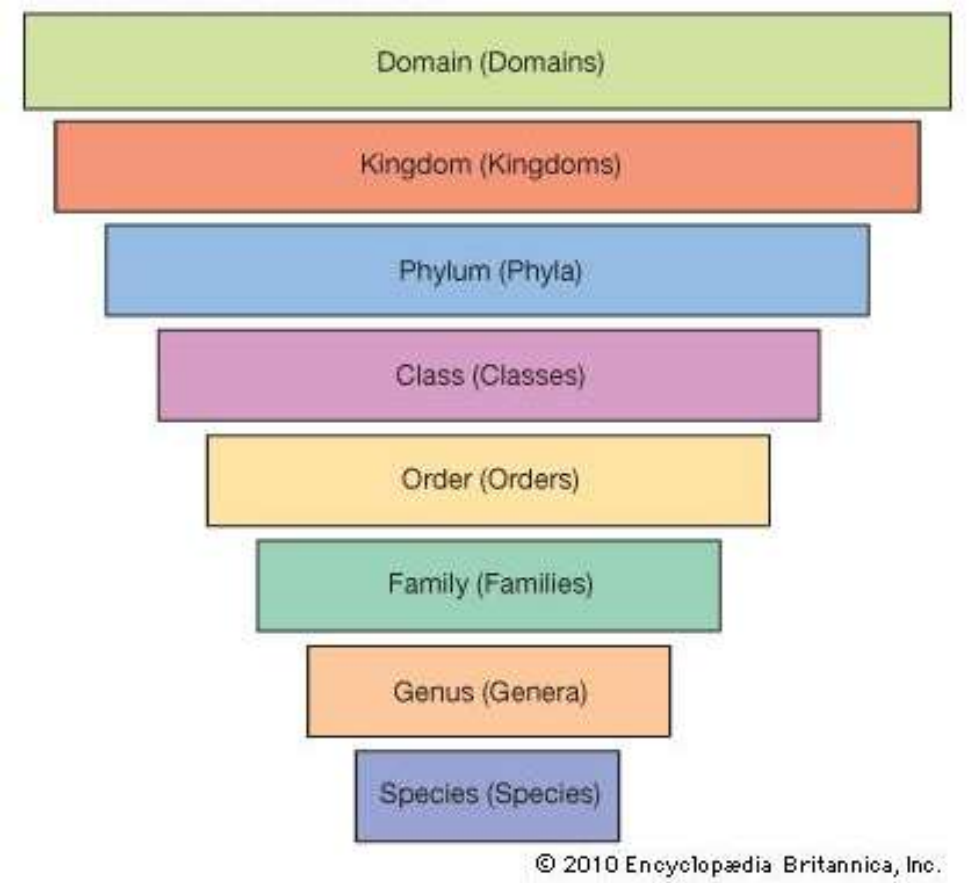
Diversity of Plant Life

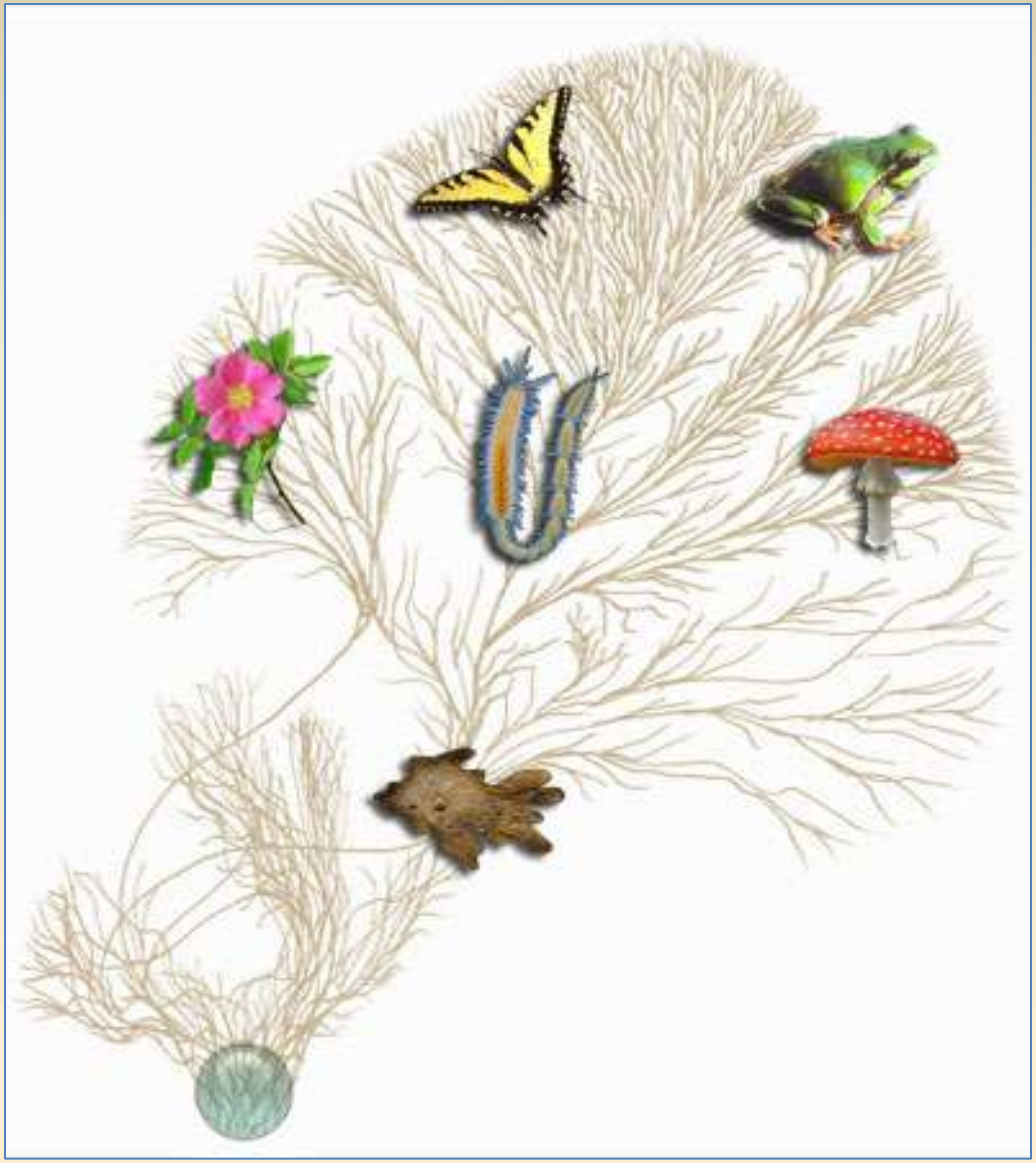
Classification of Life

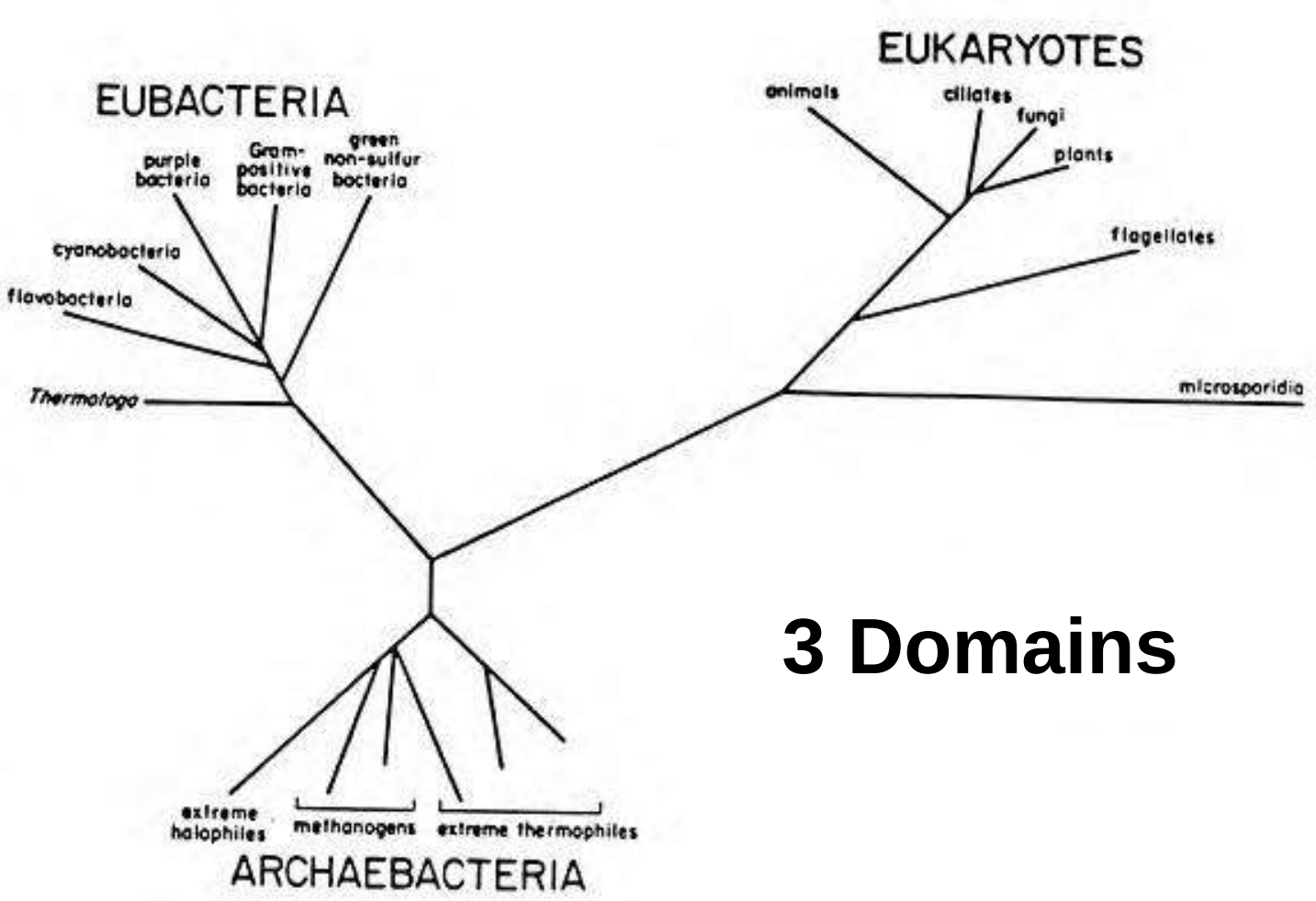
- There is a hierarchichal classification of life in which organisms are progressively nested within larger and larger categories as more distant relatives are included in the classification.
- The highest level of classification is the Domain of which there are three.



