Classification of organisms (incl. plants)

Two Types of organisms

Prokaryotes

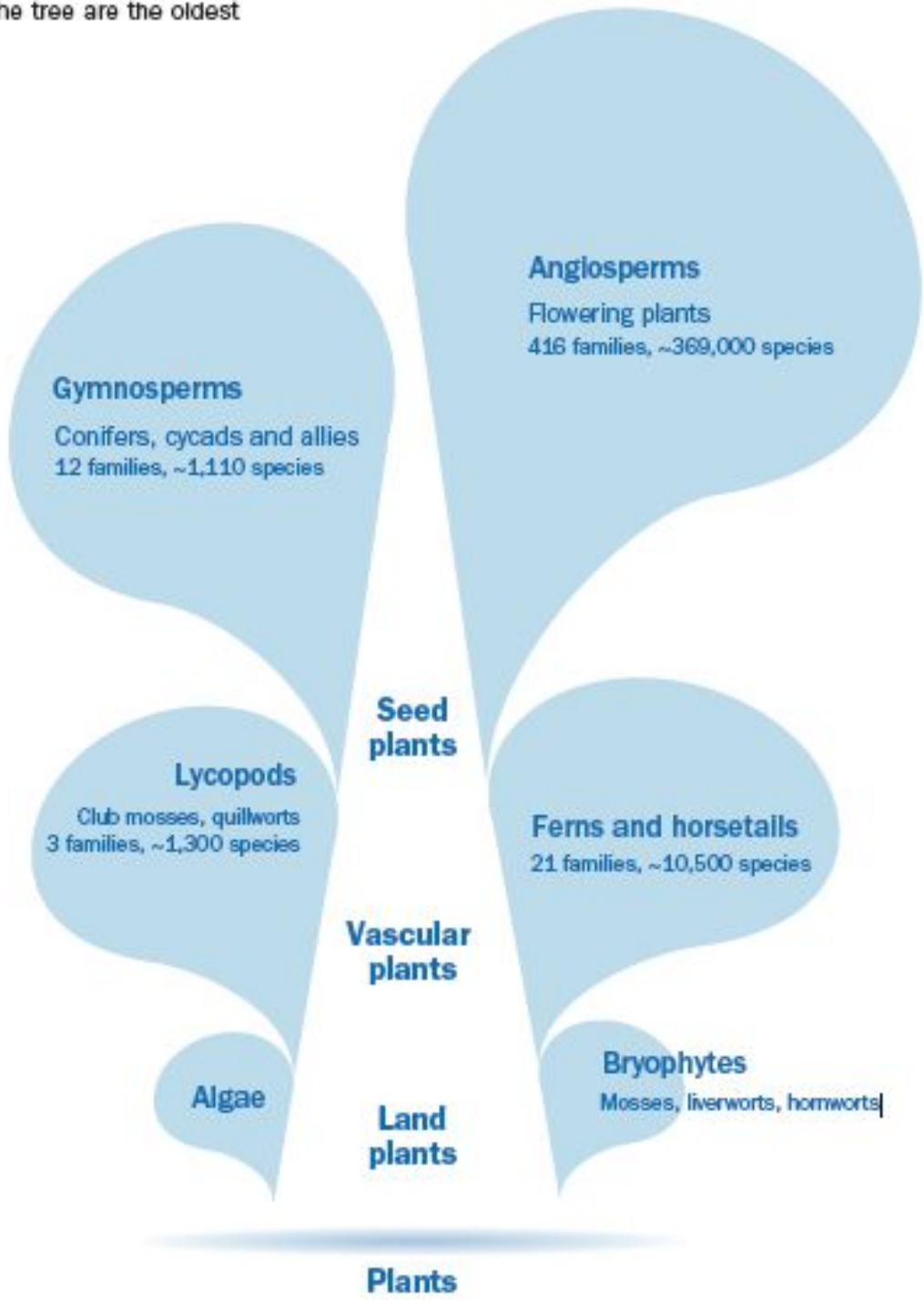
- No nucleus
- No membrane-covered organelles
- Circular DNA
- Bacteria

Eukaryotes

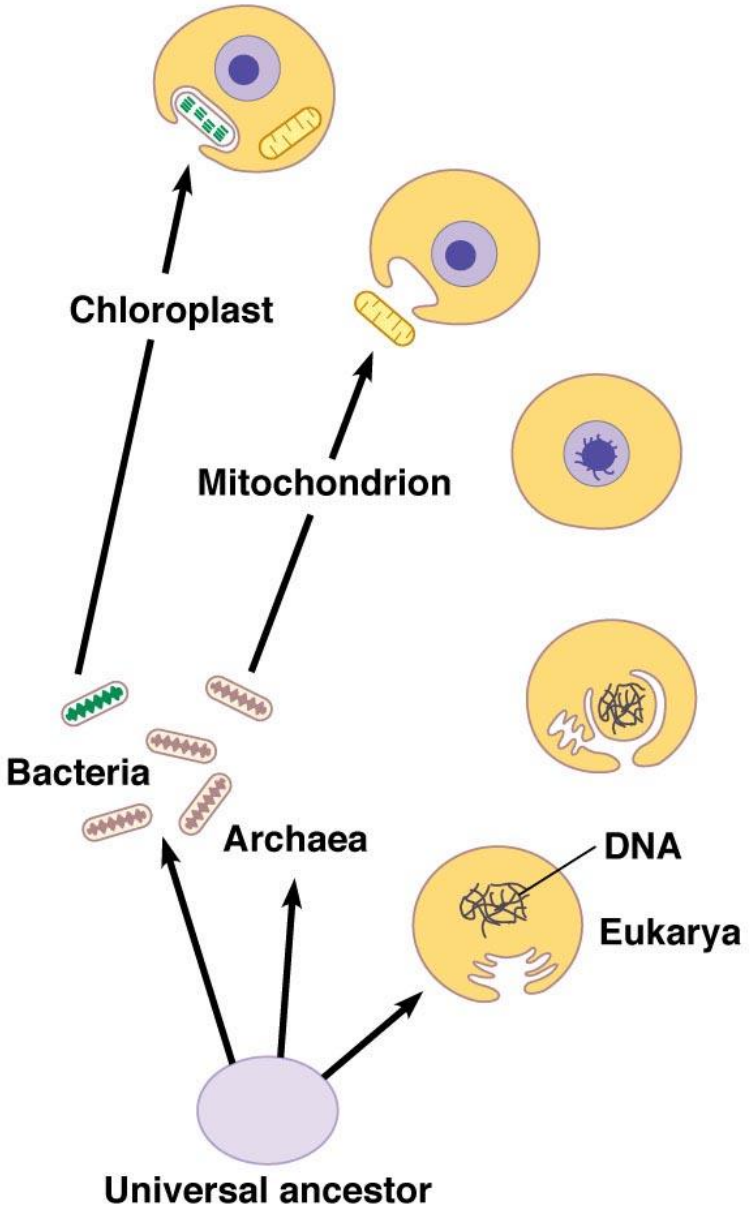
- Nucleus
- Membrane-covered organelles (example: nuclear membrane)
- Linear DNA
- All other organisms

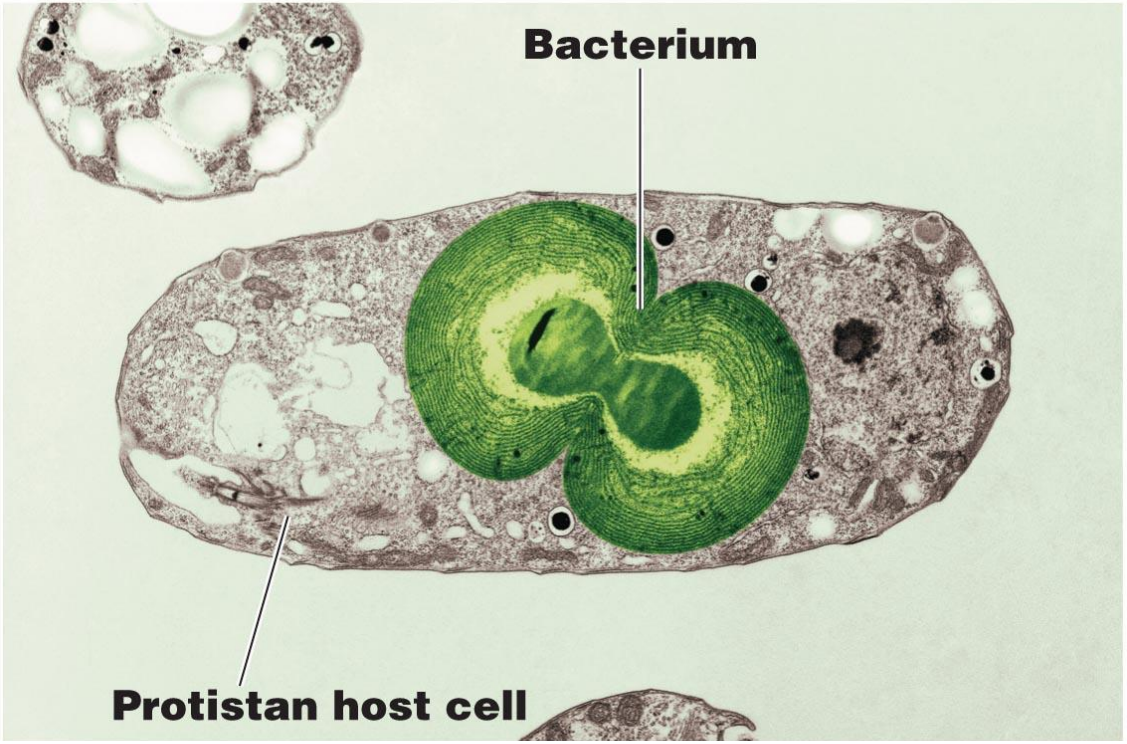
How they are the same: **cytoplasm, ribosomes, DNA**
Despite their differences they perform most of the same kinds of functions in the same way.

Groups at the bottom of the tree are the oldest
In evolutionary terms.



