Plants

Non-vascular and Vascular Plants

Plants

Plants are:

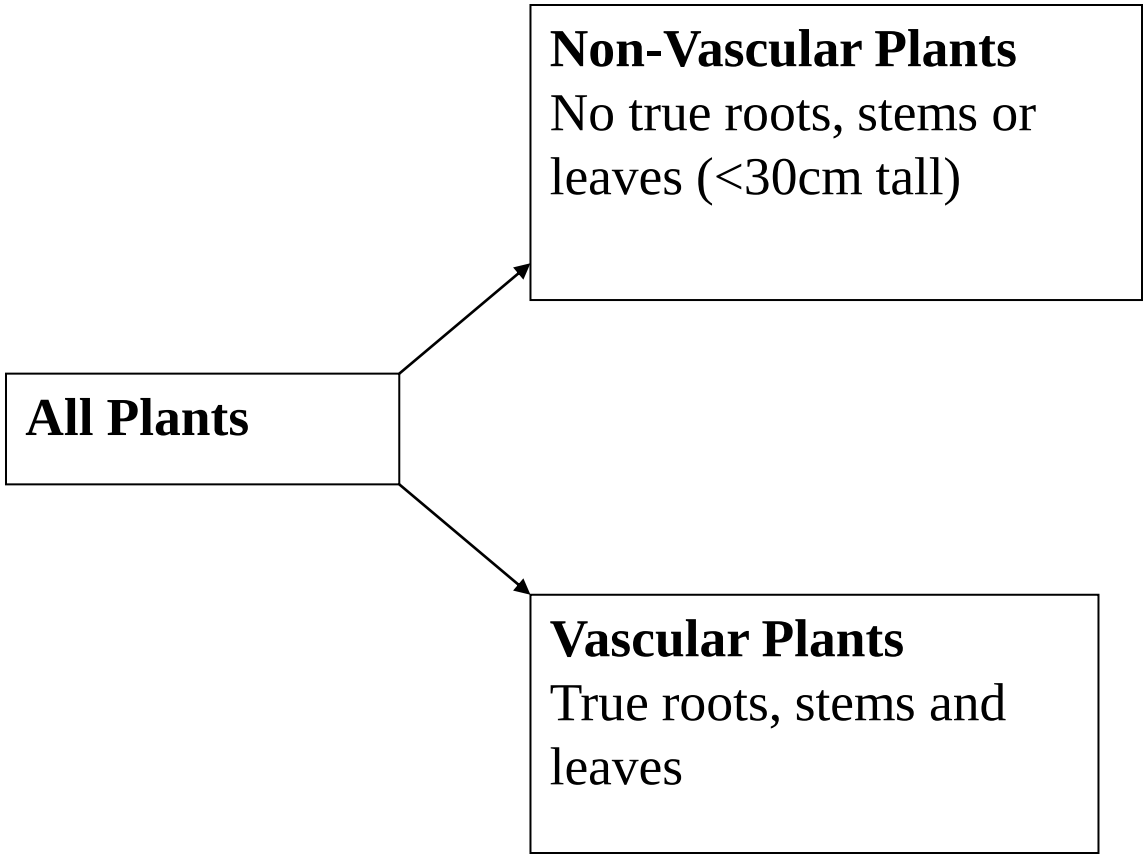
1. **Eukaryotic** (have membrane enclosed nucleus and organelles)
2. **Multicellular**
3. **Photosynthetic** (are autotrophic and contain chlorophyll)
4. lack mobility
5. show alternation of generations in their life cycles
6. contain cellulose in cell walls

- Plants most likely evolved to land from multicellular green algae.

Plants evolved into two main groups.

1. **Non Vascular Plants (Bryophytes)**
   Those which lack vascular tissue.

2. **Vascular Plants (Tracheophytes)**
   Those with vascular tissue (**Xylem -** transport water from roots to leaves and **Phloem -** transport sugar from leaves to storage areas (kind of like veins in animals))


Non-Vascular Plants
No true roots, stems or leaves (<30cm tall)
All Plants
Vascular Plants
True roots, stems and leaves

Non Vascular Plants

Division Bryophyta

(True Mosses, Hornworts and Liverworts.)

1. Less complex plants.
2. Possess few adaptations for life on land.
3. No true roots, stems or leaves (<20cm tall).
4. May have hairlike **rhizoids** instead of roots. Rhizoids anchor the plant to the substrate, and increase absorptive surface area for water and nutrients.

5. These plants lack a waxy cuticle (wax layer on the leaves) so they dry out quickly.
6. Require water for reproduction. Restricted to moist areas because sperm have flagella and must swim to egg.
7. Exhibit alteration of generations. A life cycle in which the haploid (n) phase (has 1 set of chromosomes) alternates with a diploid (2n) phase (has 2 sets of chromosomes).
8. During alternation of generation the gametophyte [haploid (n)] generation is predominant. The **gametophyte** is the stage of the plant which produces gametes (sex cells like sperm and eggs). The sperm are produced in the male gametophyte called **antheridia** and the eggs are produced in the female gametophyte called **archegonia**.

9. After fertilization, the **zygote** (the fertilized egg) develops into an **embryo** and eventually a stalk like structure called the sporophyte that grows out of the female gametophyte. The **sporophyte** is the stage of the plant which produces haploid (n) spores. The spores are produced through a process called meiosis (2n reduced to n). The spores are released from the sporangium (capsule at the tip of the sporophyte) and are carried wherever wind or water take them. Some fall in favourable conditions and germinate into a new gametophyte generation.

G (gametophyte) S (sporophyte)

Bryophyta: Mosses

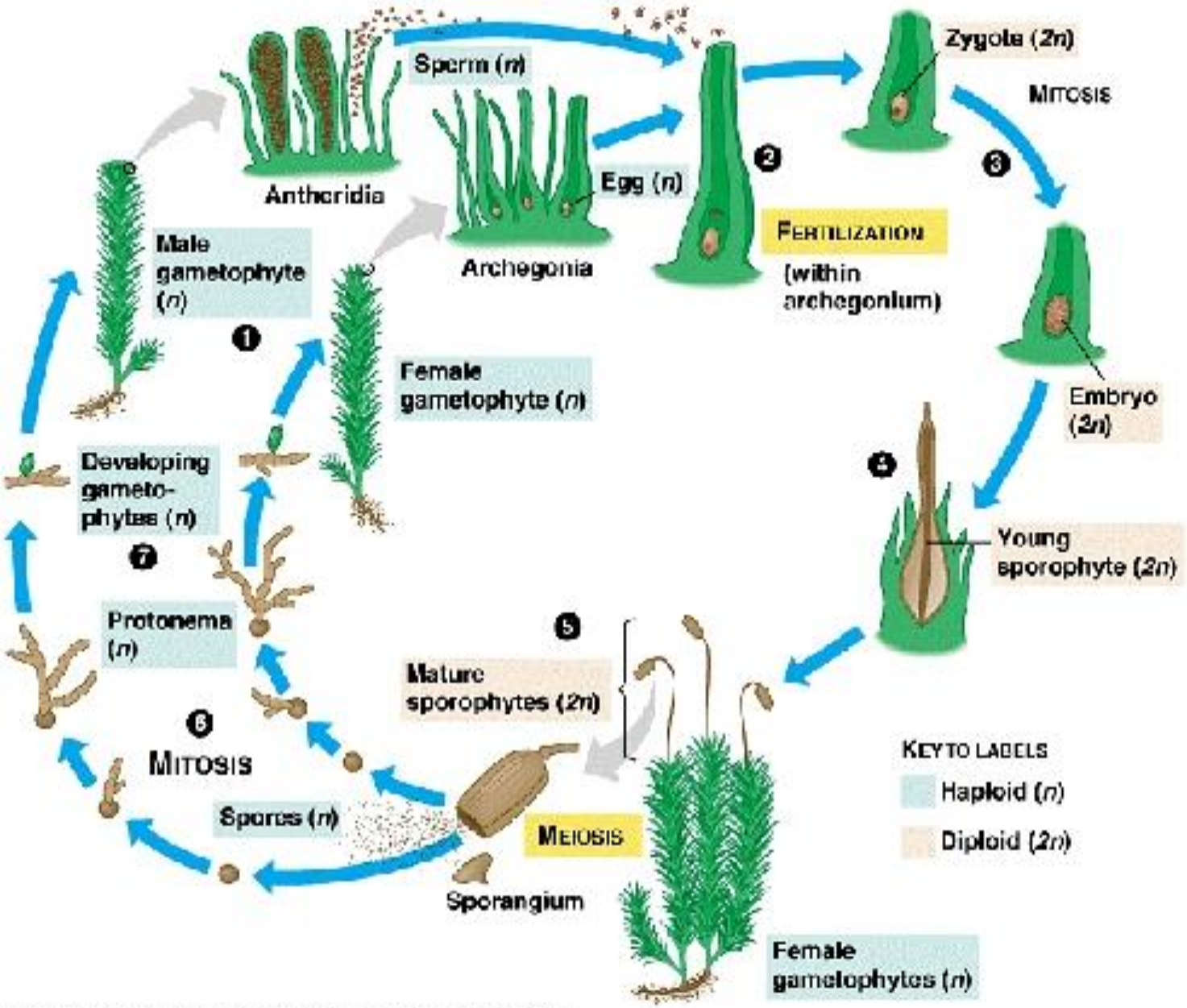
Sphagnum bogs are examples of a moss that grows abundantly in Northern Saskatchewan.

