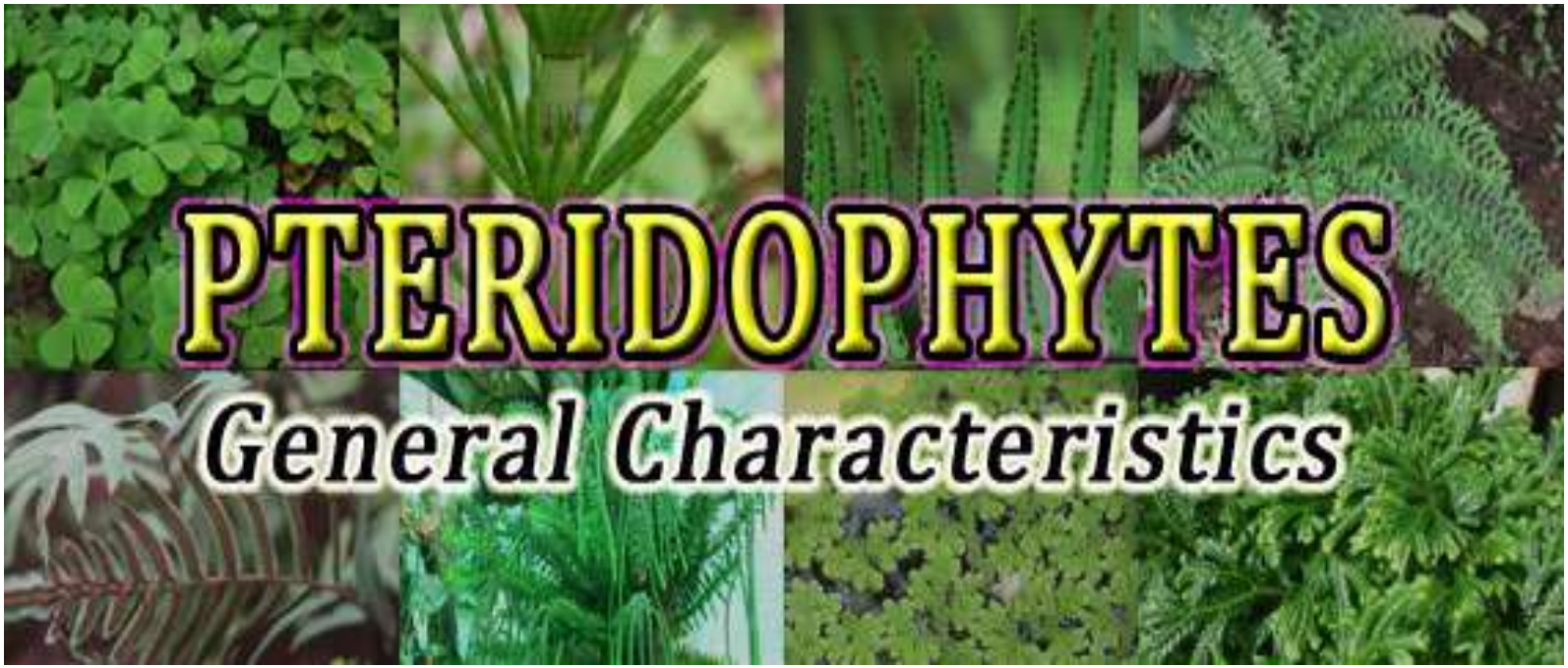

PTERIDOPHYTES
General Characteristics

PTERIDOPHYTES: GENERAL CHARACTERS

Pteridophytes: the ferns

Pteridophytes
Plants with Feather-like Leaf

- Plant with feather like leaves
- ***Pteron*** = feathers; ***phyton*** = plant
- **Vascular cryptogams:** cryptogams with vascular system
- Includes primitive living and fossil vascular plants
- Represented by 400 genera and 10500 species (living and fossil)
- Plant body is **sporophytic**, differentiated into **stem**, **root** and **leaves**
- Mature sporophyte is nutritionally **independent** of gametophyte