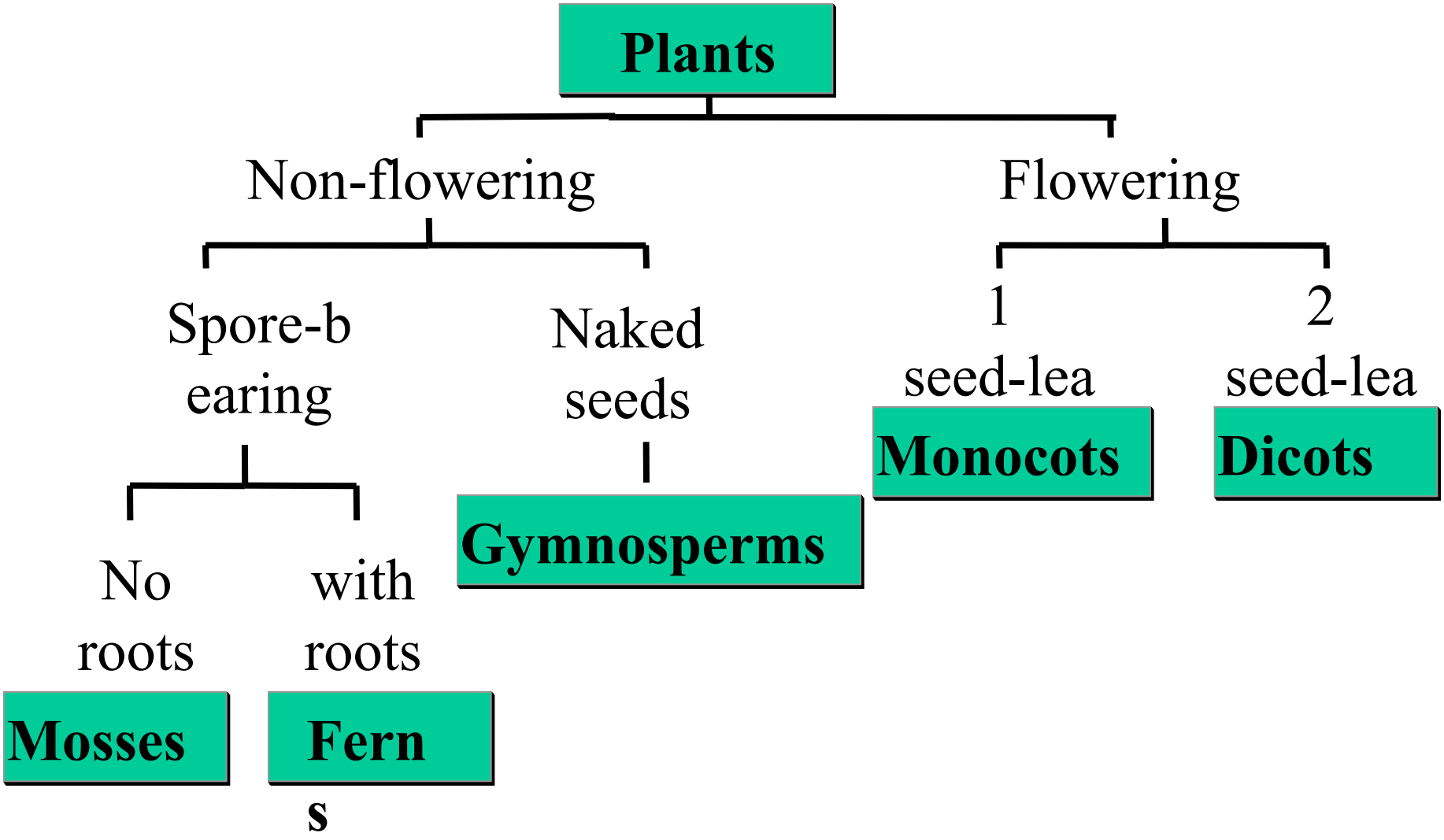
Endosymbiotic Theory: Origin of Eukaryotes





Cyanophora paradoxa: modern example of possible evolutionary process

Classification of Higher Plants



Kingdom Plantae (embryophytes)

1. **Non-vascular plants**
   Division Bryophyta (mosses)
   Division Hepatophyta (liverworts)
   Division Anthocerophyta (hornworts)
2. **Vascular plants**
   A. No seeds :
   Division Lycopodiophyta (club mosses)
   Division Monilophyta (ferns, horsetails, whisk ferns)

- Class Psilotopsida- whisk ferns
- Class Equisetopsida- horsetails
- Class Polypodiopsida - ferns

   B. Production of seeds :

1) No flowers : Gymnosperms
   Division Pinophyta (Coniferophyta)- (conifers)
   Division Cycadophyta (cycads)
   Division Ginkgophyta (ginkgo)
   Division Gnetophyta (gnetae)
2) Flowers : Angiosperms
   Division Anthophyta (flowering plants)

Bryophytes

- phylum Hepatophyta - liverworts
- phylum Anthocerophyta - hornworts
- phylum Bryophyta - mosses

liverwort

hornwort

mosses

Bryophyta

- The bryophytes consist of about 20,000 plant species
- Gametophyte dominant
- Lack vascular tissues
- Homosporous
- Possess waterproof cuticle
- Dispersal by windblown spores
- Swimming sperm

Mosses and their relatives are seedless nonvascular plants

- Nonvascular plants grow close to the ground to absorb water and nutrients.
- Seedless plants rely on free-standing water for reproduction.
- Liverworts belong to phylum Hepatophyta.
  - often grow on wet rocks or in greenhouses
  - can be thallose or leafy

- **Hornworts belong to phylum Anthocerophyta**

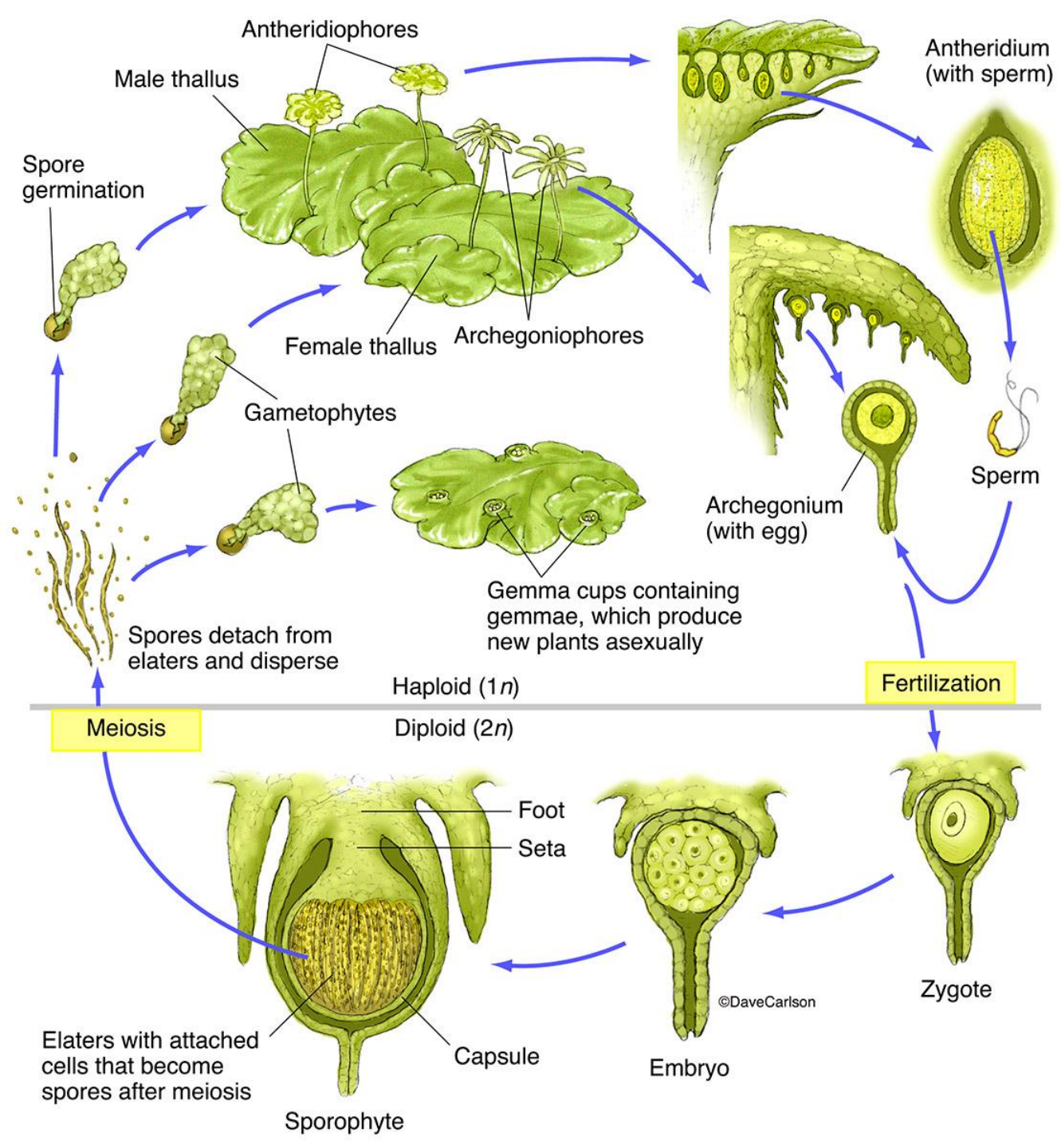
  – found in tropical forests and along streams

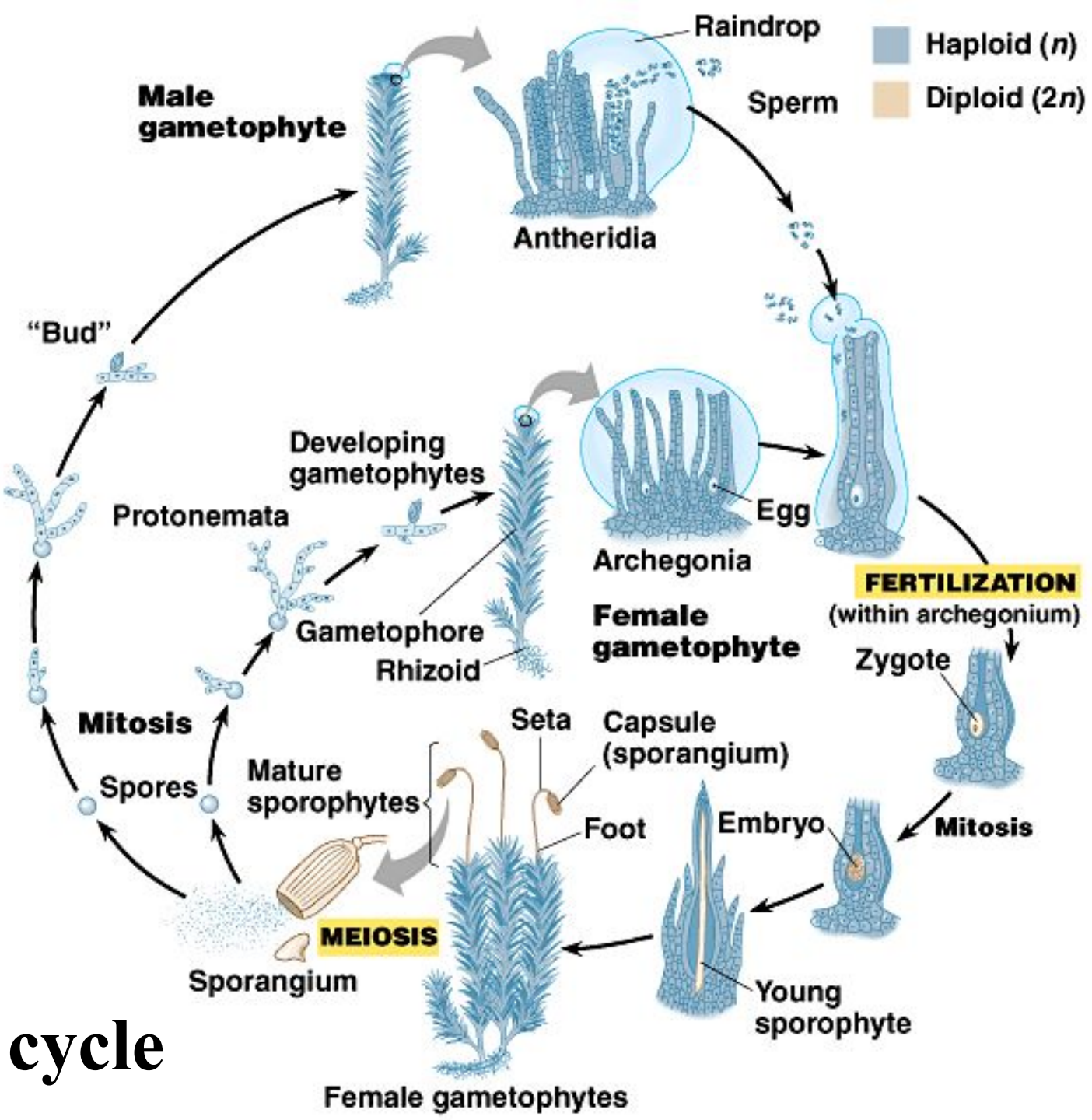
  – flat, lobed body with little green “horns”