Hornwort

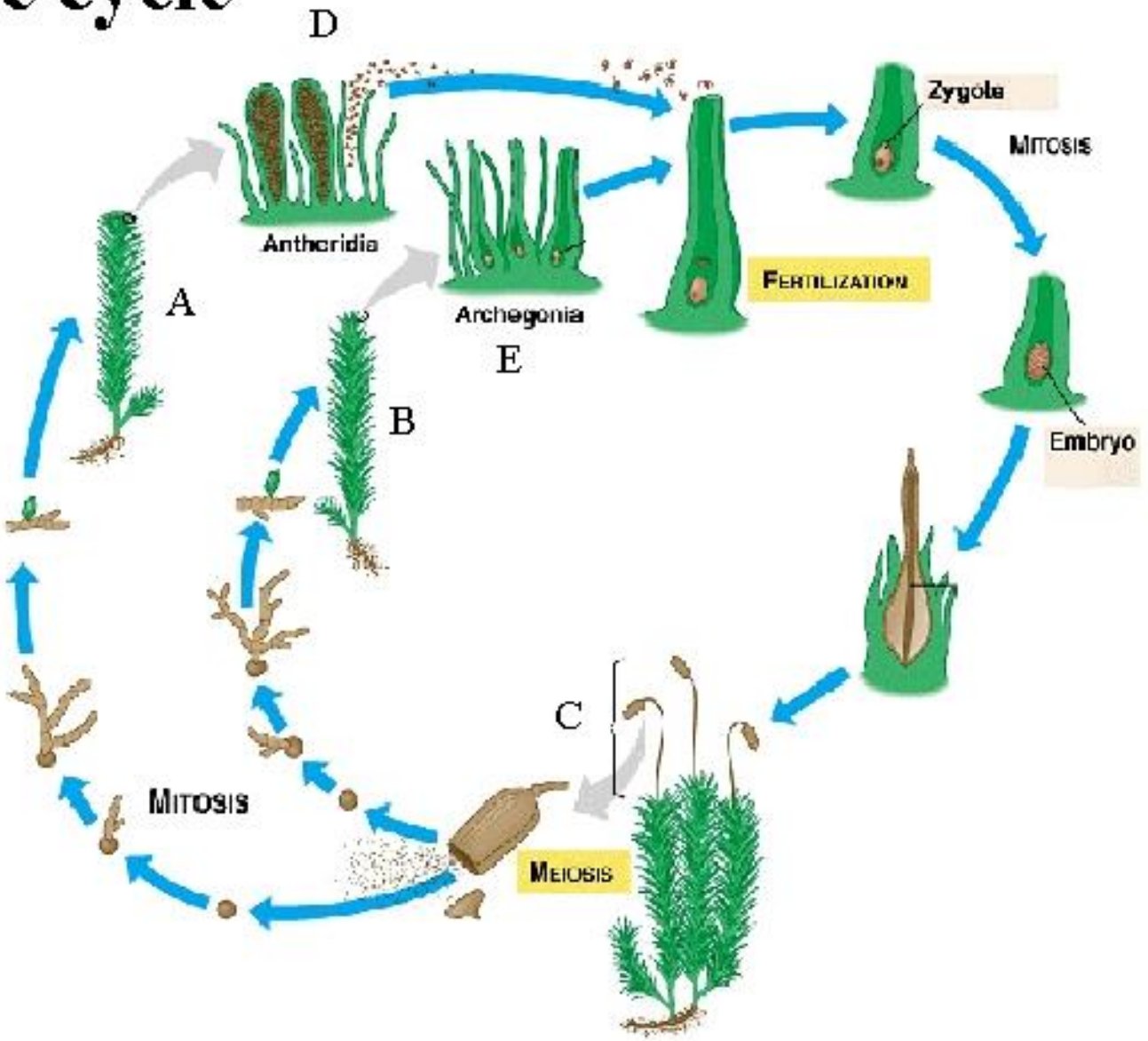
Liverwort

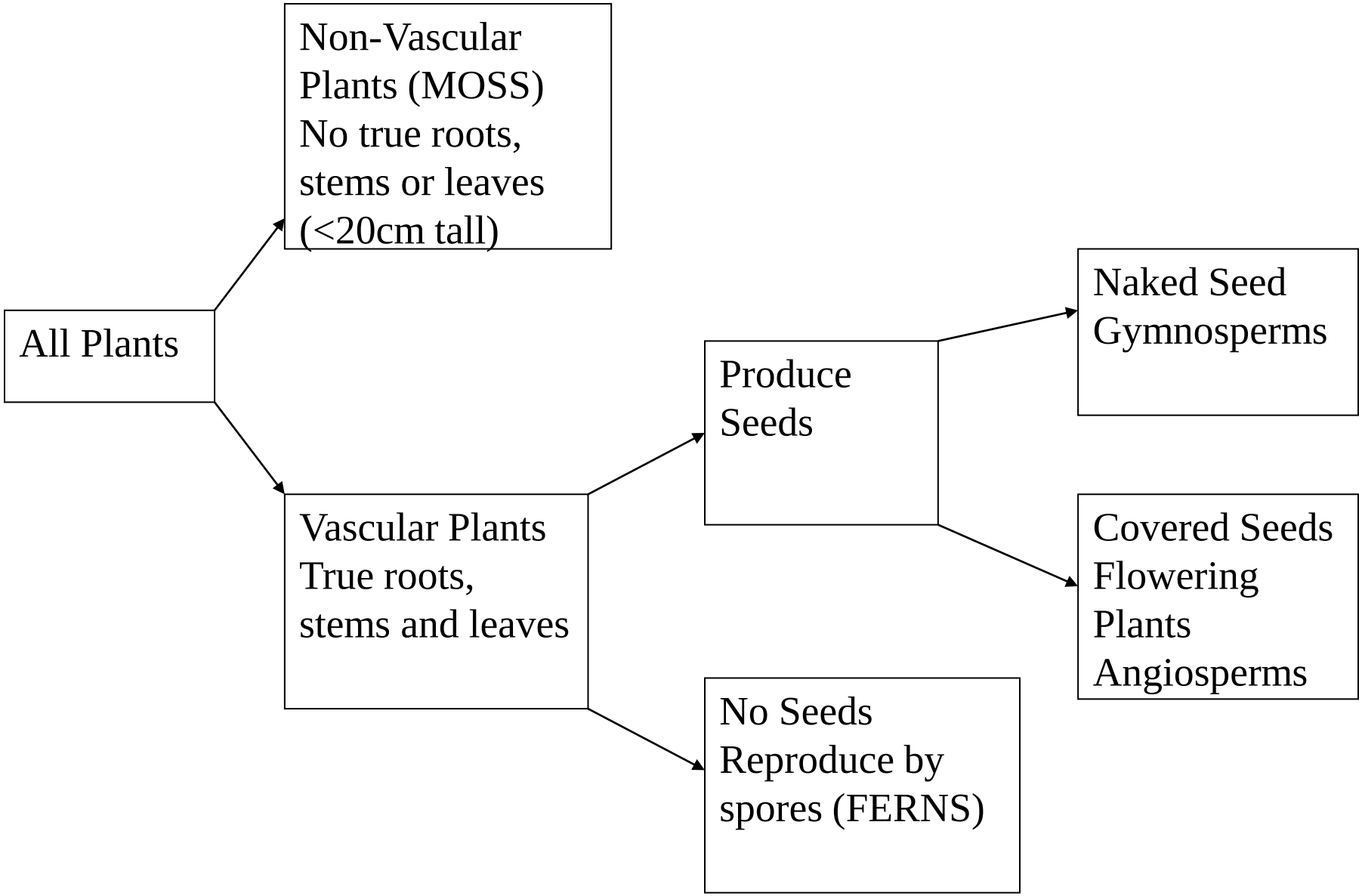
Liverwort - Archegonia

Moss Life cycle



Moss Life cycle




All Plants
Non-Vascular Plants (MOSS) No true roots, stems or leaves (<20cm tall)
Vascular Plants True roots, stems and leaves
Produce Seeds
Naked Seed Gymnosperms
Covered Seeds Flowering Plants Angiosperms
No Seeds Reproduce by spores (FERNS)