General Characters

- Majority of the living Pteridophytes are terrestrial and prefer to grow in cool, moist and shady places e.g., ferns. Some members are aquatic (e.g., *Marsileci, Azolla*), xerophytic (e.g., *Selaginella rupestris, Equisetum*) or epiphytic (e.g*., Lycopodium squarrosum)*

- Majority of the Pteridophytes are herbaceous but a few are perennial and tree like (e.g., *Angiopteris).* Smallest Pteridophyte is *Azolla* (an aquatic fern) and largest is *Cyathea* (tree fern).
- Plant body is sporophytic and can be differentiated into root, stem and leaves.
- Roots are adventitious in nature with monopodial or dichotomous branching.
- Stem is usually branched. Branching is monopodial or dichotomous. Branches do not arise in the axil of the leaves. In many Pteridophytes stem is represented by rhizome.
- Leaves may be small, thin, scaly (microphyllous e.g., *Equisetum*), simple and sessile (e.g., *Selaginella*) or large and pinnately compound (megaphyllous e.g., *Dryopteris)*.
- Vascular tissue is present in stem and root. It consists of xylem and phloem. Xylem consists of tracheids only and phloem has only sieve tubes.
- The steel is protostele (e.g., *Rhynia, Lycopodium*), siphonostele (e.g., *Equisetum*), dictyostele (*Adiantum*) or polycyclic (e.g., *Angiopteris*).