- **Mosses belong to phylum Bryophyta.**

  - most common seedless nonvascular plants
  - sphagnum moss commonly used by humans as “peat”

Life cycle of Marchantia

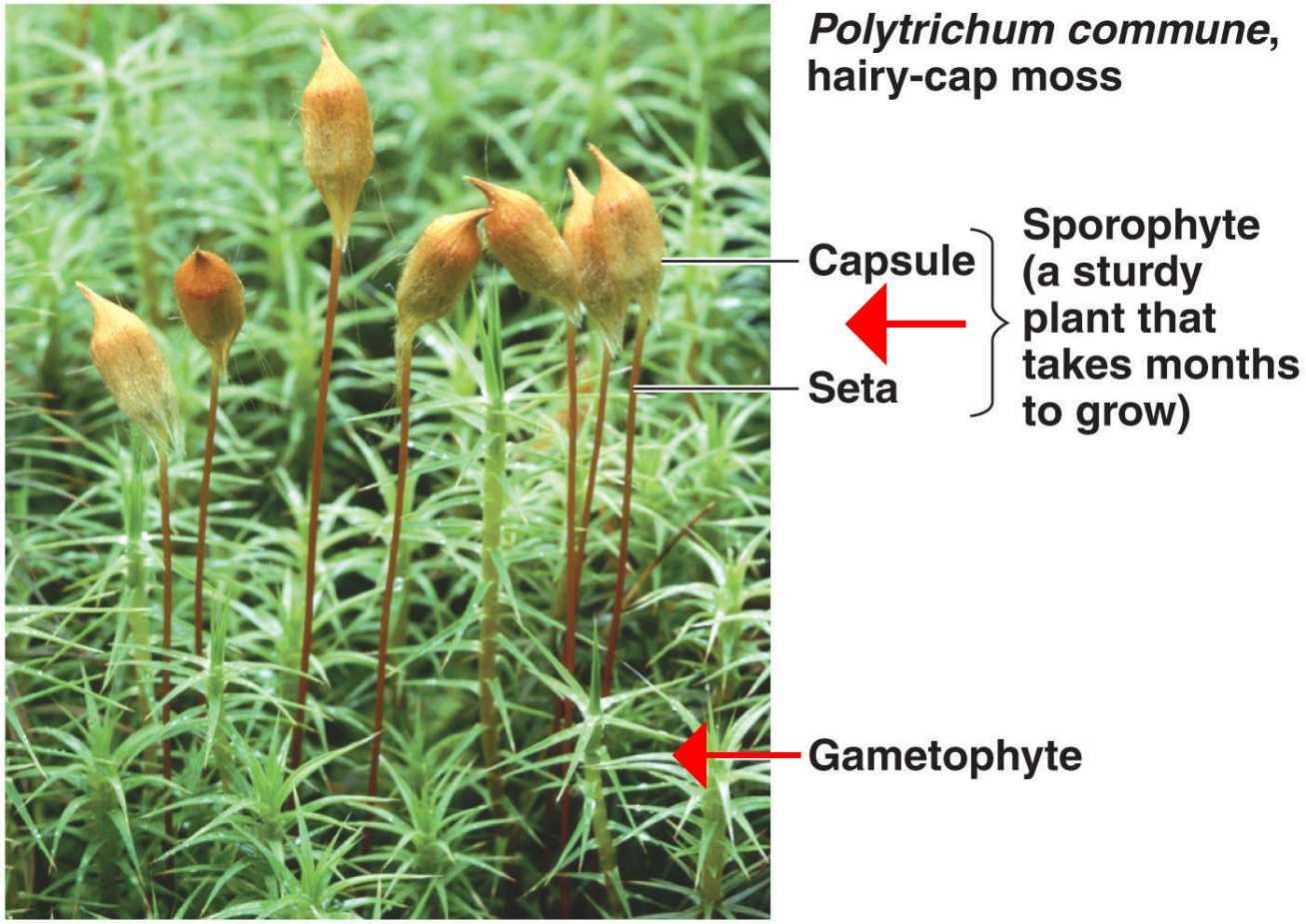




Moss Life cycle

Moss Protonema

Alternation of Generations: Mosses

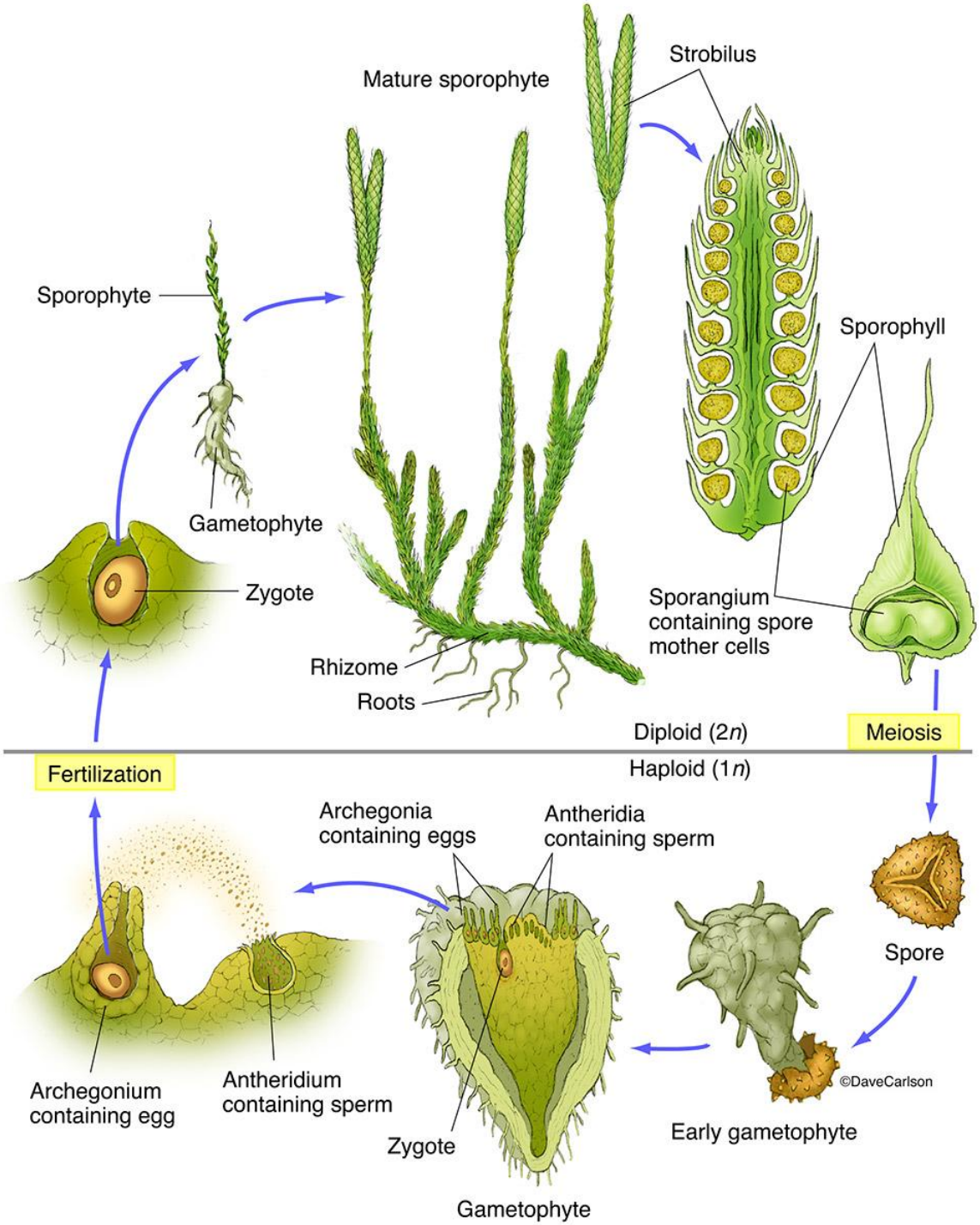


leafy, haploid gametophyte with emerging diploid sporophyte

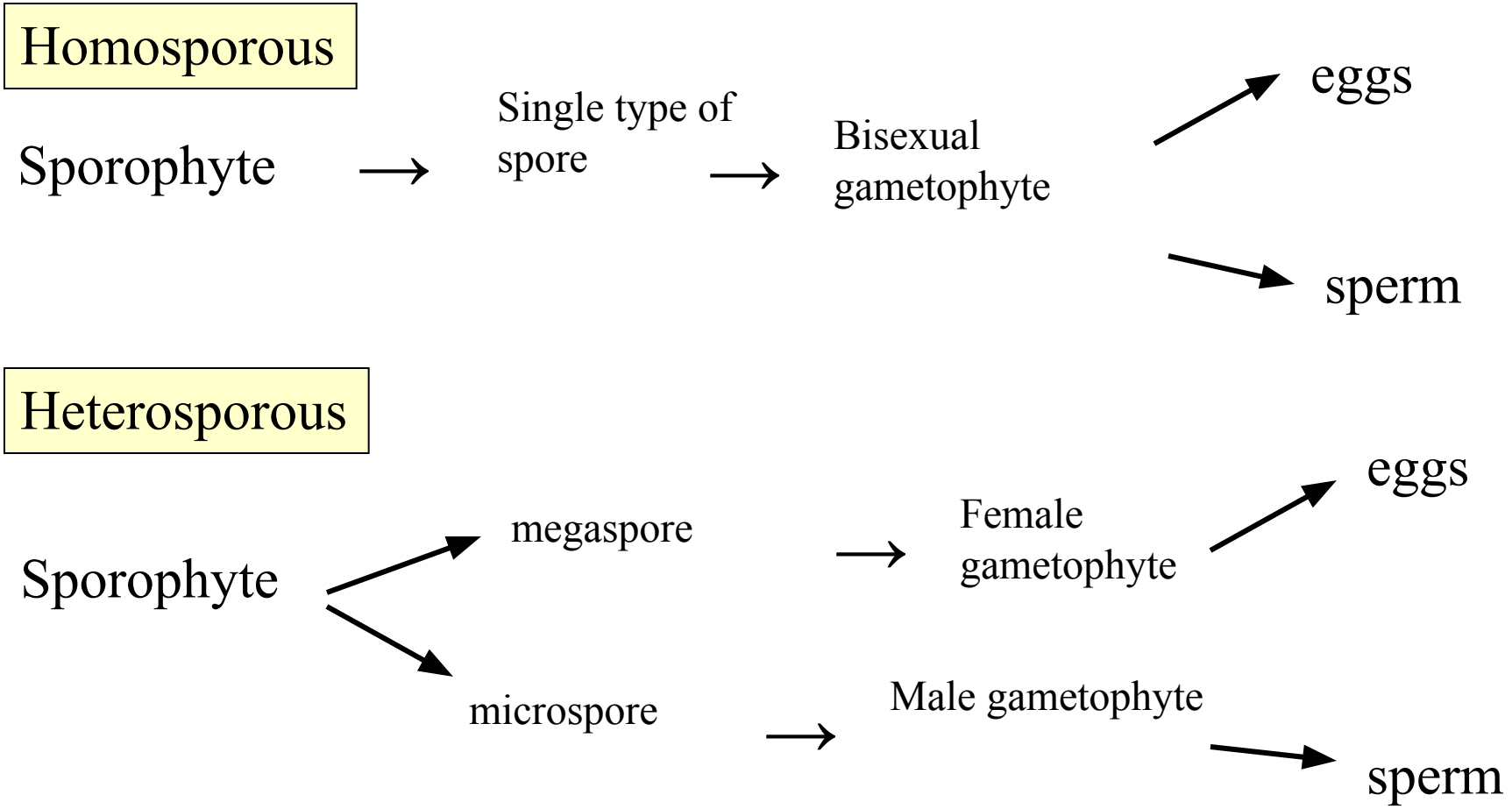
Division Lycopodiophyta (club mosses)

- There are around 1,290 (Christenhusz & Byng 2016) living (extant) species of Lycopodiophyta