Vascular Plants

Division Tracheophyta

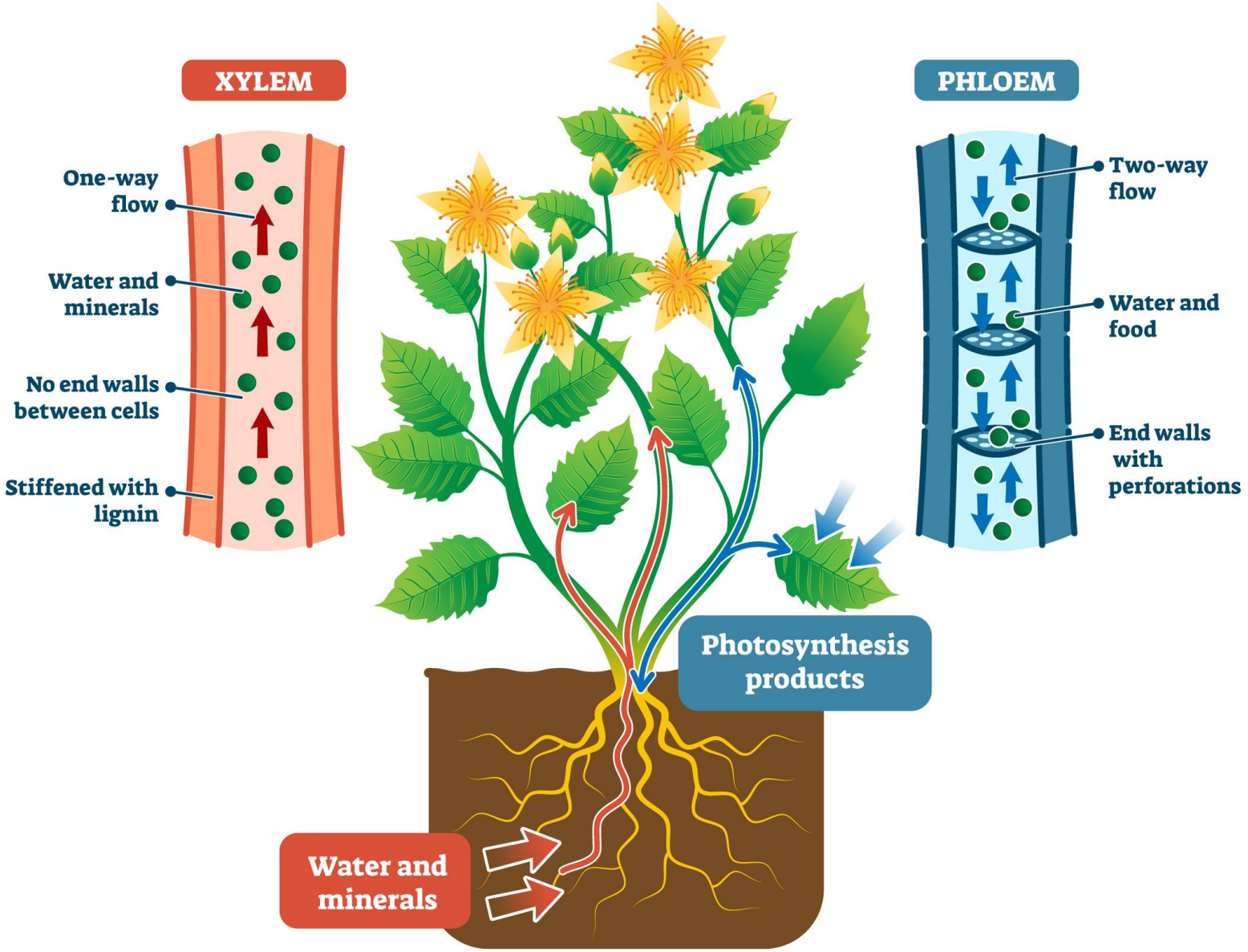
(Ferns, Herbs, Shrubs, Trees, and Flowering plants)

1. Vascular (conducting) tissue (Xylem and Phloem) is always present.

   Xylem - is a vascular tissue in plants that carries water and minerals to leaves.

   Phloem - is a vascular tissue in plants that carry food (glucose) made in the leaves throughout the plant.

XYLEM AND PHLOEM

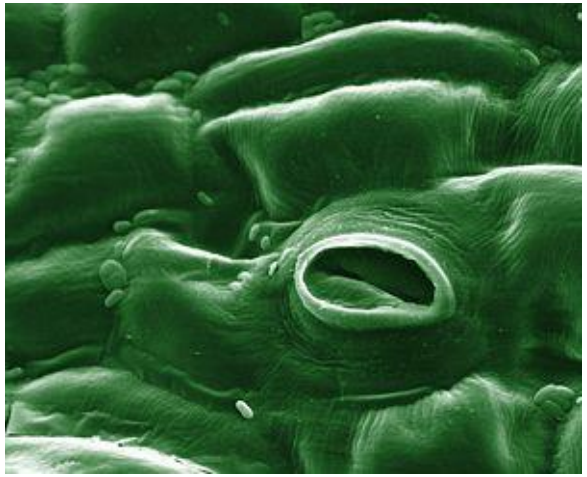


2. Vascular plants have well developed root systems for efficient collection of water and nutrients from the soil. The above ground cells absorb sunlight and produce food through photosynthesis.
3. The vascular tissue also offers support to the plant allowing it to grow very tall.
4. During alternation of generations the sporophyte is predominant and the gametophyte is reduced.

   G (gametophyte) S(sporophyte)
5. Reproduction is independent of water for most.