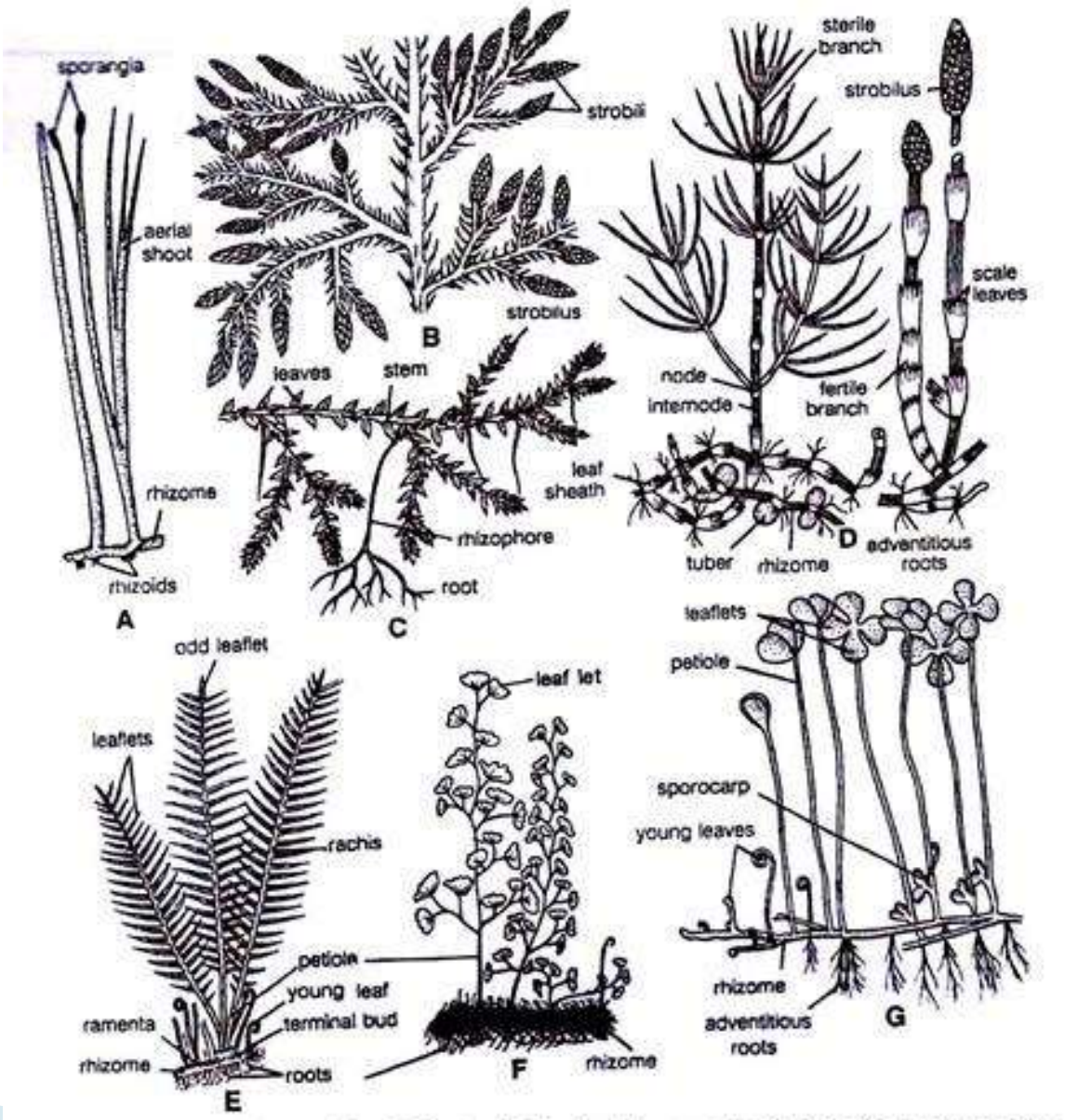


Fig 1 (A–G). Different forms of Pteridophytes A. *Rhynia*, B. *Lycopodium*,C. *Selaginella*, D. *Equisetum* E. *Pteris*, F. *Adiantum*, G. *Marsilea*

Microphyllous and Megaphyllous

Microphyllous–*Lycopodium*

Megaphyllous–*Pteris*

Circinate vernation in Pteridophytes

Extinct and Extant Forms

Selaginella

Pteris

Dryopteris

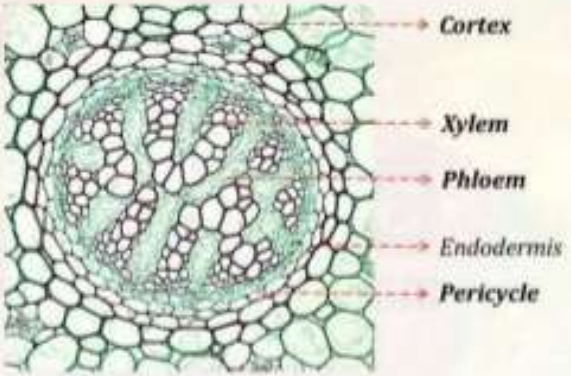
Adiantum

Equisetum

STELAR EVOLUTION IN PTERIDOPHYTES

What is stele? What are the components of stele?

- *Stele is the central cylinder or core of vascular tissue in higher plants*
- Stele consists of:
  - **Xylem**
  - **Phloem**
  - **Pericycle**
  - **Medullary (if present)**