- A vascular system allows club mosses to grow higher off the ground.
- They need free-standing water for reproduction.
- Club mosses belong to Lycopodiophyta.
  - ❑ not true mosses
  - ❑ oldest living group of vascular plants

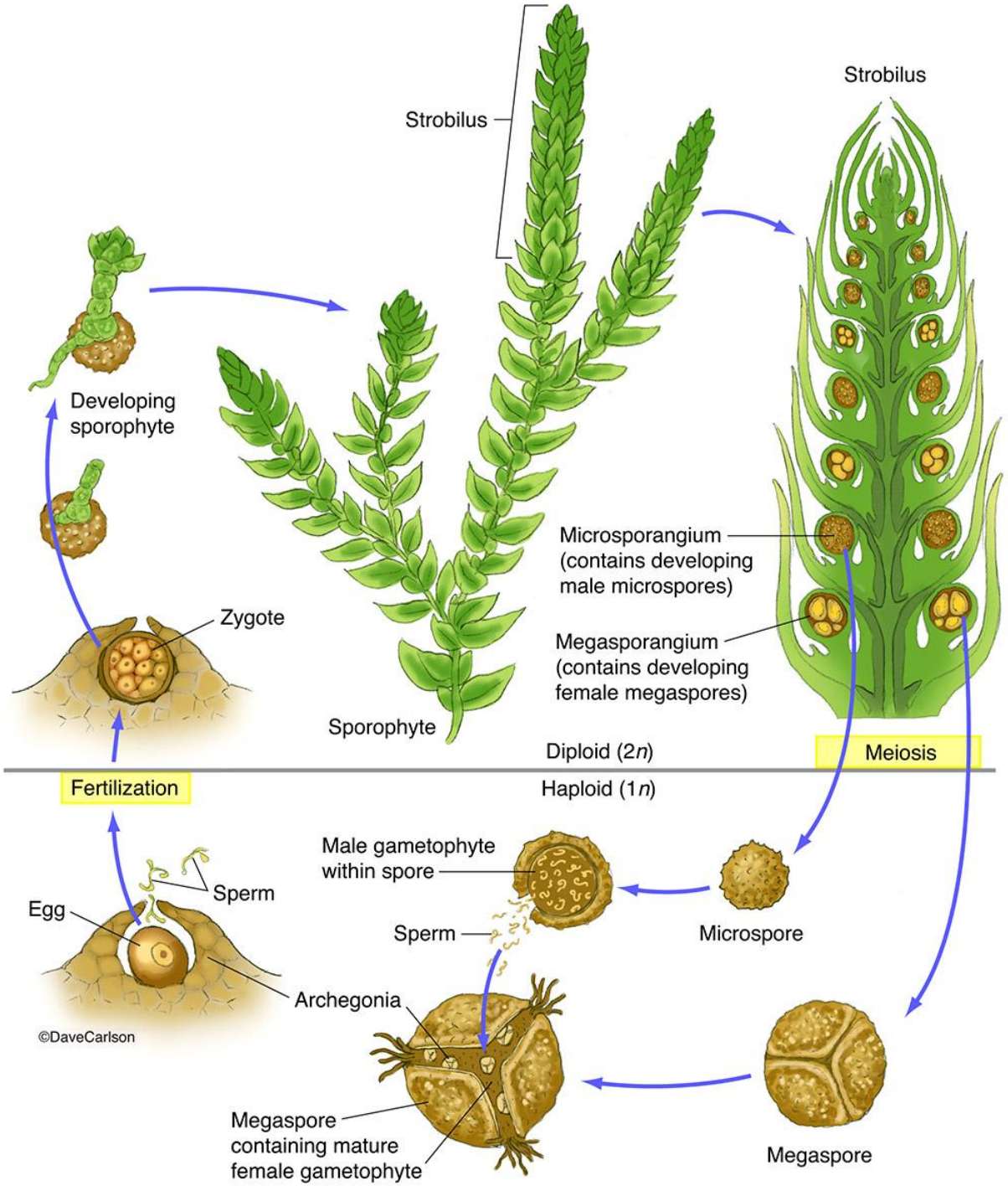
Life cycle of Lycopodium



Homosporous vs. Heterosporous Plants



Life cycle of Selaginella

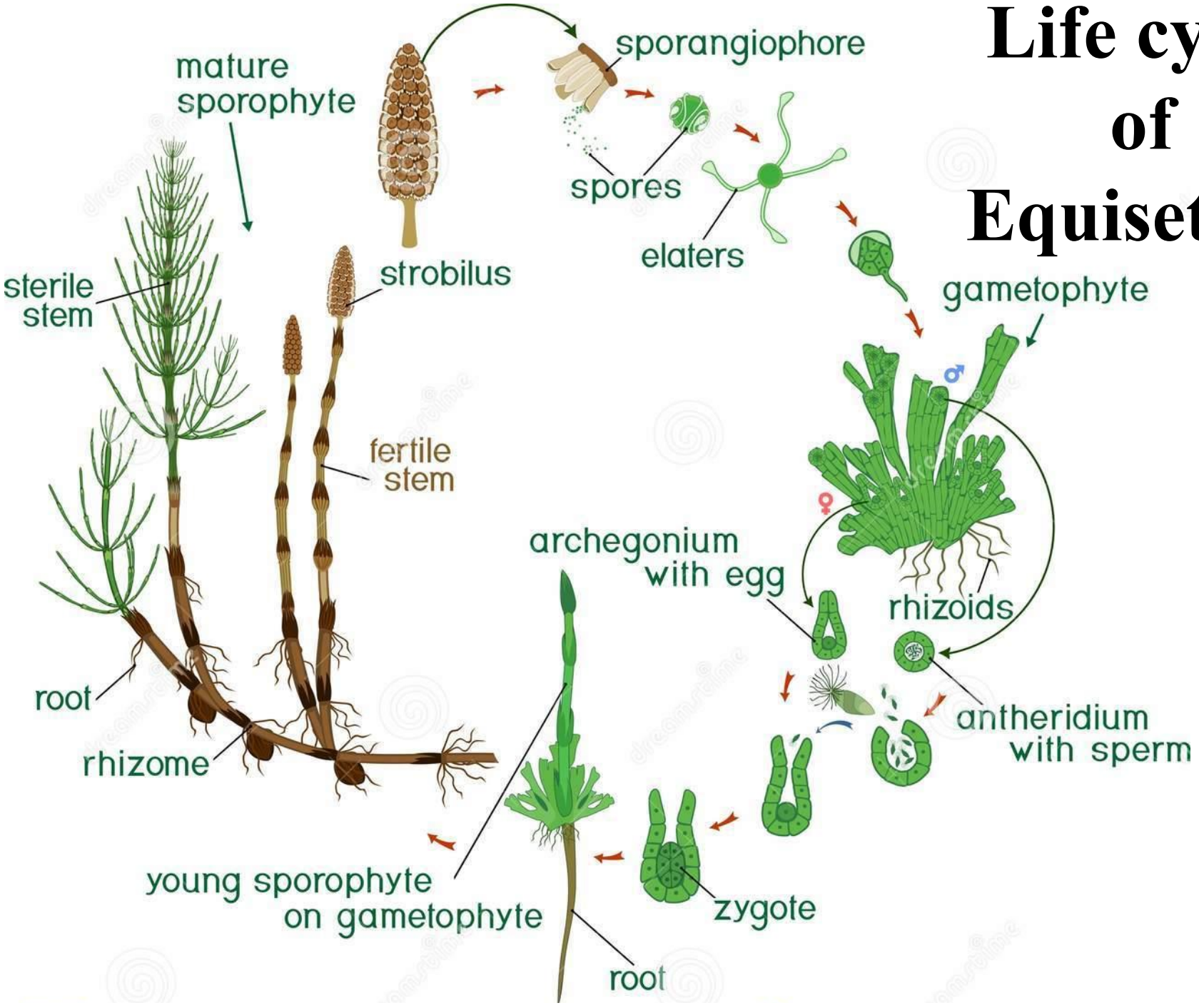


Division Equisetophyta (horsetails)

- There are twelve living (extant) species of Equisetophyta.