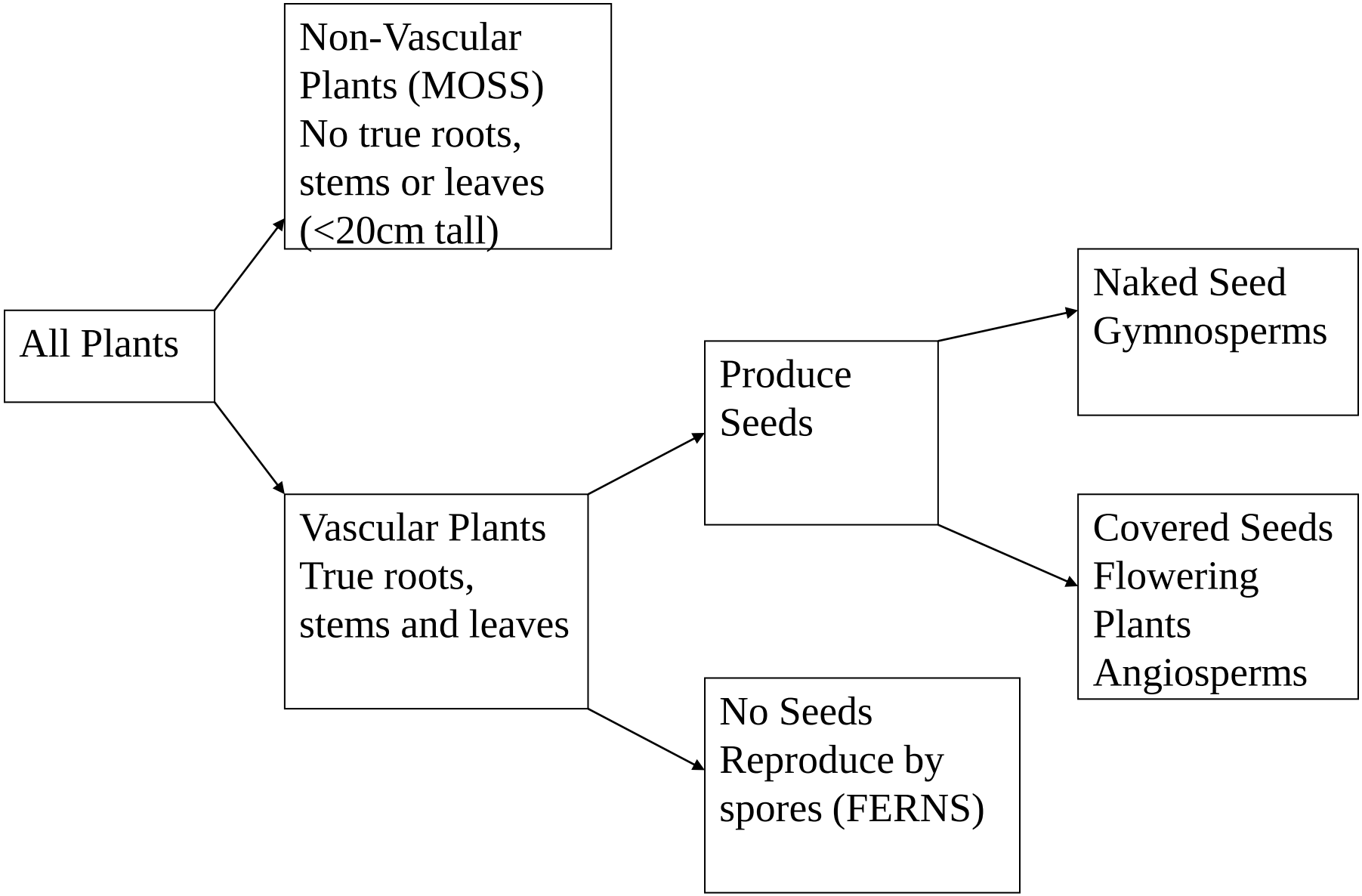
6. **Waxy cuticle** is a layer of wax on the outer surface of leaves to prevent water loss.

7. Because of the waxy cuticle, tiny slits called **stomates** are found in leaves which provide openings for gas exchange. (CO_2 in and O_2 out)



The vascular plants are divided into two main groups:

1) Those that **do not** produce seeds such as ferns that reproduce with spores.
2) Those that produce seeds. The seed producers are further grouped into two groups:
    a) Those that produce **naked seeds** such as pine trees.
    b) Those that produce **seeds enclosed in a fruit** (flowering plants).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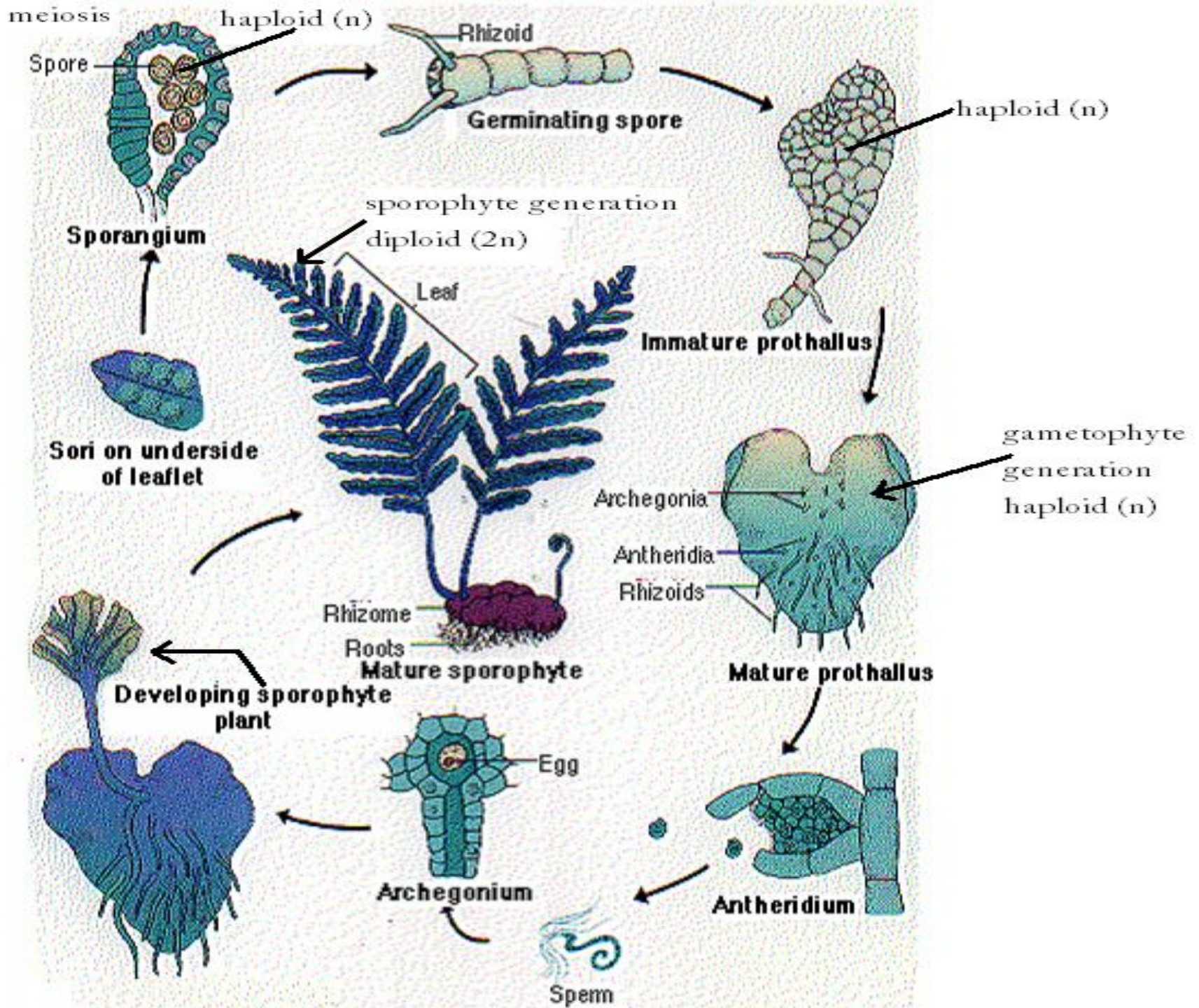
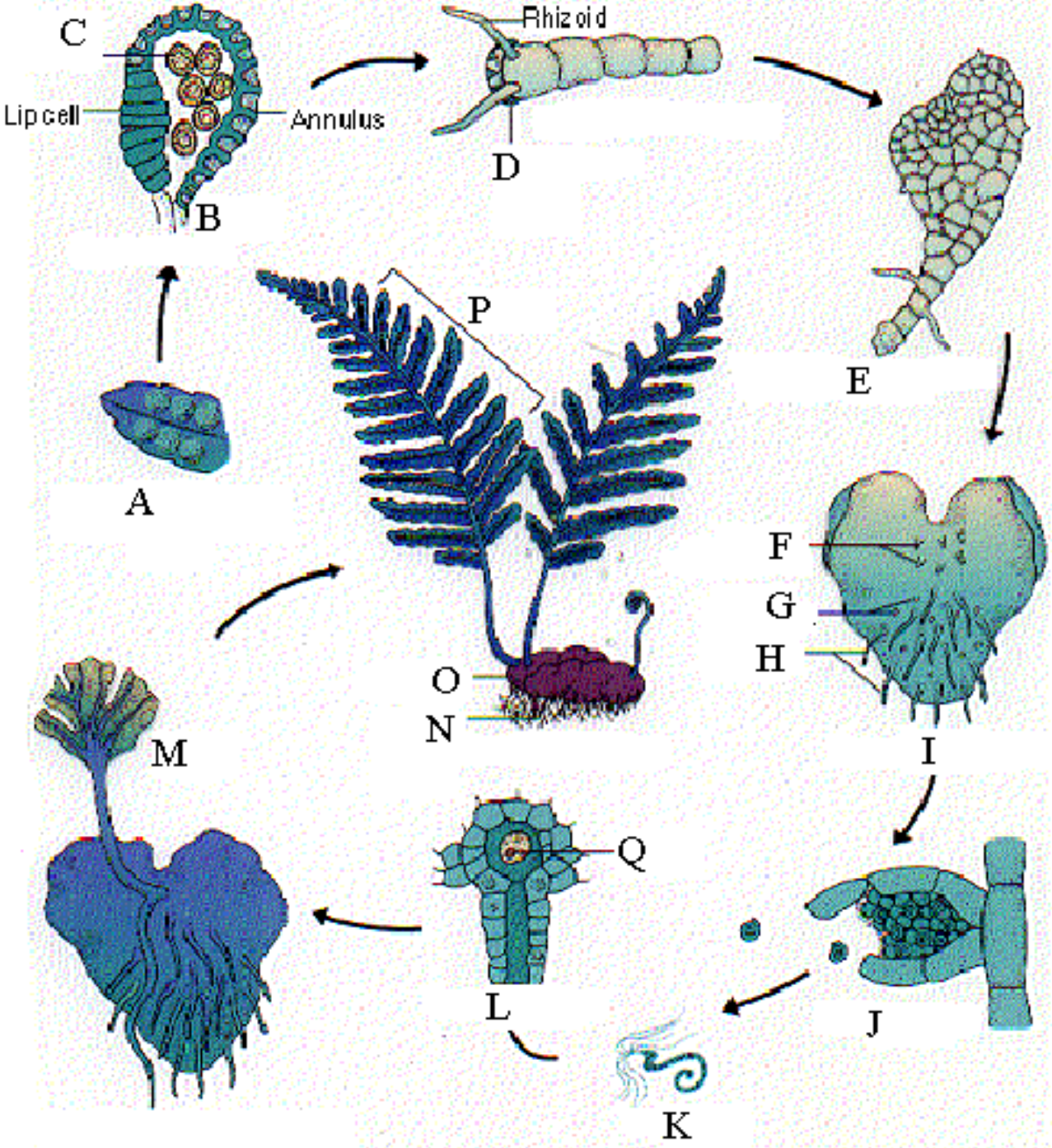
Seedless Vascular Plants