Phylogenetic Tree of Life

- There is also an alternative, evolutionary tree of life, based on the tree-like branching relationships of groups from a common ancestor.
- This effort is still an active area of research today.
- Cladistics





3 Domains

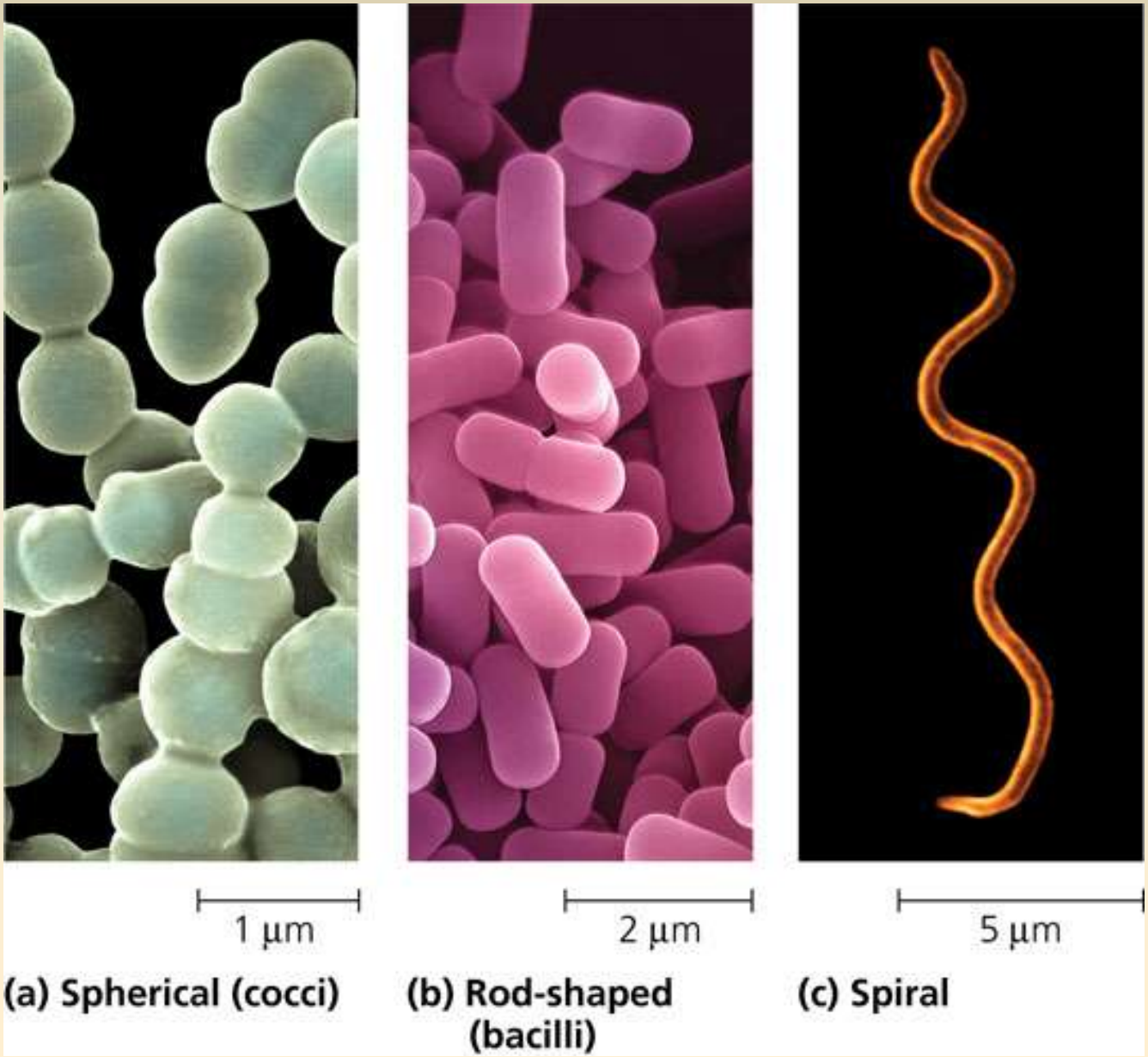
Carl Woese
1980s
ssRNA Sequences

Domains Bacteria and Archaea

- Domain Bacteria
- Domain Archaea

- The domains Bacteria and Archaea are both prokaryotes (they have no nucleus and the DNA is not arranged in chromosomes). Prokaryote derived from the Greek *Pro* meaning before and *karyon* meaning a kernel [i.e. a nucleus]