- Hosetails typically grow in wet areas, with whorls of needle-like branches radiating at regular intervals from a single vertical stem.
- They need water conditions for reproduction.
- Today horsetails are recognized as a group close relatives of the typical ferns (Pteridopsida).

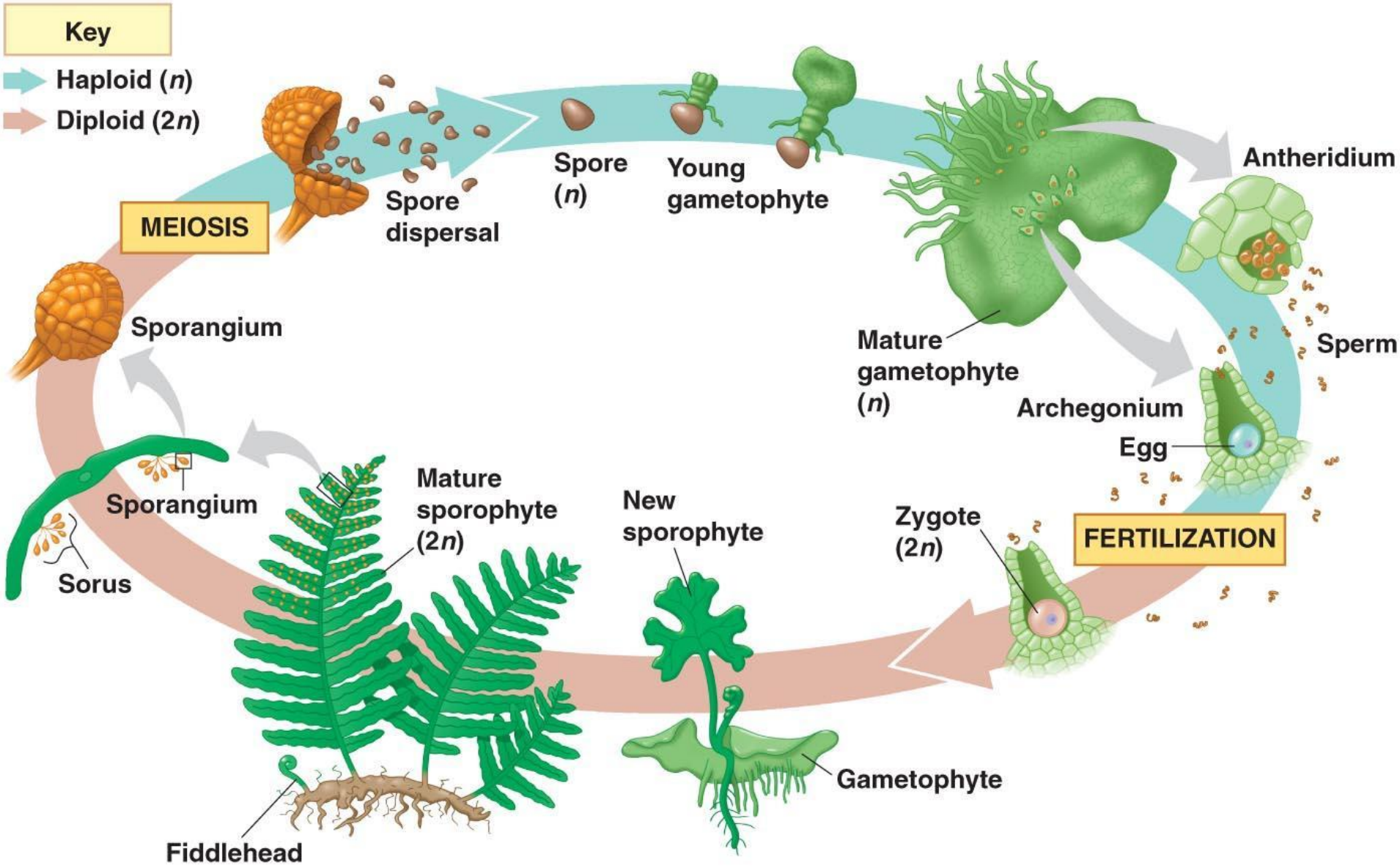
Life cycle of Equisetum



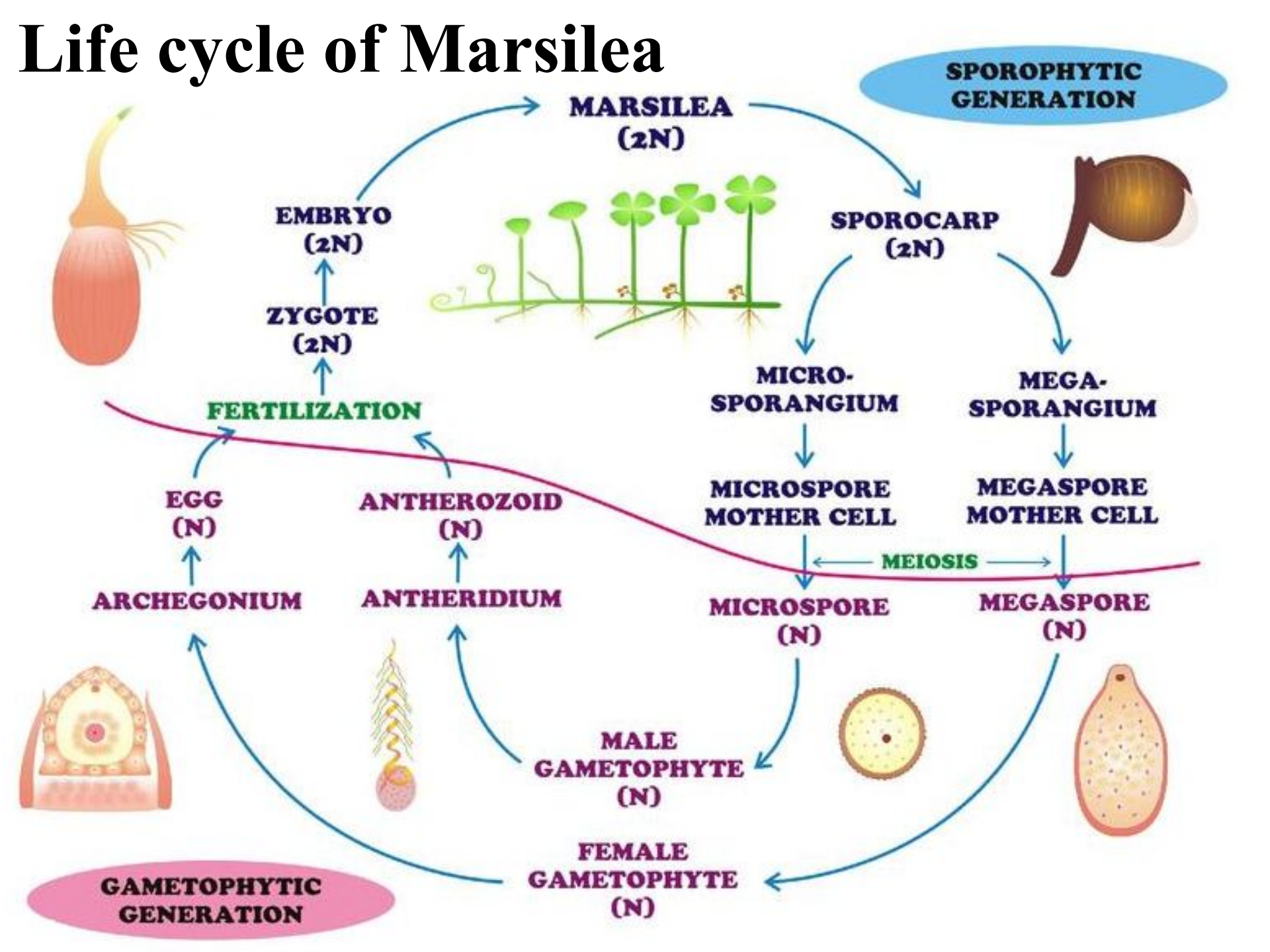
Division Pterophyta: Ferns

- Sporophyte dominant
- Possess vascular tissues and roots
- Leaves are megaphylls
- Homosporous
- Possess waterproof cuticle
- Dispersal by windblown spores
- Swimming sperm

Life cycle of Dryopteris



Life cycle of Marsilea



Alternation of Generations: Ferns

Ferns

Sporophyte = dominant (most conspicuous) individual

Gametophyte = small, fragile structure most people (even botanists!) never notice