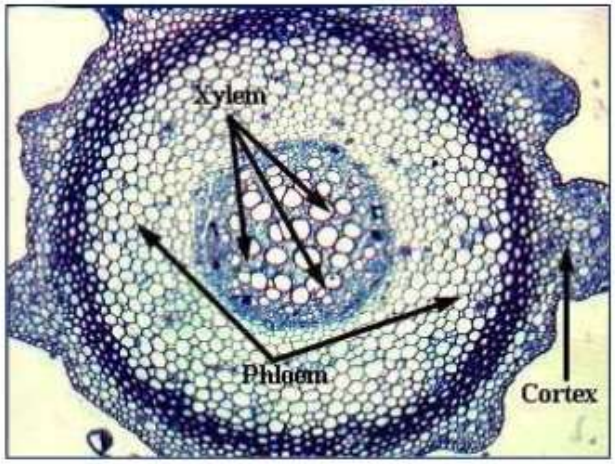


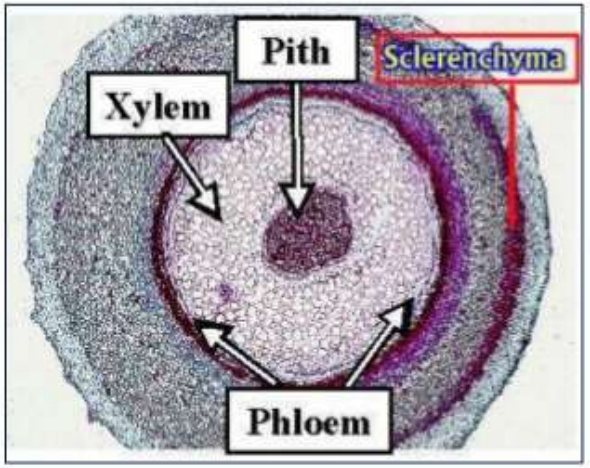
A Pteridophyte Stele
Lycopodium

- Term 'stele' used by Van Tieghem and Douliot (1886) in 'Stelar Theory'

BASIC TYPES OF STELES

- PROTOSTELE – Central Xylem, surrounding Phloem. No Pith. Primitive
- SIPHONOSTELE – Protostele with Central Pith. Advanced





Types of Stele in Plants

Protostele
(Stele without Pith)

- **Haplostele**
  Smooth central xylem
  Xylem surrounded by phloem
  Eg. *Rhynia, Lygodium*
- **Actinostele**
  Star shaped xylem
  Phloem between star arms
  Eg. *Lycopodium serratum*
- **Plectostele**
  Xylem as plates
  Phloem between xylem plates
  Eg. *Lycopodium clavatum*
- **Mixex protostele**
  Xylem as patches in phloem
  Eg. *Lycopodium sernuum*
- **Mixed protostele with pith**
  With pith like parenchyma
  Eg. *Hymenophyllum*

Siphonostele
(Stele with Pith, no leaf gap)

- **Cladosiphonic Siphonostele**
  Without leaf gap
  Eg. *Selaginella*
- **Ectophloic siphonostele**
  Phloem external to xylem
  Eg. *Osmunda*
- **Amphiphloic siphonostele**
  Phloem both sides of xylem
  Eg. *Marsilea* rhizome

Solenostele
(Stele with pith and leaf gap)

- **Ectophloic Solenostele**
  Phloem external to xylem
- **Amphiphloic solenostele**
  Phloem both sides of xylem
  Eg. *Adiantum pedatum*
- **Dictyostele**
  Many meristels
  Eg. *Pteris*
- **Polycyclic stele**
  Many circles of VB
  Eg. *Pteridium aquilinum*
- **Eustele**
  VB arranged as a broken ring
  Eg. *Dicot Stem*
- **Atactostele**
  Scattered arrangement of VB
  Eg. *Monocot Stem*

Stelar System Evolution
(in Pteridophytes & Higher Plants)

Reproduction in Pteridophytes

- Reproduction takes place by means of spores which are produced inside sporangia.
- The development of the sporangium may be leptosporangiate (sporangium originates from a single cell) or eusporangiate (sporangium develops from a group of cells).
- Spores on germination give rise to multicellular gametophytic bodies called prothalli (sing. prothallus).
- In homosporous Pteridophytes prothalli are monoecious (antheridia and archegonia develop on the same prothallus). In heterosporous species prothalli are always dioecious. Microspores on germination give rise to male prothalli and megaspores to the female prothalli.