(True Ferns, Whisk Ferns, Club Mosses, Horsetails)

1. 300 million years ago these plants dominated the landscape.
2. Found mainly in humid areas (tropics) because their short lived gametophytes lack vascular tissue and also water is still required for fertilization.
3. Fern leaves are called **fronds**.
4. On lower surface of fronds are clusters of sporangia called **sori** that produce thousands of dustlike spores by meiosis.

5. A germinating spore develops into a small haploid gametophyte called a prothallus.
6. Antheridia and archegonia develop on the gametophyte and as in Bryophytes water is required for the sperm to swim to the egg. Once fertilization occurs, the zygote will form a new sporophyte that grows right out of the small prothallus.
7. Many have a section of underground stem that aids in absorption.

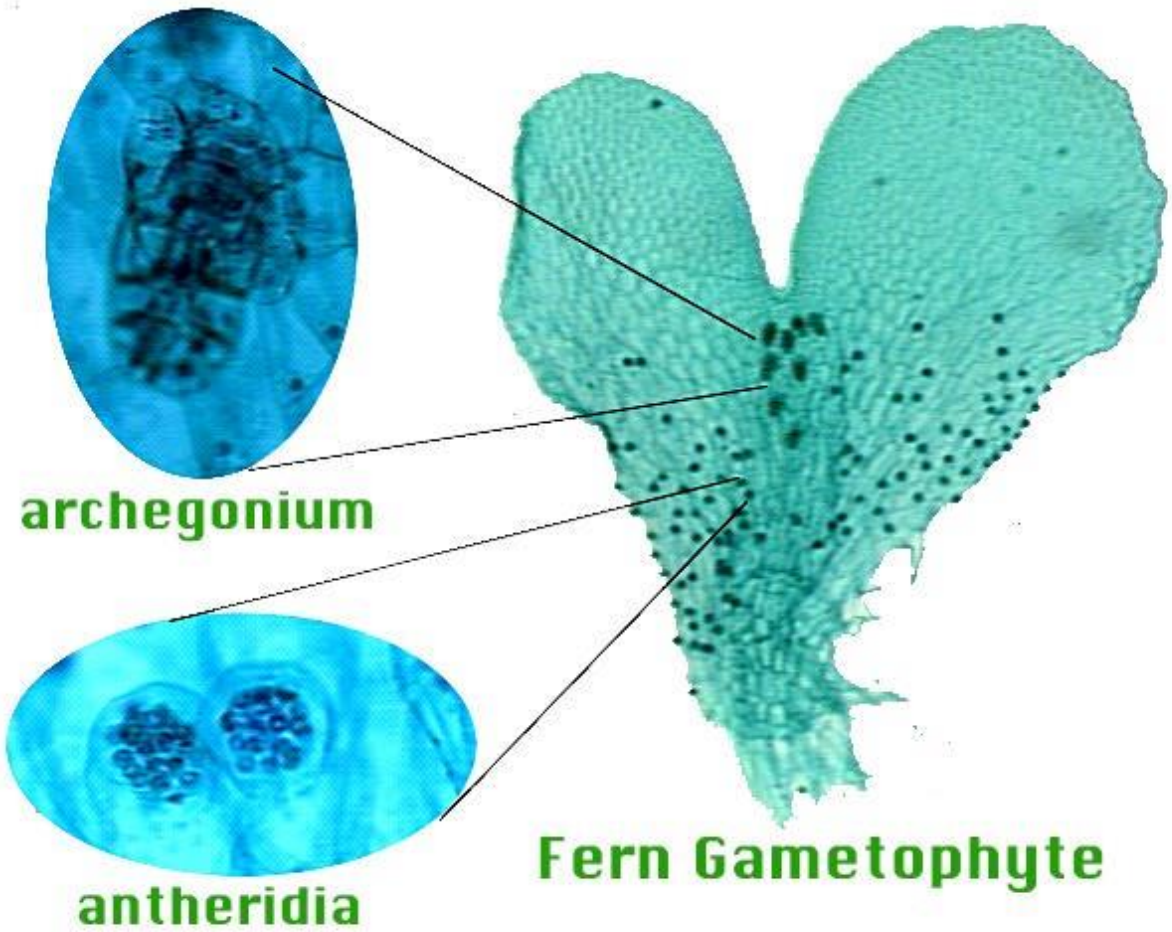

meiosis
haploid (n)
Spore
Rhizoid
Germinating spore
haploid (n)
Sporangium
sporophyte generation
diploid (2n)
Leaf
Immature prothallus
Sori on underside
of leaflet
gametophyte
generation
haploid (n)
Archegonia
Antheridia
Rhizoids
Rhizome
Roots
Mature sporophyte
Mature prothallus
Developing sporophyte
plant
Egg
Archegonium
Antheridium
Sperm