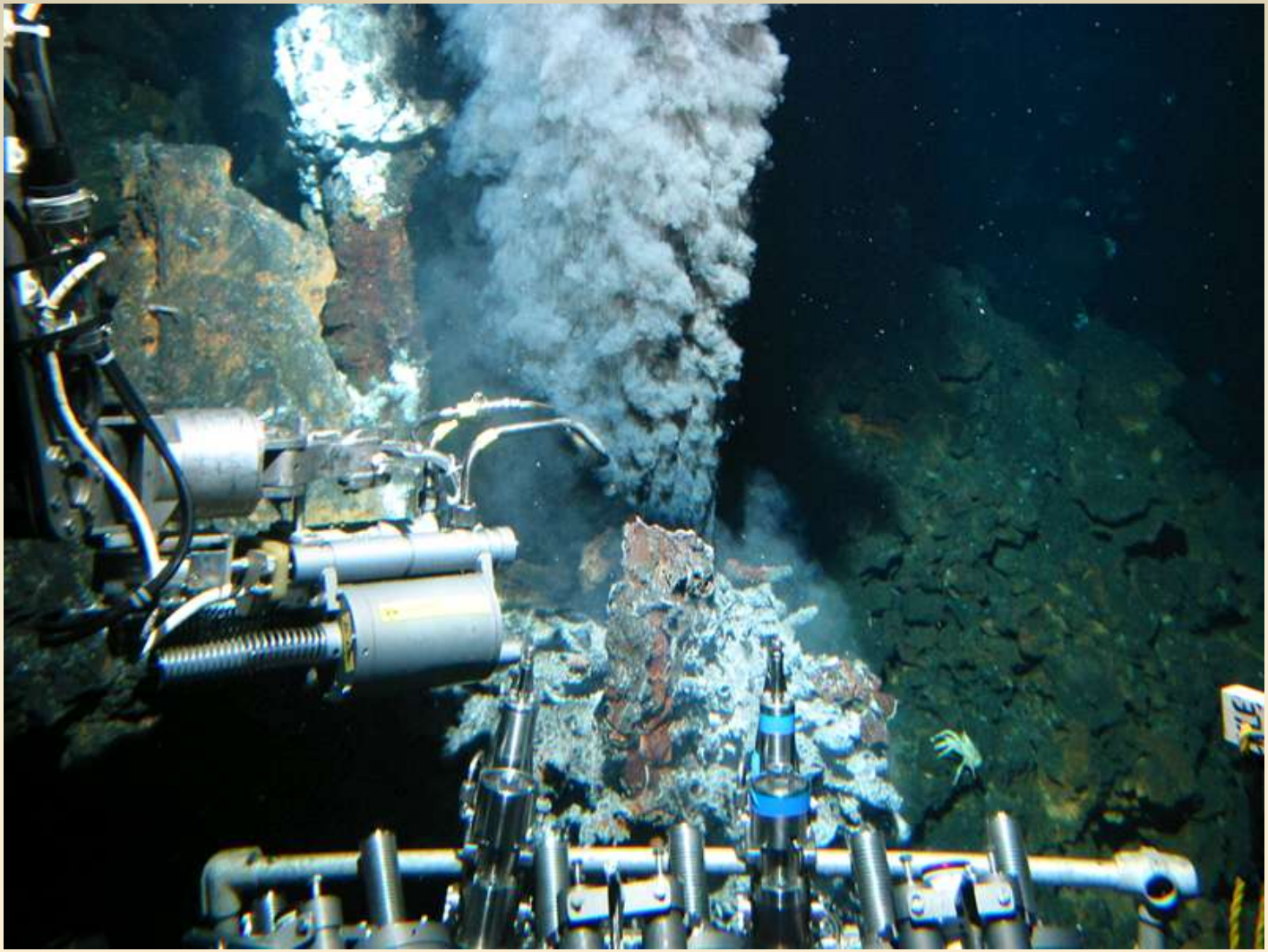
Domain Bacteria



Domain Archaea

Archaea in hot springs

Domain Archaea



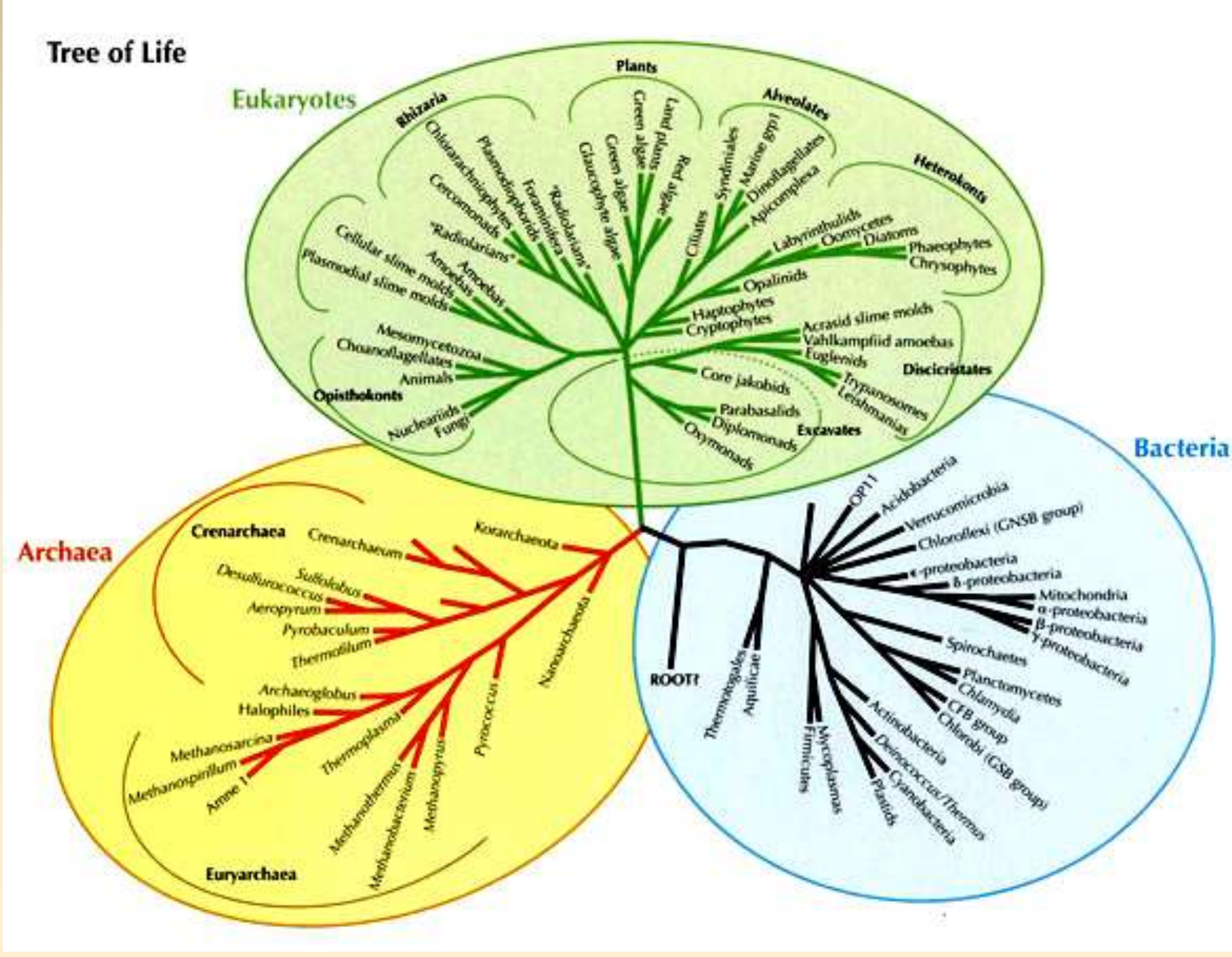
Archaea in hydrothermal vent

Domain Eukarya

- Domain Eukarya eukaryotic, has nucleus
- includes three kingdoms the Plantae, Fungi and Animalia.
- There are also a number of unicellular eukaryotes that may form as many as five other kingdoms. These were formerly grouped in the Protista.