Development of Sporangium

On the basis of development, the sporangia in Pteridophytes are divided into two types:

(i) Eusporangiate Type:
Sporangium develops from group of superficial cells. These cells divide periclinally into primary wall layers and inner primary sporogenous cells . The outer wall layers form the wall of the sporangium while inner sporogenous cells divide meiotically and form spores

(ii) Leptosporangiate Type:
This type of sporangium arises from a single superficial cell. It divides transversely to form an outer and an inner cell. While the inner cell forms the stalk, the entire sporangium develops from the outer cell. The outer cell divides by three successive periclinal divisions and in this way a tetrahedral apical cell is formed.
It divides by periclinal division to form the outer jacket cell and inner primary sporogenous cell . Jacket cell forms the single layered sporangial wall while primary sporogenous cell divides into tapetal initial and sporogenous tissue. Sporogenous tissue divides meiotically to give rise to haploid spores while tapetal initial forms two layered tapetum

Development of Sporangium

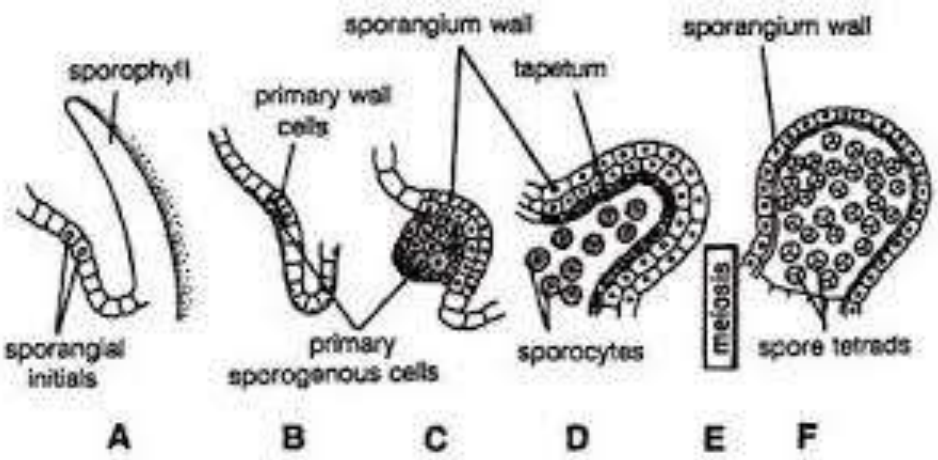