Alternation of Generations: Ferns

Frond = diploid sporophyte

Sorus = collection of sporangia where meiosis occurs

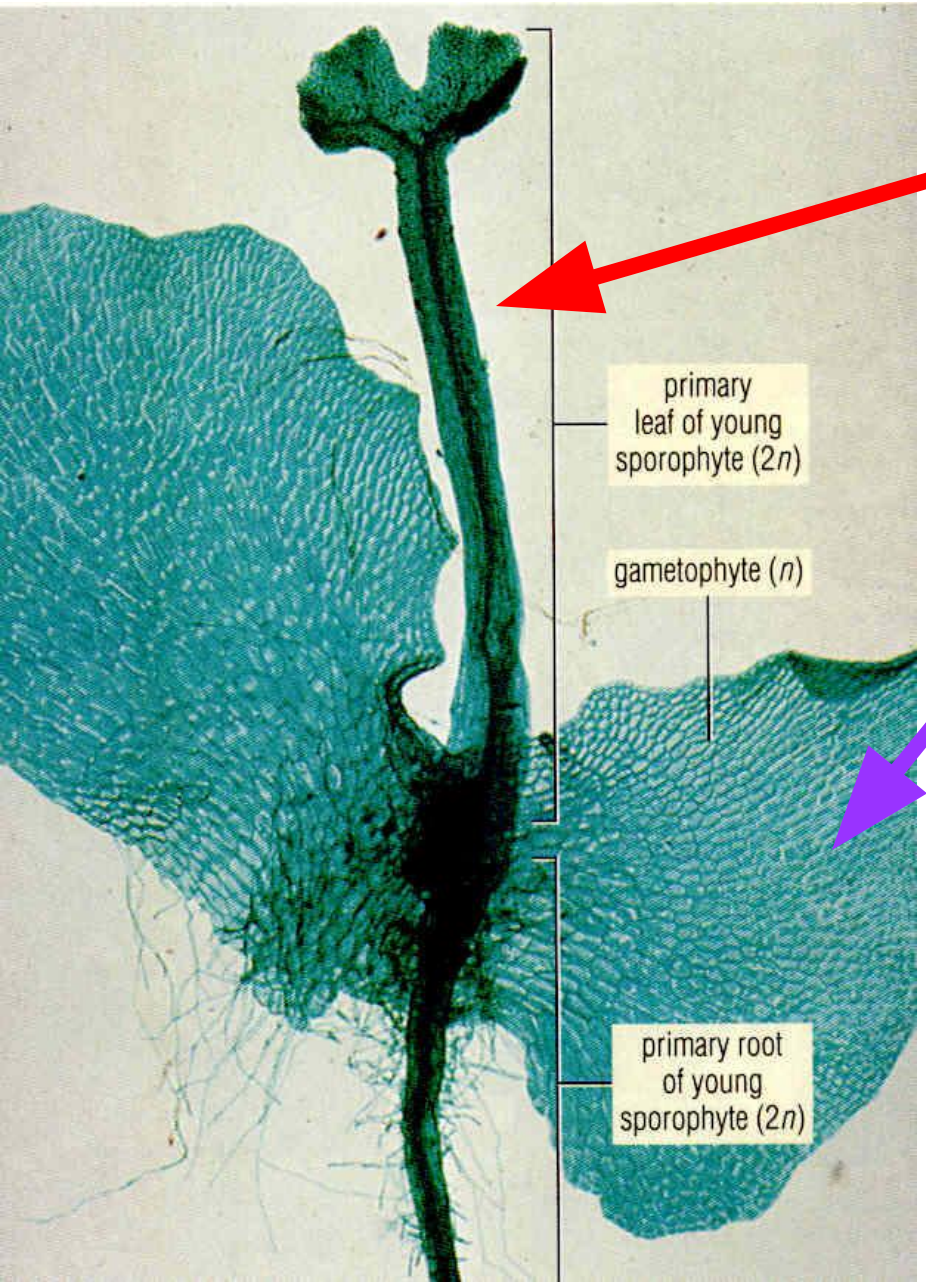
Sori on a Fern Sporophyll

Sorus Close Up

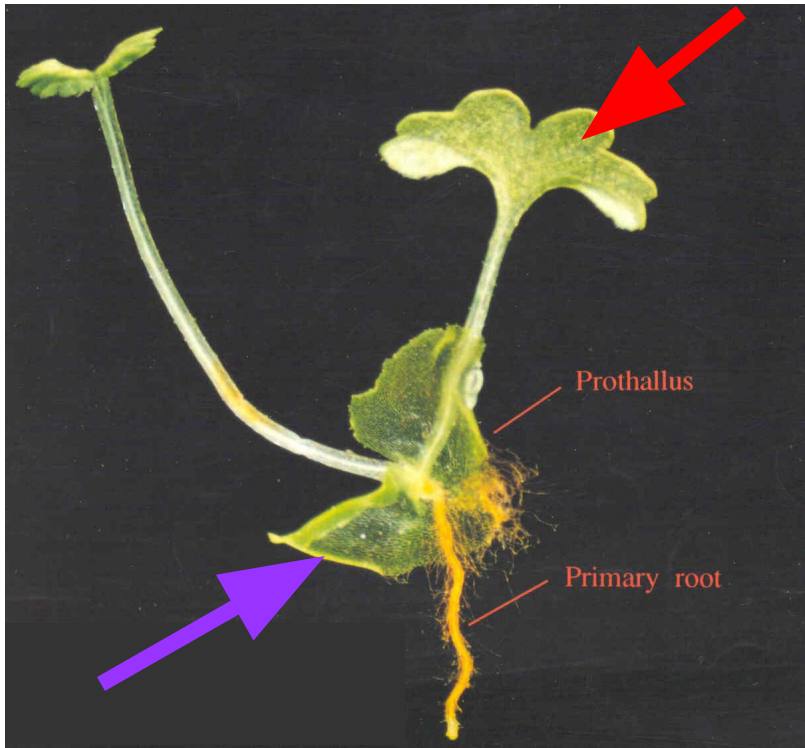
Fern Sporangium

Fern Gametophytes

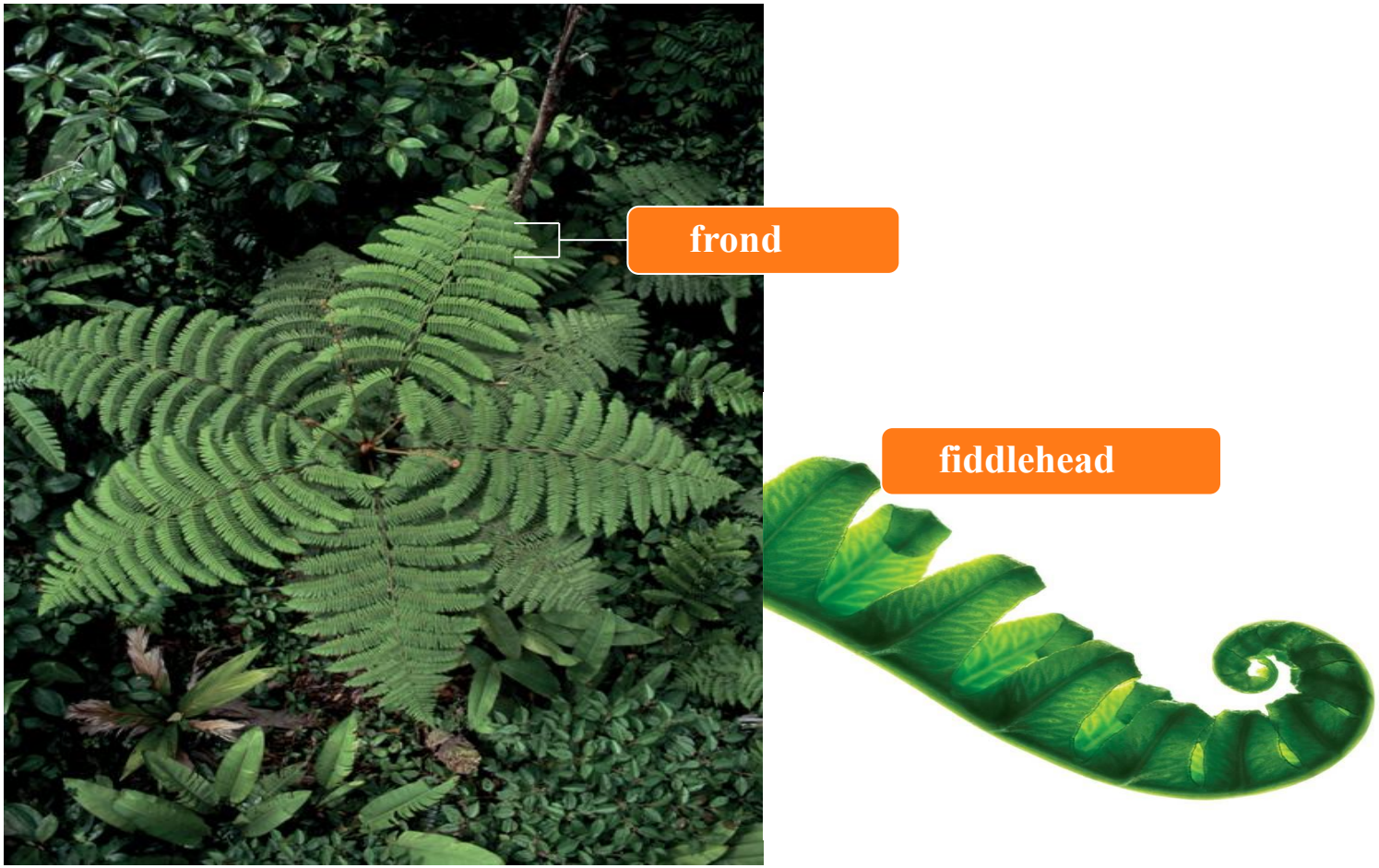
Alternation of Generations: Ferns



young **diploid sporophyte** beginning to grow from the **haploid gametophyte**



Ferns and their relatives belong to phylum Pteridophyta



- whisk ferns and horsetails are close relatives of ferns
- ferns have large leaves called fronds

Vascular Seed Plants

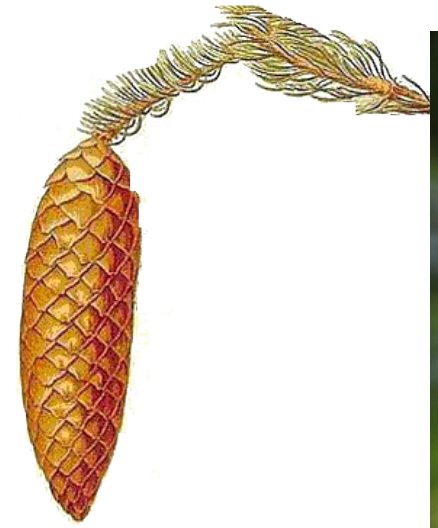
- Gymnosperms
- **Nonflowering**
- Bear seeds on the upper surface of scales inside of cones
- Contain true roots, stems, and leaves
- Examples Conifers, Pines

- Angiosperms
- **Flowering plants**
- Flower is a group of modified leaves used for sexual reproduction; seeds found in fruit
- Contains true roots,stems, and leaves
- Examples: rose, lily, oak, maple, pea, and grass

Seed plants include cone-bearing plants and flowering plants

- Seed plants have several advantages over their seedless ancestors.
  - can reproduce without free-standing water, via pollination
  - pollination occurs when pollen meets female plant parts
  - seeds nourish and protect plant embryo
  - seeds allow plants to disperse to new places

Gymnosperms



- Leaves are needle-like
- Most are evergreen
- They are called soft wood.
- Reproductive structure is a cone or cone-like structure.

Gymnosperms do not have seeds enclosed in fruit

- most gymnosperms are cone-bearing and evergreen.
- the cone is reproductive structure of most gymnosperms.
- pollen is produced in male cones.
- eggs are produced in female cones.
- seeds develop on scales of female cones.

Cycads are gymnosperms in phylum Cycadophyta

- look like palm trees with large cones
- grow in tropical areas

It includes about 130 species of tropical and subtropical evergreen low trees.