Domain Eukarya

- Plantae, Fungi and Animalia are mostly multicellular, but plants are autotrophic (produce their own food by photosynthesis) whereas the fungi and animals are heterotrophic (consume other organisms)


Tree of Life
Eukaryotes
Plants
Rhizaria
Alveolates
Heterokonts
Chlorarachniophytes
Plasmodiophorids
Foraminifera
"Radiolarians"
Glaucophyte algae
Green algae
Land plants
Red algae
Ciliates
Syndiniales
Marine grp I
Dinoflagellates
Apicomplexa
Labyrinthulids
Oomycetes
Diatoms
Phaeophytes
Chrysophytes
Cercomonads
"Radiolarians"
Amoebas
Cellular slime molds
Plasmodial slime molds
Opalinids
Haptophytes
Cryptophytes
Acrasid slime molds
Vahlkampfiid amoebas
Euglenids
Discicristates
Core jakobids
Trypanosomes
Leishmanias
Mesomycetozoa
Choanoflagellates
Animals
Opisthokonts
Nucleariids
Fungi
Parabasalids
Diplomonads
Oxymonads
Excavates
Bacteria
OP11
Acidobacteria
Verrucomicrobia
Chloroflexi (GNSB group)
ε-proteobacteria
δ-proteobacteria
Mitochondria
α-proteobacteria
β-proteobacteria
γ-proteobacteria
Spirochaetes
Planctomycetes
Chlamydia
CFB group
Chlorobi (GSB group)
Deinococcus/Thermus
Cyanobacteria
Plastids
Actinobacteria
Mycoplasmas
Firmicutes
ROOT?
Thermotogales
Aquificae
Archaea
Crenarchaea
Crenarchaeum
Korarchaeota
Desulfurococcus
Sulfolobus
Aeropyrum
Pyrobaculum
Thermofilum
Nanoarchaeota
Archaeoglobus
Halophiles
Methanosarcina
Methanopyrus
Thermoplasma
Methanothermus
Methanobacterium
Pyrococcus
Amne 1
Euryarchaea