Fig. 2. (A-F) Development of Eusporangiate type of Sporangiu

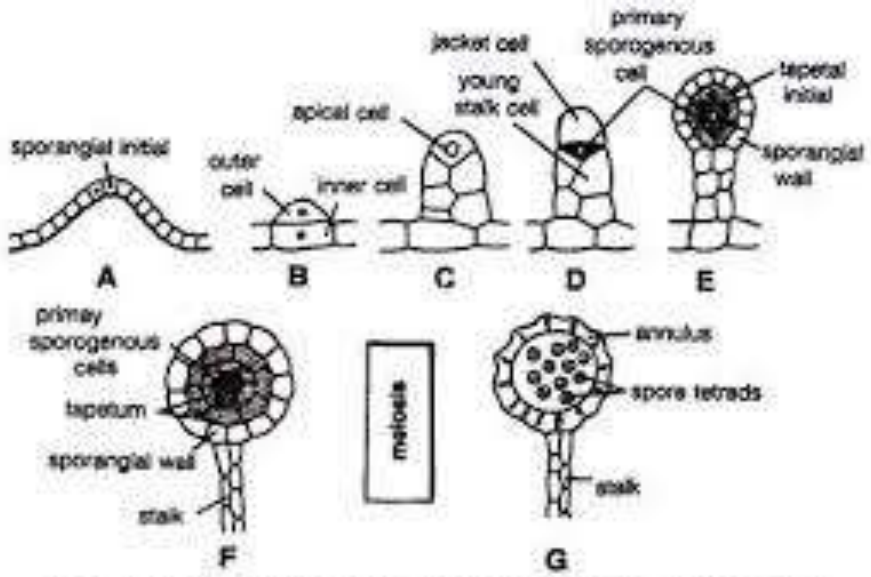


Fig. 3. (A-G) Development of Leptosporangiate type of Sporangium

Pteridophytes-Sporangium

Sporangium- *Equisetum*

Sporangium- *Dryopteris*

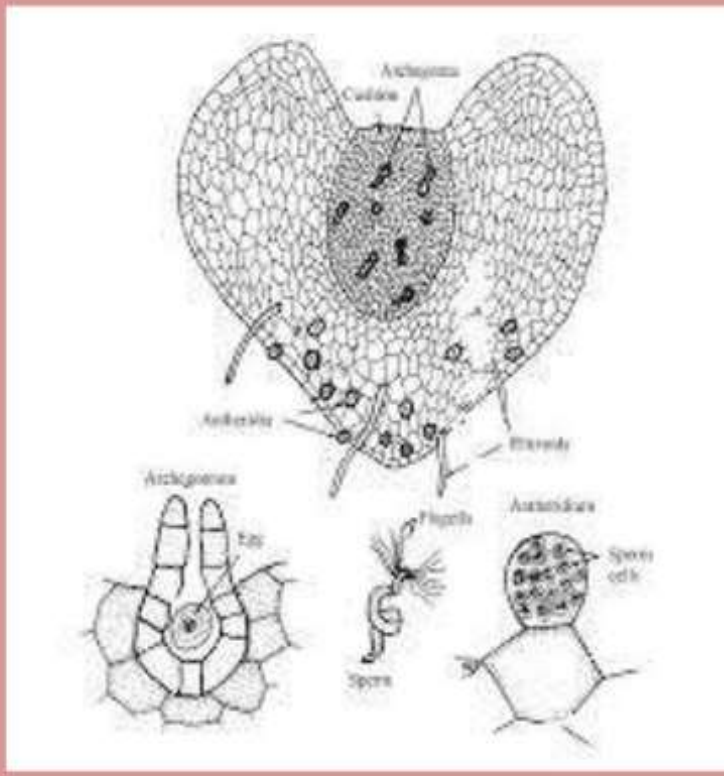
Reproduction (cont.)

- Antheridia and archegonia are developed on prothalli.
- Antheridium is surrounded by a single layered sterile jacket.
- Archegonium consists of four vertical rows of neck cells, 1-2 neck canal cells, ventral canal cell and egg.
- Antherozoids are unicellular, biflagellate (e.g., *Selaginella*) or multiflagellate (e.g., *Equisetum* and ferns) and motile.
- Antherozoids are attracted towards the neck of the archegonium
- Water is essential for fertilization (zooidogamous).
- Fertilization results in the formation of zygote or oospore, which ultimately develops into well-developed sporophyte.
- The fertilized egg divides transversely or vertically. Another cross wall forms a quadrant stage producing stem, leaf, foot and root.
- Plants show heteromorphic alternation of generation. The main plant body is sporophytic and forms a dominant phase in the life cycle.

