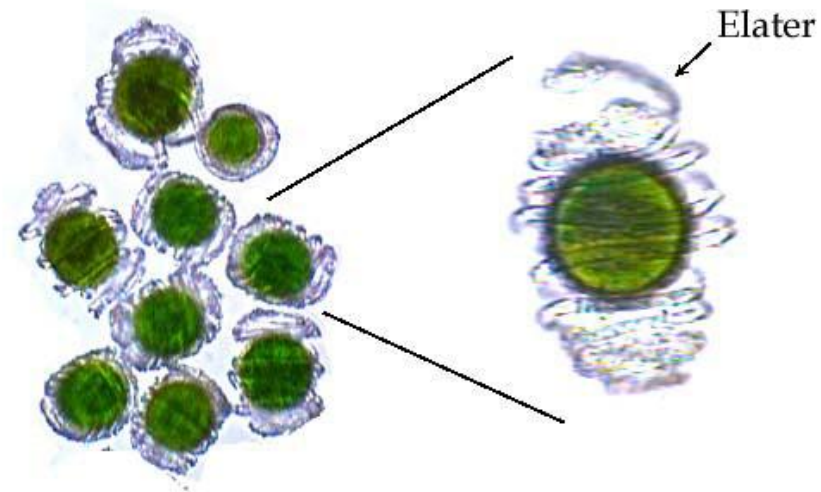
# Reproduction by Spores



## Spores of *Equisetum* and Elaters



## *Equisetum* Spores





# Life cycle

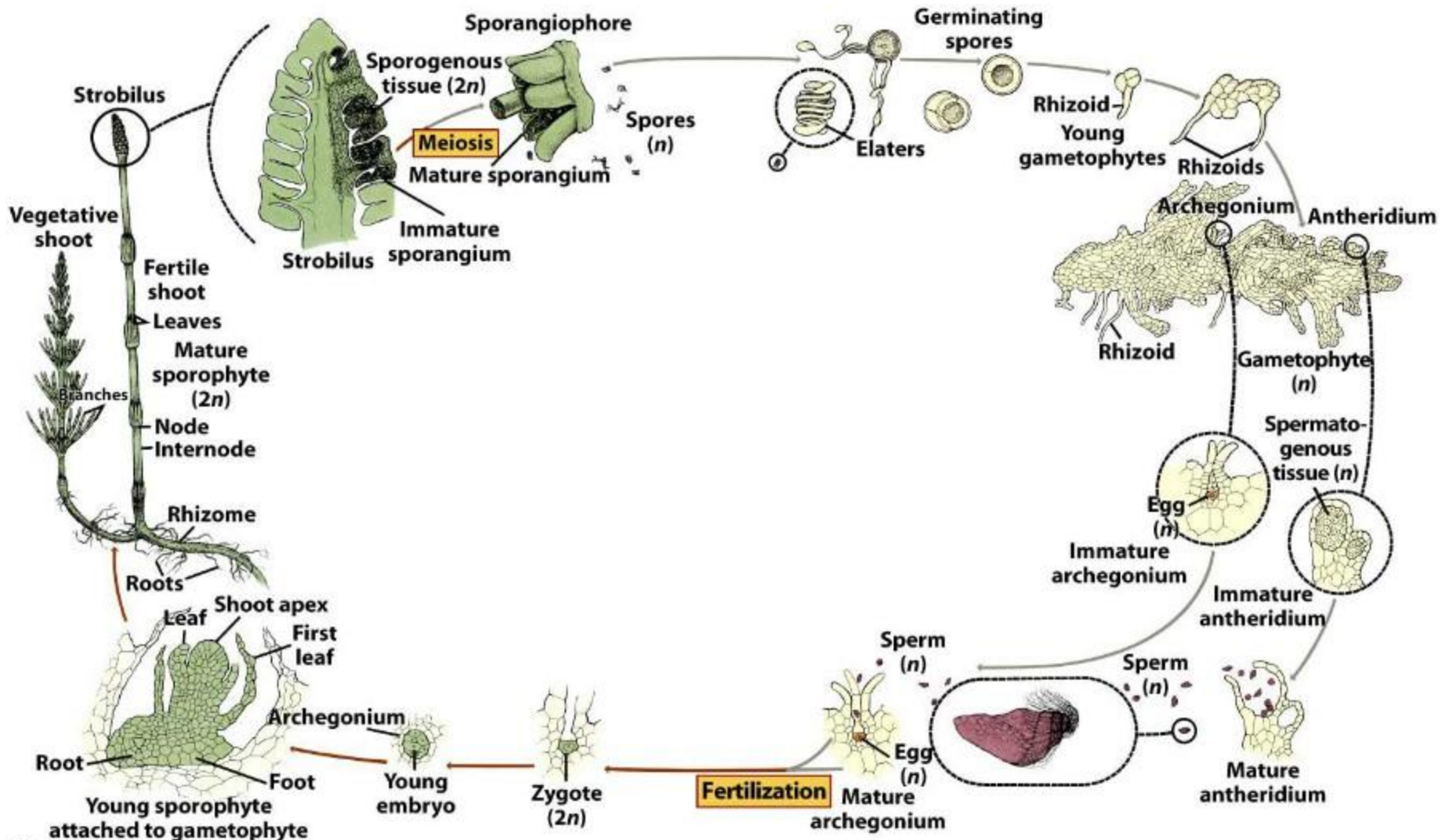


Figure 17-40  
 Biology of Plants, Seventh Edition  
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