The phylogeny of land plants

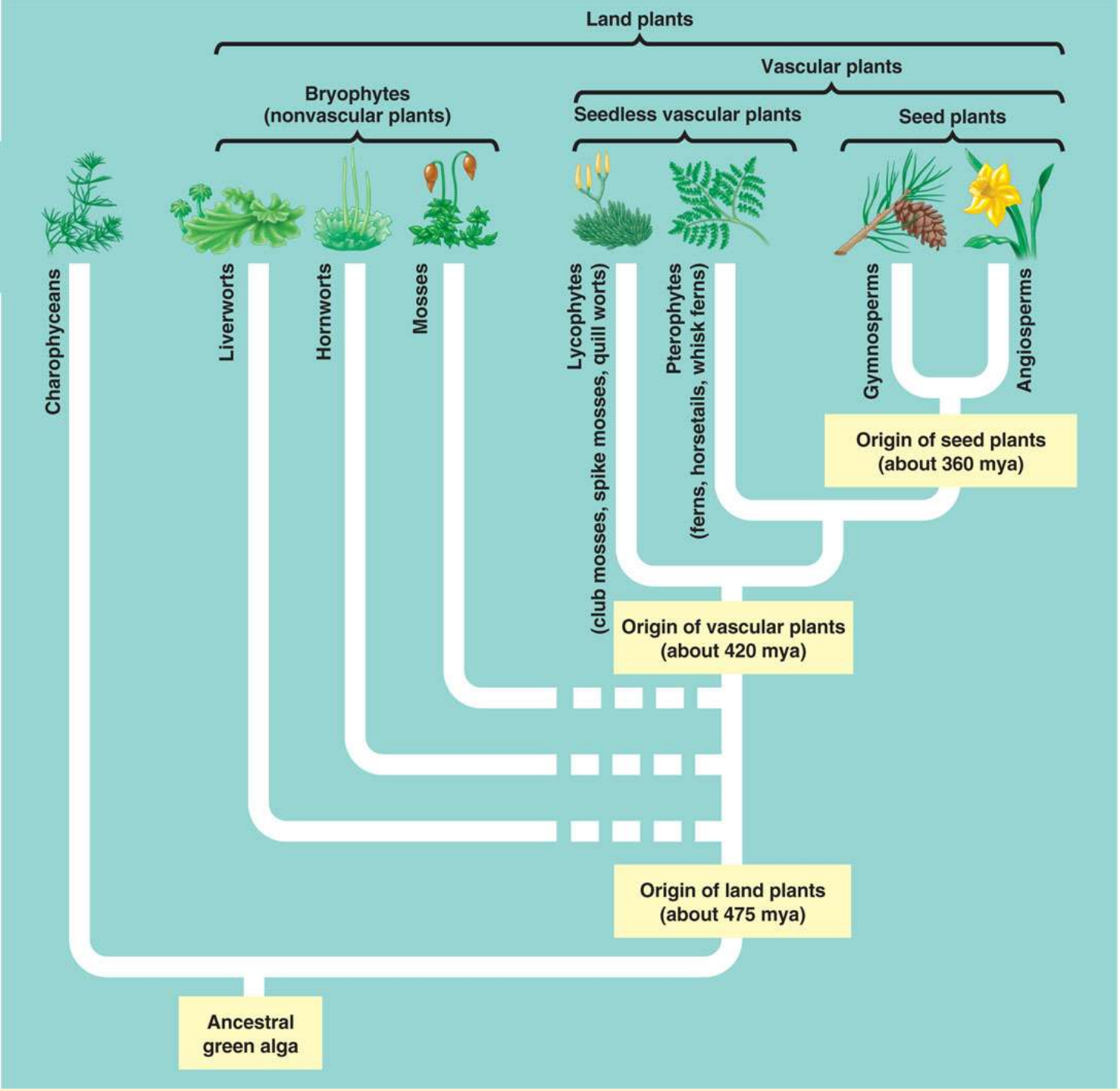
The likely ancestor are charophycean algae

- same chloroplast DNA, ribosomal DNA
- same membrane structure, peroxisomes, sperm cells

Chara

Four main groups of Land Plants

- Bryophytes (mosses, etc.)
- Ferns and relatives
- Gymnosperms
- Angiosperms

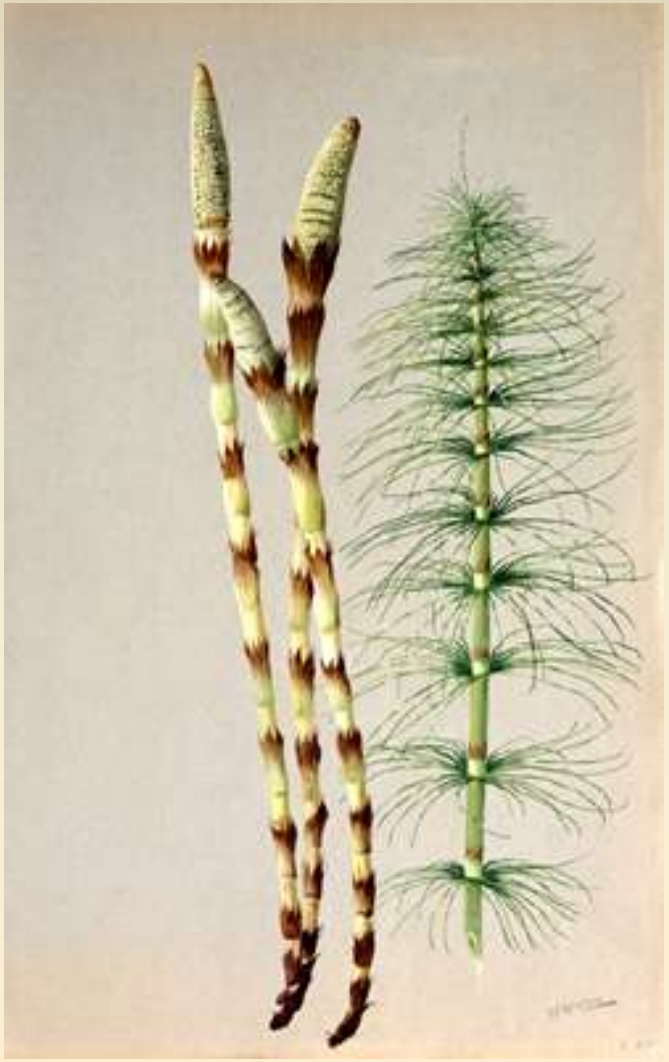

Land plants
Vascular plants
Bryophytes (nonvascular plants)
Seedless vascular plants
Seed plants
Charophyceans
Liverworts
Hornworts
Mosses
Lycophytes (club mosses, spike mosses, quill worts)
Pterophytes (ferns, horsetails, whisk ferns)
Gymnosperms
Angiosperms
Origin of seed plants (about 360 mya)
Origin of vascular plants (about 420 mya)
Origin of land plants (about 475 mya)
Ancestral green alga

Bryophytes (Mosses, etc.)