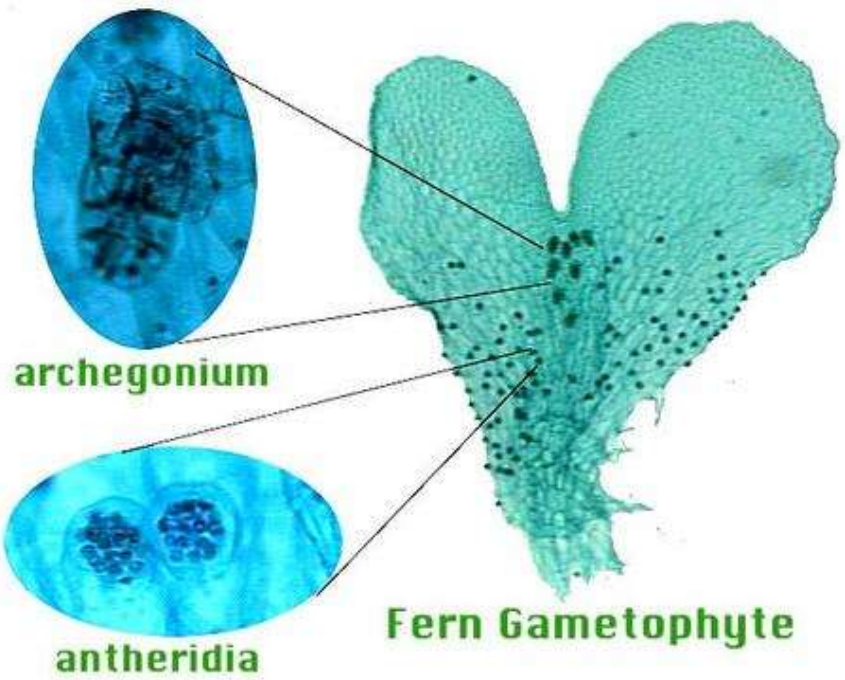
Pteridophytes–Gametophyte

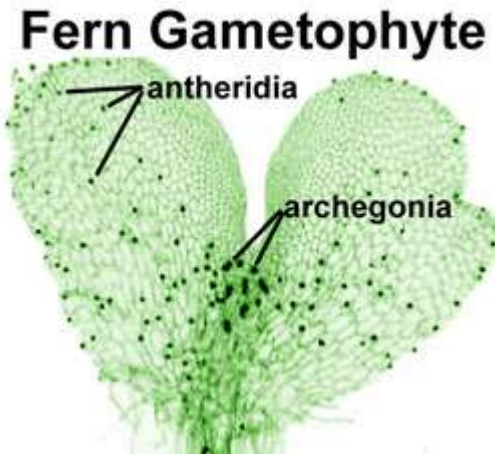
SEX - ORGANS

- The sexual reproduction is oogamous.
- The gametophyte or prothallus bears the sex organs, antheridia and archegonia.
- Normally, the gametophytes formed from the homosporous are monoecious, that is both antheridia and archegonia are borne on the same gametophyte or prothallus.
- The gametophytes formed from the heterosporous are dioecious, i.e., the antheridia and archegonia develop in separate male and female gametophytes.



Pteridophytes-Gametophyte





Life Cycle in Pteridophytes

Majority of the Pteridophytes are homosporous e.g., *Lycopodium, Pteris* etc. Spores on germination produce monoecious gametophyte. The gametophytes produces gametes which fertilizes producing zygote. The zygote foprms the sporophyte.