Ginkgos are gymnosperms in phylum Ginkgophyta

- only one species alive today, *Ginkgo biloba*
- grown in gardens and used in urban landscaping

Gnetophyta includes three relict genera: Gnetum, Welwitschia, and Ephedra

- The primary difference between gnetophytes and other gymnosperms is the vessel elements similar to those found in flowering plants

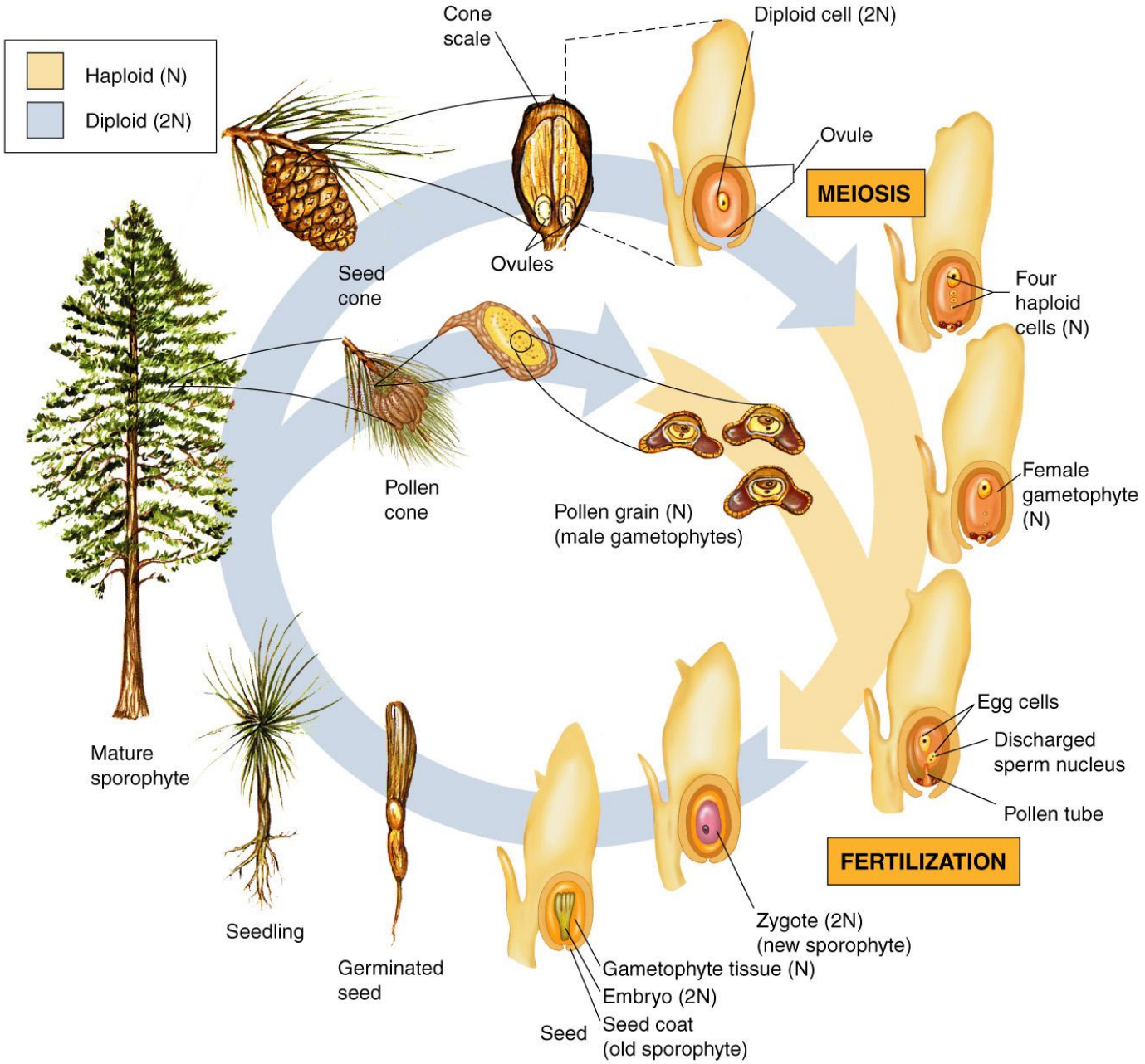
Gnetophyta consists of about 70 species.

Conifers are gymnosperms in phylum Coniferophyta

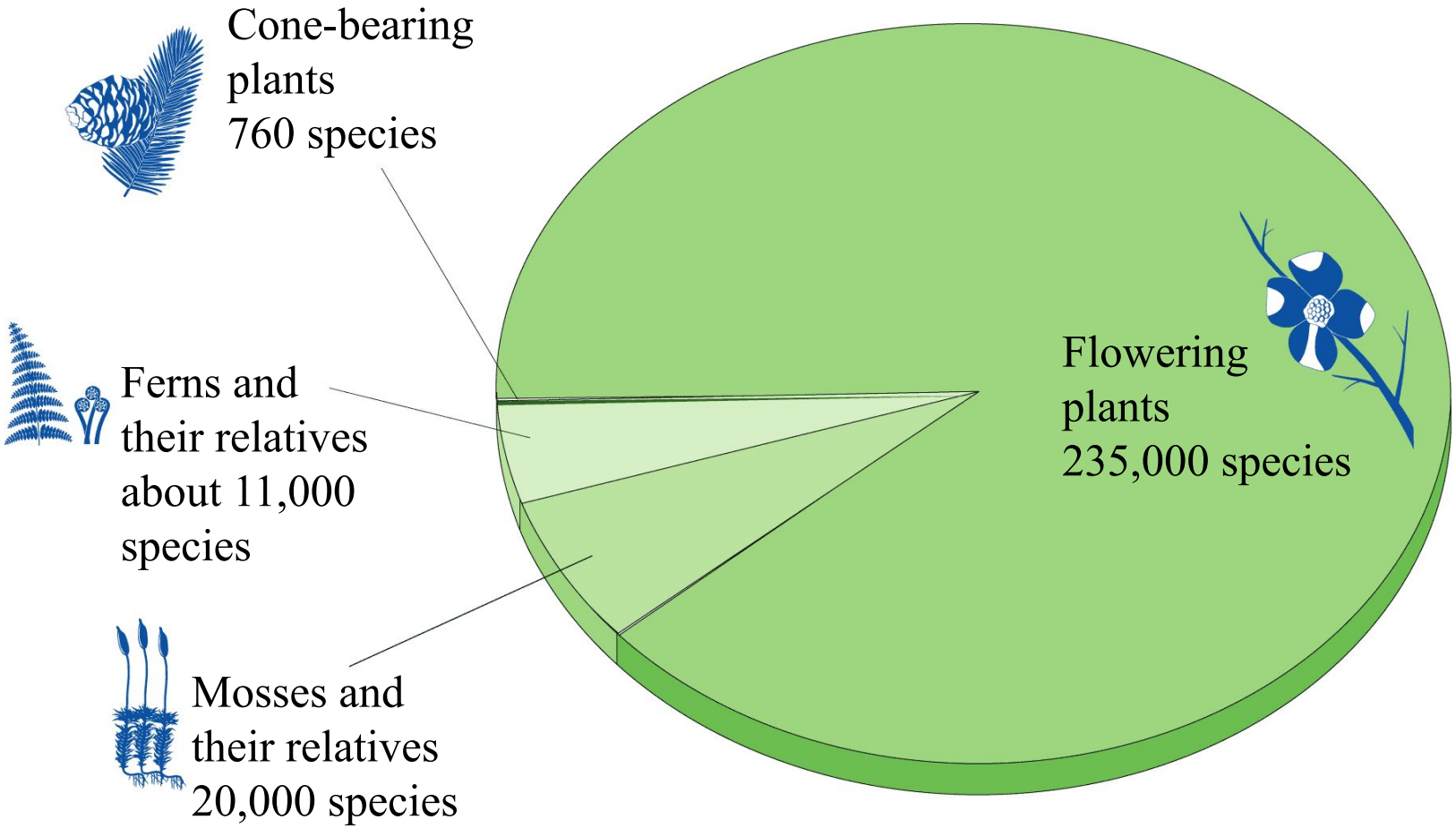
- All extant conifers are perennial woody plants.
- The great majority are trees, though a few are shrubs.
- They are the dominant plants over large areas of land, most notably the taiga in Northern Hemisphere.

It includes about 560 species of tropical and subtropical evergreen low trees.

Life Cycle of Gymnosperm



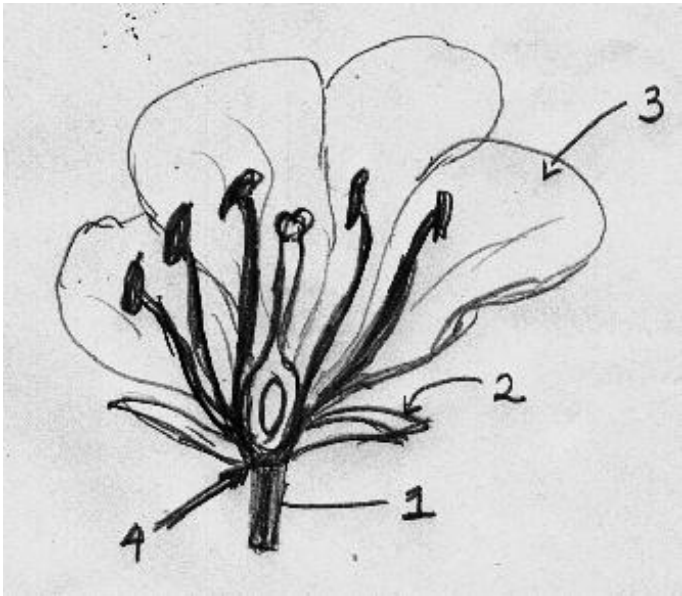
Diversity of Plants



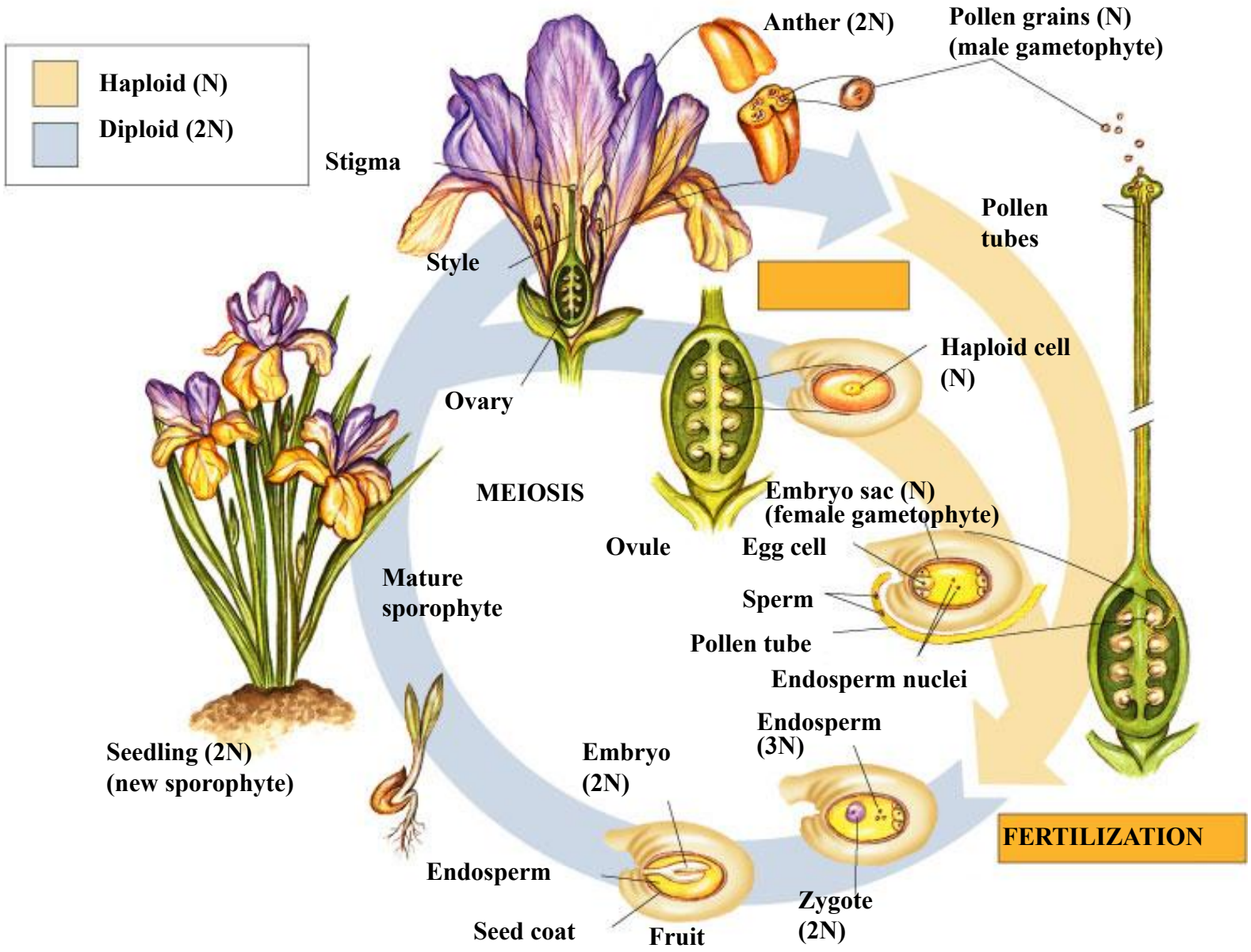
Form 2 main groups nonvascular and vascular plants