C
Lip cell
Annulus
B
Rhizoid
D
E
P
A
F
G
H
I
O
N
M
Q
L
J
K

Pteridophyta
Ferns

A Fern Frond

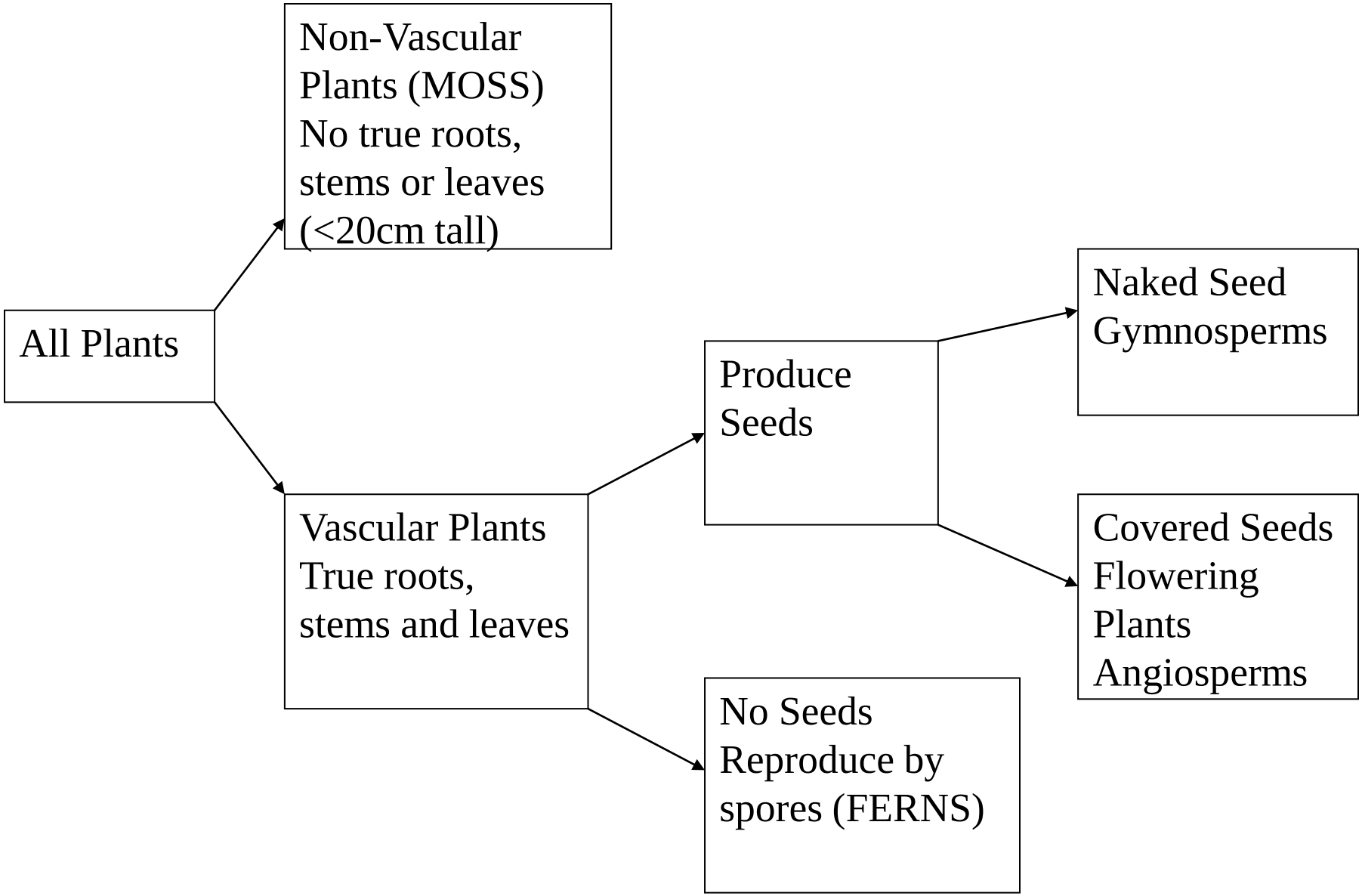
Sori on the underside of the Fern


archegonium
antheridia
Fern Gametophyte

Whisk Fern

Club Moss (not an actual moss)

Horsetail (not an actual horse)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Seeded Vascular Plants

1. These are the most successful plants and are often called "higher" plants.
2. All have vascular tissue including roots, stems, and leaves.
3. Gametophyte is microscopic within the tissue of the sporophyte.
4. Have separate male and female gametophytes.
5. Seed type is the main criteria for distinguishing the two major seed-bearing groups.
    1. **Gymnosperms** (naked seed)
    2. **Angiosperms** (covered seeds flowering plants)

Gymnosperms (Conifers)

(Pines, Junipers, Firs, Cypress, Spruce, Redwoods)

1. Almost all are woody trees or shrubs.
2. Provide paper pulp and wood for home construction.
3. Leaves are usually needle shaped and many are evergreen. These leaves are adapted to hot dry summers and cold winters.
4. Roots are often wide and shallow to allow for a good hold in areas where soil is scarce.
5. Seeds are naked (not covered by fruit).
6. Seeds are attached to the surface of modified leaves (scales) of a cone.

7. **Pollen** grains (male equivalent to sperm cells) released from male cones are wind blown and become trapped in sap of female cone (this is called pollination). When the pollen reaches the ovule (egg) fertilization occurs. Fertilization typically occurs 1 year after pollination and the seed requires an additional year to mature.
8. After fertilization, the zygote develops into an embryo which is surrounded by a protective layer called a seedcoat. These seeds are shed from the female cone and are carried by wind and water. If conditions are favourable, the seed germinates and a seedling (young plant) develops.

Conifers: Gymnosperms

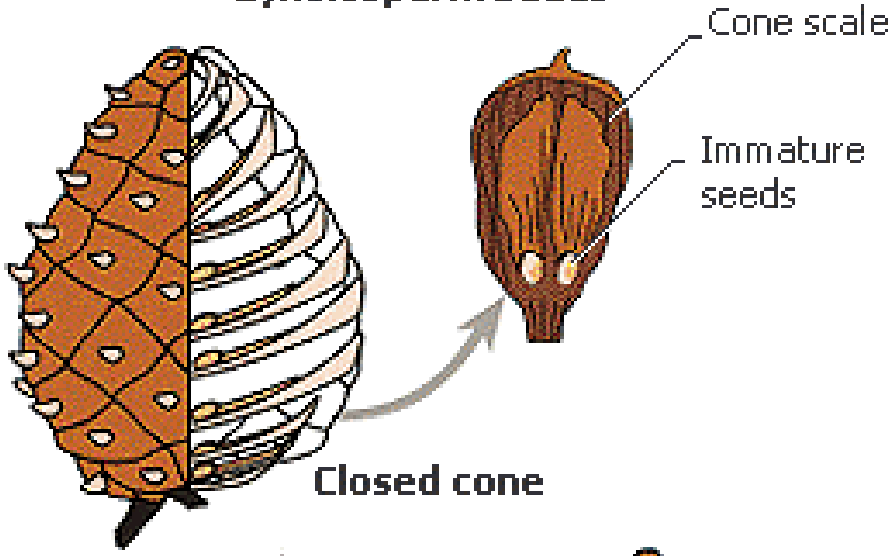
Pines
(Scotch
Pine)

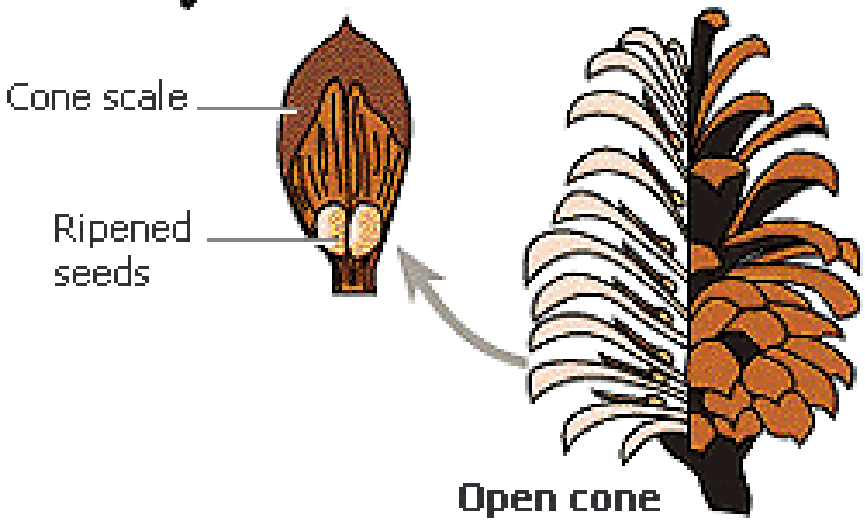
Juniper

Fir
Tree

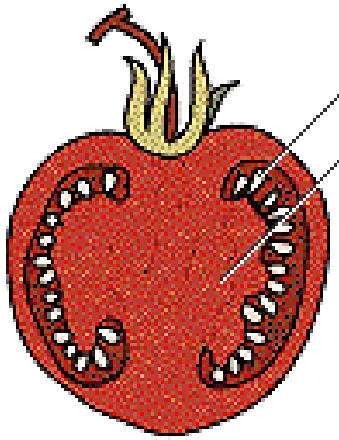
Pine Cones (male and female)