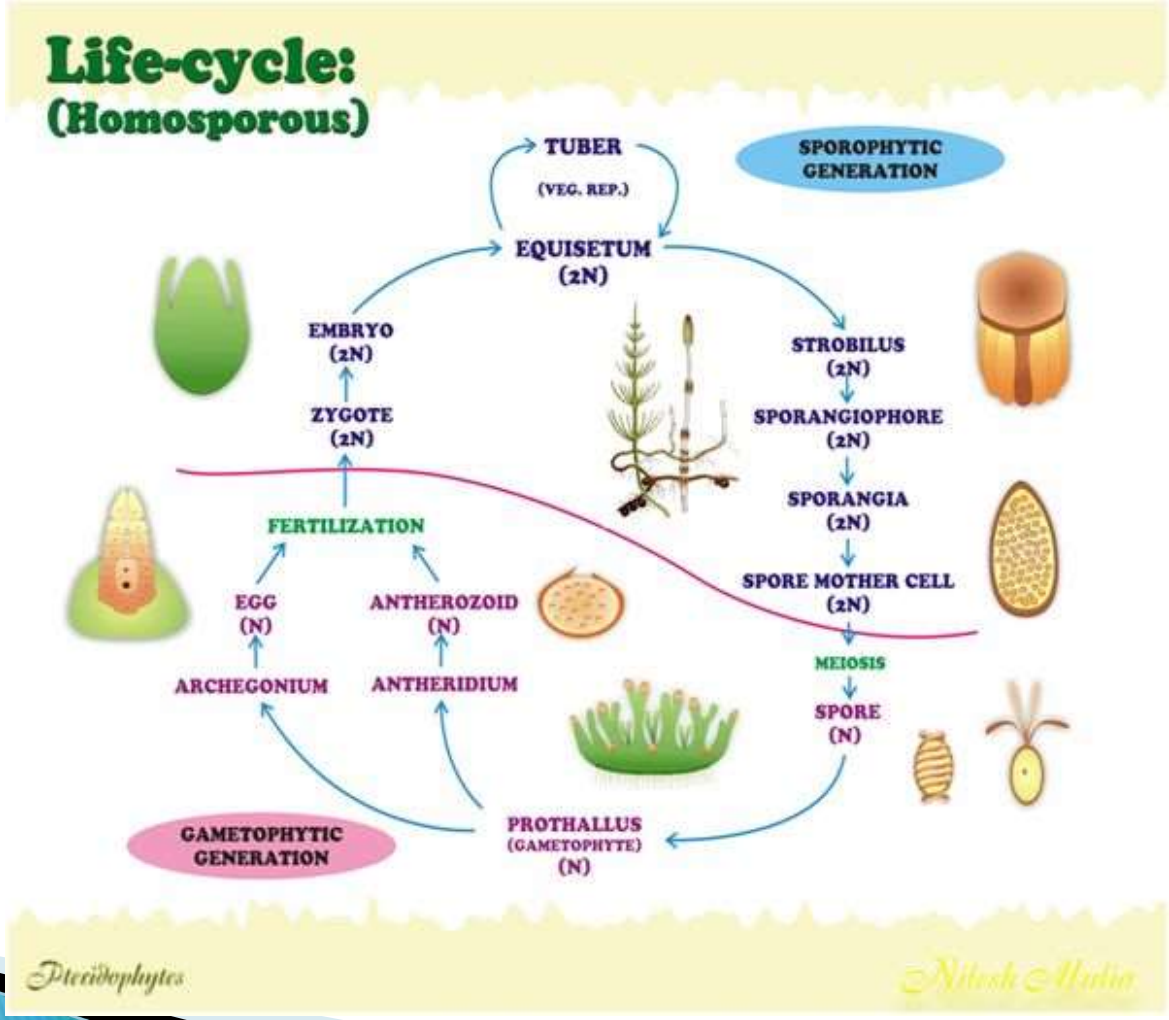
Some Pteridophytes are heterosporous and produce two types of spores: microspores and megaspores.
Microspores on germination produce male gametophyte (prothallus) while megaspores on germination produce female gametophyte (prothallus). So, the prothalli are dioecious. Antheridia and archegonia develop on the same prothallus (monoecious) or on different prothalli (dioecious). The male and female gametes fuse to form zygote which develops into sporophyte.

Thus, the life cycle of a Pteridophyte consists of an alternate succession of sporophytic and gametophytic generations

Difference between homosporous and heterosporous

	Homosporous pteridophytes	Heterosporous pteridophytes
(i)	In these pteridophytes only one kind of spore is produced.	In these pteridophytes two kinds of spores are produced.
(ii)	The spores are equal in size.	The smaller spores are called microspores and the larger spores are called megaspores.
(iii)	The spores are produced from the same sporangia.	The microspores are produced from the microsporangia and the megaspores are produced from the megasporangia.
(iv)	The spores develop one kind of gameto-phyte.	The microspore develops into male gametophyte whereas the megaspore develops into female gametophyte.
(v)	Spores germinate in soil and produce independent gametophyte.	Spores germinate within sporangia and produce dependent gametophyte.
(vi)	*e.g., Lycopodium*	*e.g., Selaginella, Salvinia.*

Life Cycle–Homosporous



Life Cycle-Heterosporous