Angiosperms

- Broad leaf plants
- Most are deciduous
- Called hardwood
- They are divided into two groups based on the number of seed leaves (cotyledons) they contain.

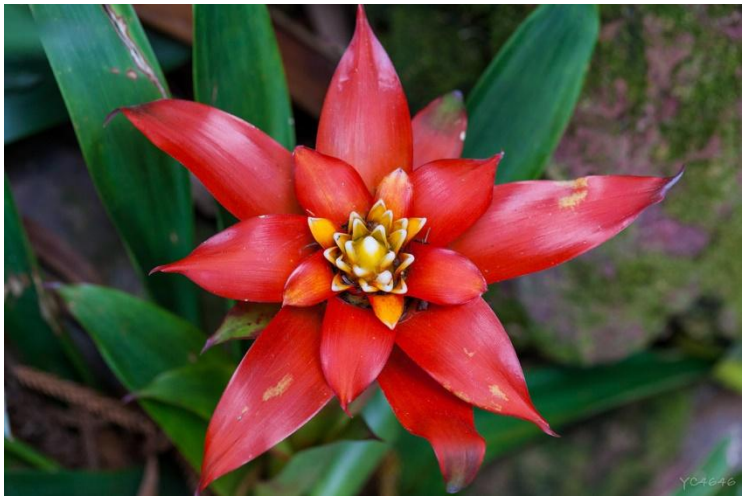


Life Cycle of Angiosperms



Monocotyledons

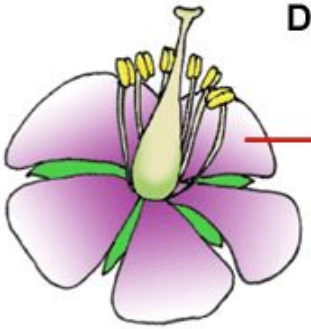
- "Monocots"
- 1 cotyledon
- Parallel veins on leaves
- Fibrous roots
- Flowers in multiples of 3
- Ex) grass, corn



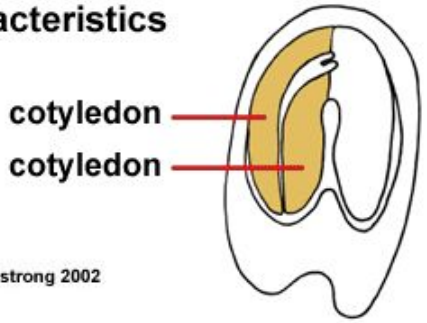
Dicotyledons

- “Dicots”
- 2 cotyledons
- Netted veins
- Tap root
- Flowers, 4’s or 5’s
- Ex) Peanuts, green beans

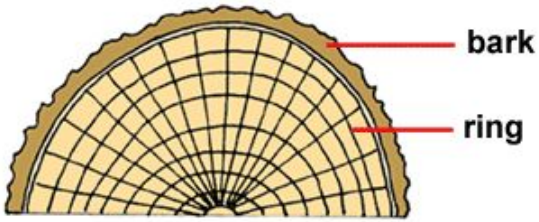
Dicot Characteristics



Flower parts in 4's or 5's.



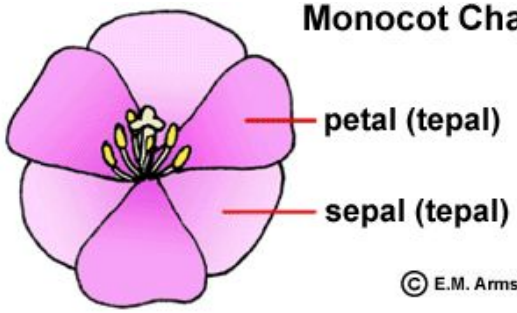
Seed with two cotyledons.



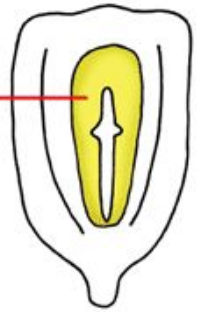
Wood with concentric growth rings.

Leaf with net venation.

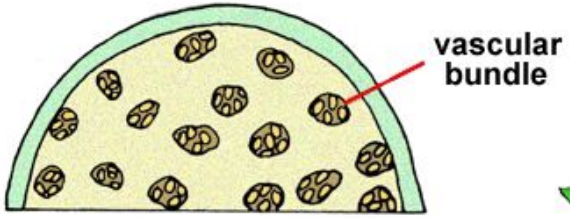
Monocot Characteristics



Flower parts in 3's.



Seed with one cotyledon.

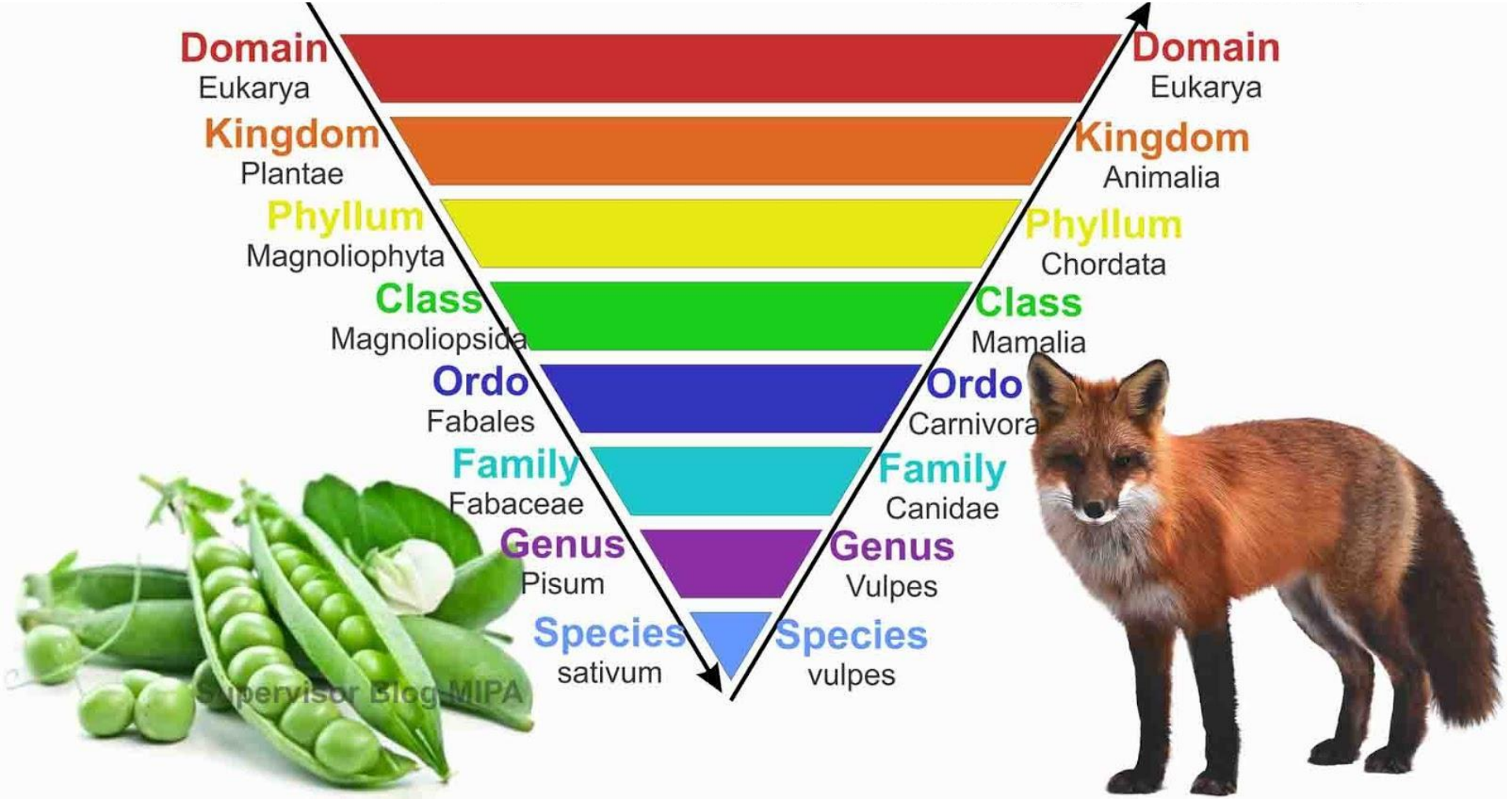


Stem with vascular bundles.

Leaf with parallel venation.

Taxonomic Hierarchy Chart	
Kingdom	Plantae (plants)
Division (Phylum)	Spermatophyta (seed bearing plants)
Subdivision	Angiospermae (flowering plants with covered seeds)
Class	Liliopsida (monocots)
Order	Zingiberales (ginger family)
Family	Musaceae (bananas)
Genus	*Strelitzia*
Species	*reginae*
Common name	Bird of Paradise

Linnaean System



Dichotomous Keys

- In the field, biologists use dichotomous keys to **identify** organisms.
- Dichotomous key-A chart that identifies organisms based on their characteristics. Its used by excluding organisms based on their **OBSERVABLE** features.

1. a. long, tubular objects ---------- go to #2
   b. short, non-tubular objects ---------- go to #4

2. a. constructed from plastic ---------- go to #3
   b. constructed from material other than plastic ---------- pencil

3. a. green & grey ---------- highlighter
   b. blue & clear ---------- pen

4. a. black & silver ---------- pencil sharpener
   b. silver ---------- paper clip