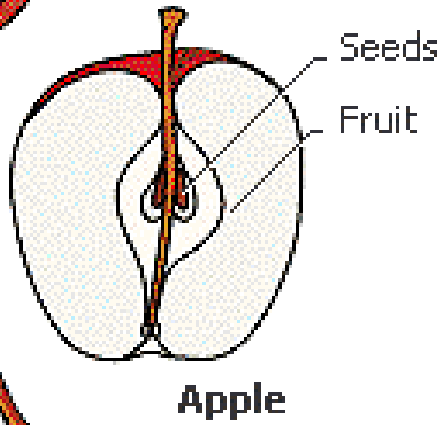
Gymnosperm Seeds

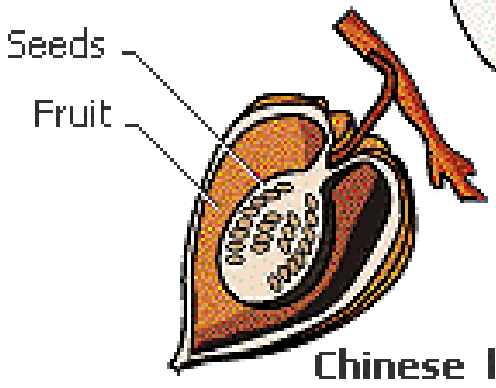




Angiosperm Seeds and Fruits



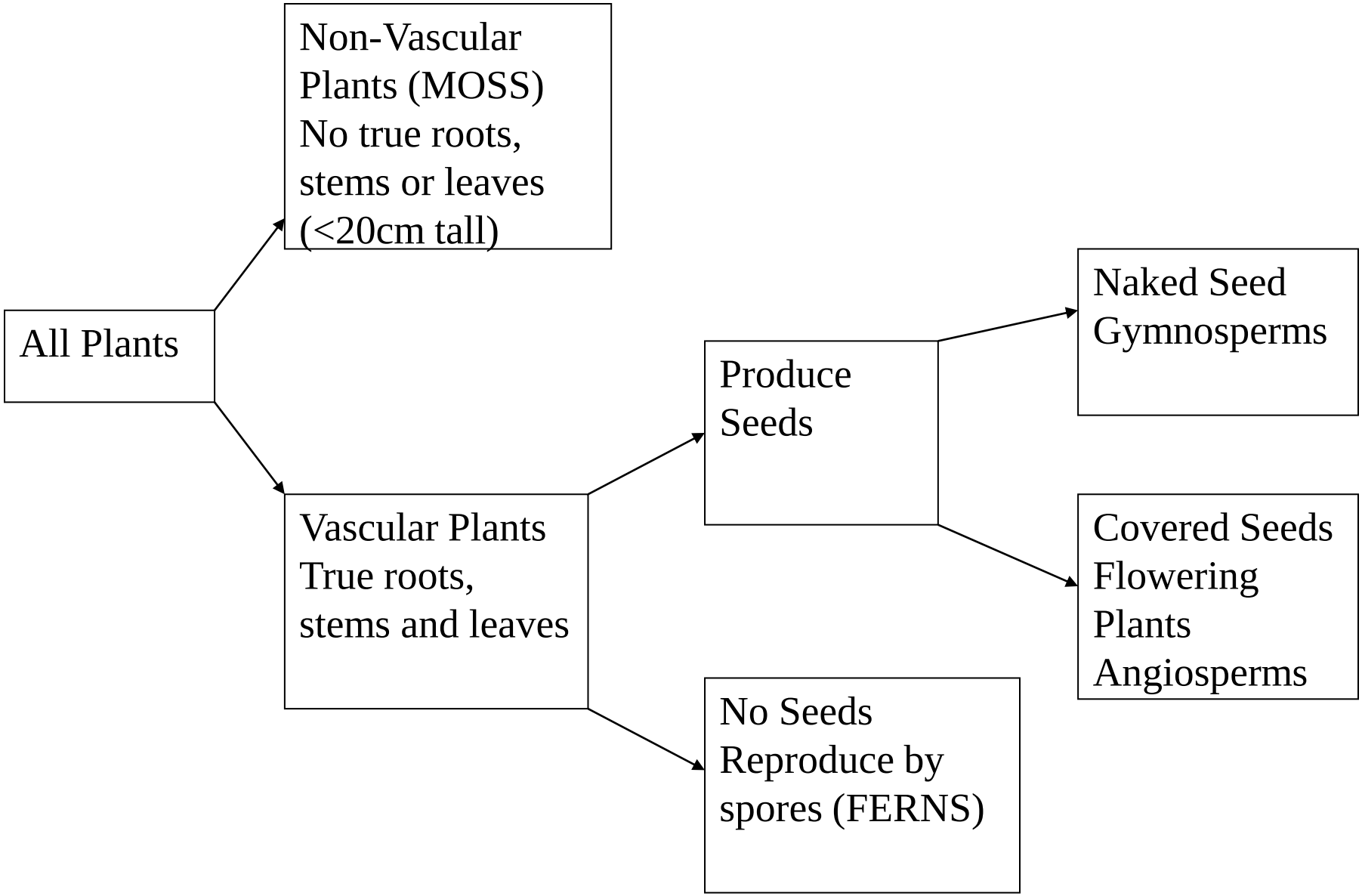




Sequoiadendron Giganteum_...
(Giant Sequoia)

Giant Sequoias:

- Fastest growing trees in the world.
- Bark as much as 4 feet thick.
- The trees have survived for 3,000 years.
- Some of the largest trees measure 35 feet in diameter and up to 300 feet (30 stories) in height.
- The tallest standing giant sequoia is 311 feet tall and the tallest redwood is 367 feet tall.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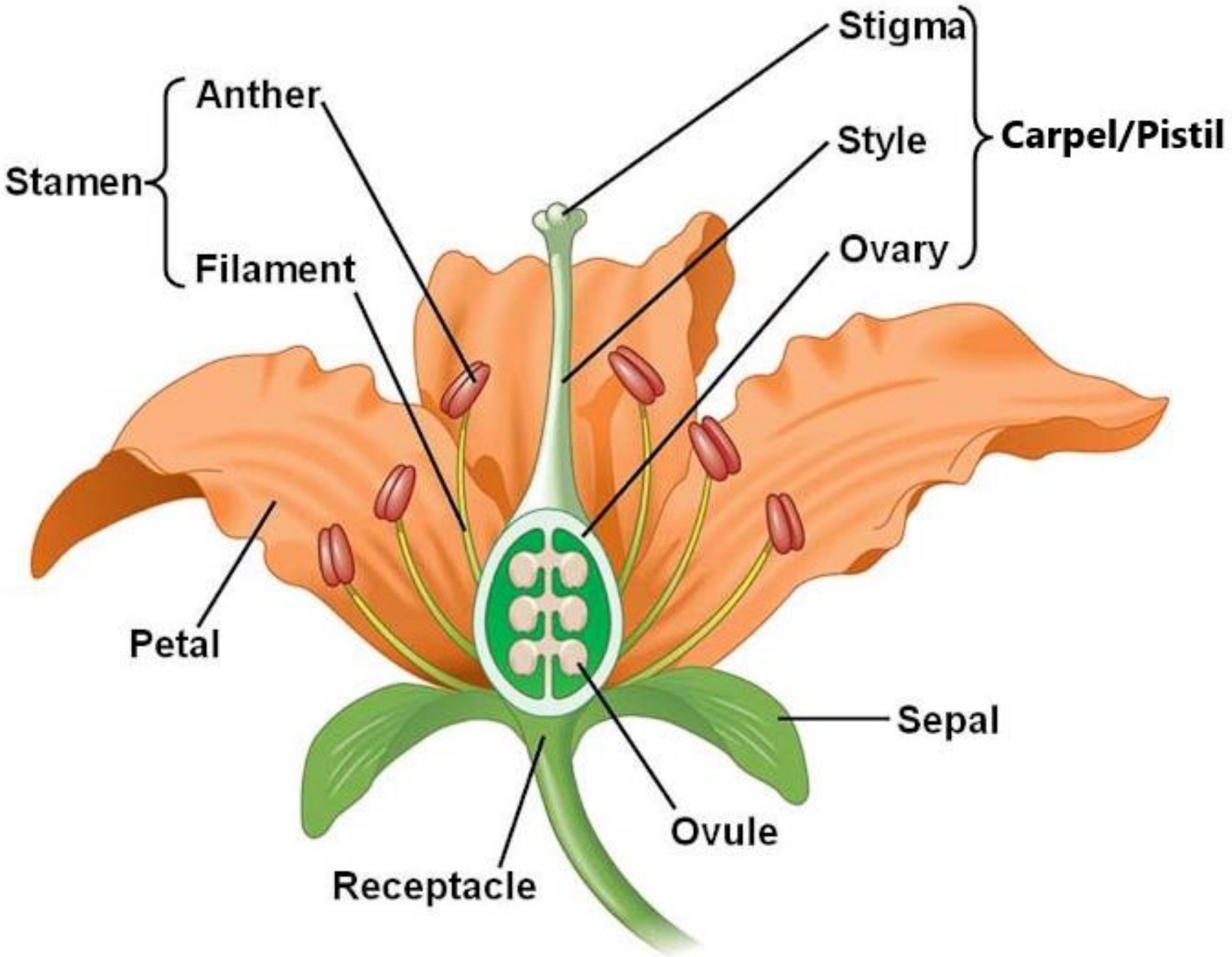
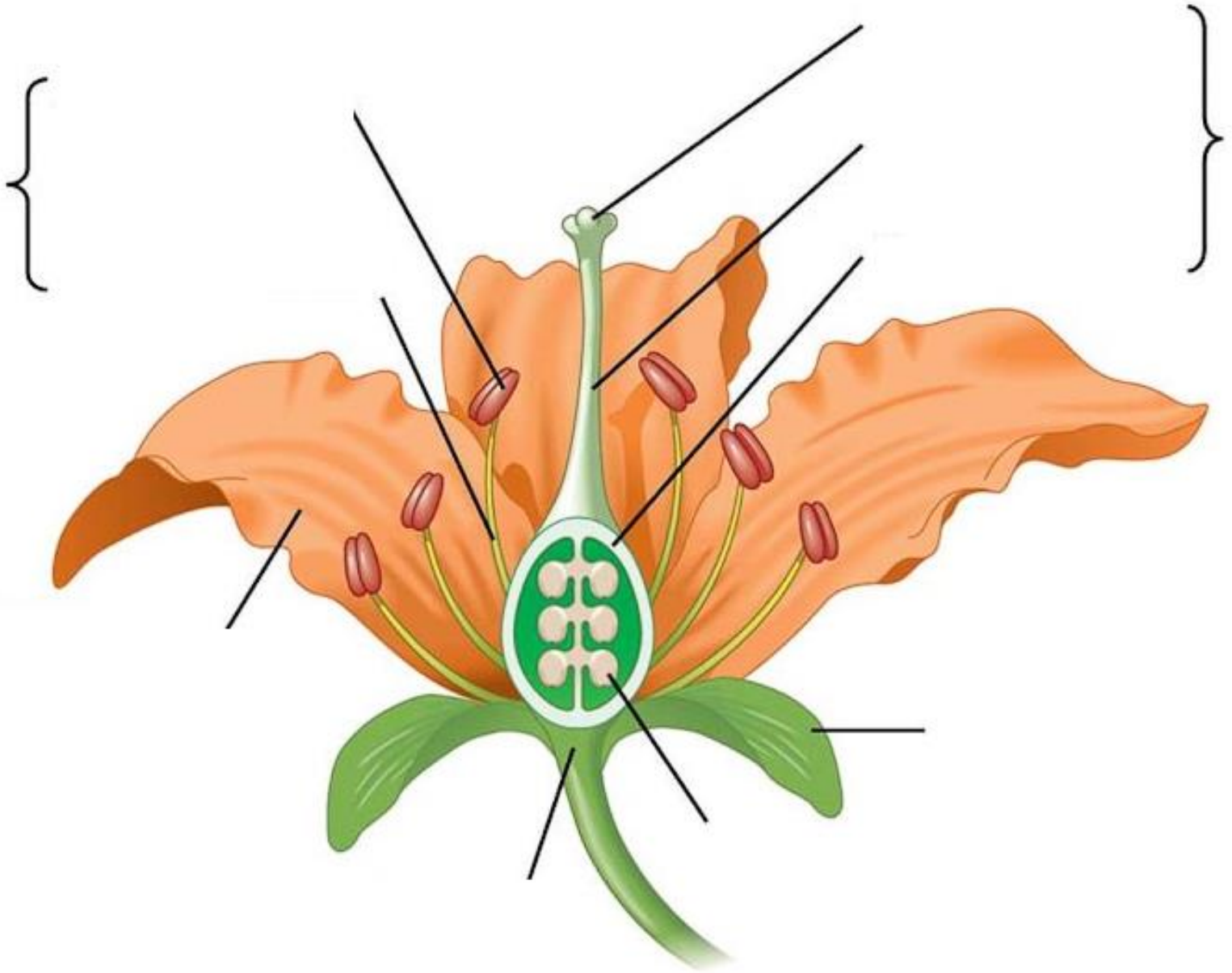
Angiosperms (Flowering plants)

(Rose, Daisy, Elm, Poplar, Banana, Palms, Violets, Bluegrass …)

1. There are more than 250 000 known angiosperms (more than all other plant divisions combined).
2. All have flowers which contain the reproductive parts.
3. Most rely on insects, birds, or mammals to spread the pollen.
4. **Stamen** is male part of flower. It consists of thin stalk called a **filament** and an **anther** where the pollen is formed.

5. The **pistil** (sometimes called carpel) is the female part of the flower. It consists of the **stigma** which is the sticky part where pollen grains land and grow, the **style** is the slender stalk by which the pollen grains reach the ovary, and the **ovary** where the ovule containing the egg cell is found.
6. At the base of each petal a sugary liquid called nectar is produced.
7. After fertilization the petals fall off and the fertilized ovule called a seed grow and change into a fruit.
8. The fleshy part of the fruit is stored food for the embryo.


Stigma
Anther
Style
Carpel/Pistil
Stamen
Ovary
Filament
Petal
Sepal
Ovule
Receptacle



Apple Flowers and Fruit

Orange Flowers and Fruit

Banana Flowers and Fruit

Pea Flower and Pod

Elm

Grass Flowers

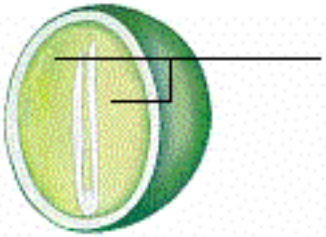
The angiosperms (flowering plants) can be further divided into two broad categories. The **monocots** and the **dicots**.

Monocots

- One cotyledon (seed leaf)
- Vascular bundles distributed throughout stem
- Veins parallel
- Floral parts in threes or multiples thereof

Dicots

- Two cotyledons (seed leaves)
- Vascular bundles arranged in a ring in the stem
- Veins netlike
- Floral parts in four or fives or multiples thereof

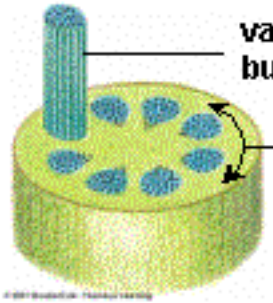


In seeds, two cotyledons (part of the embryo)

Usually four or five floral parts (or multiples of these)

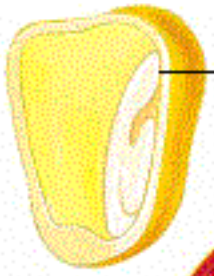
Usually a netlike array of leaf veins

Basically, three pores of furrows in pollen grain



Vascular bundles arrayed as a ring in stem

DICOTS

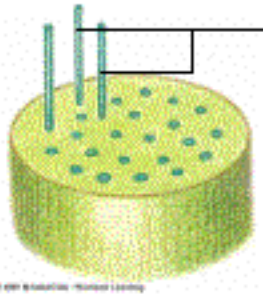


In seeds only one cotyledon

Usually three floral parts (or multiples of three)

Usually a parallel array of leaf veins

Basically, one pore or furrow in pollen grain



Vascular bundles distributed ground tissue of stem

MONOCOTS