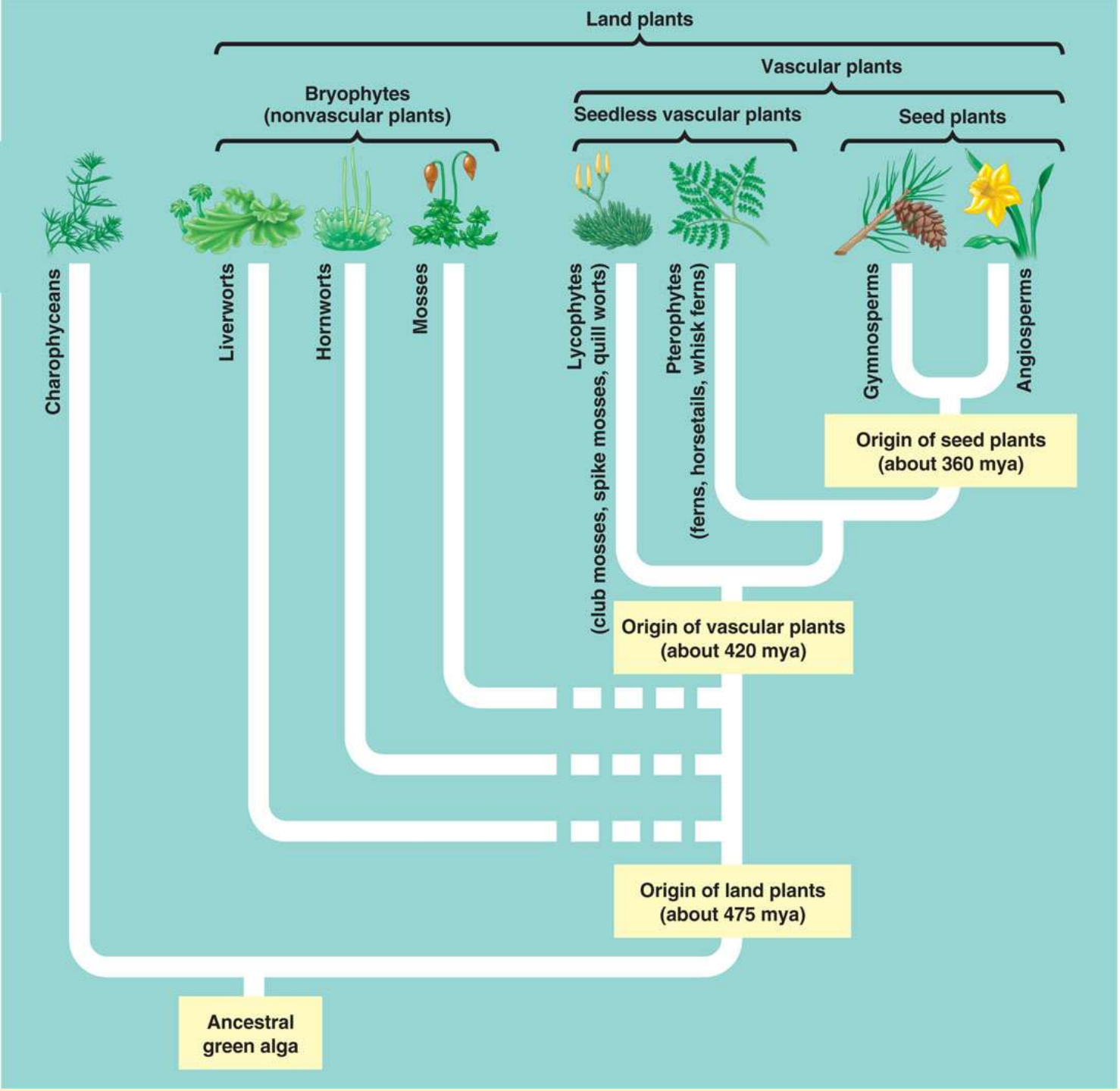
Bryophyta (liverworts)

Flattened thallus body
Found on rocks in wet areas

Ferns and fern allies



Equisetum - Horsetail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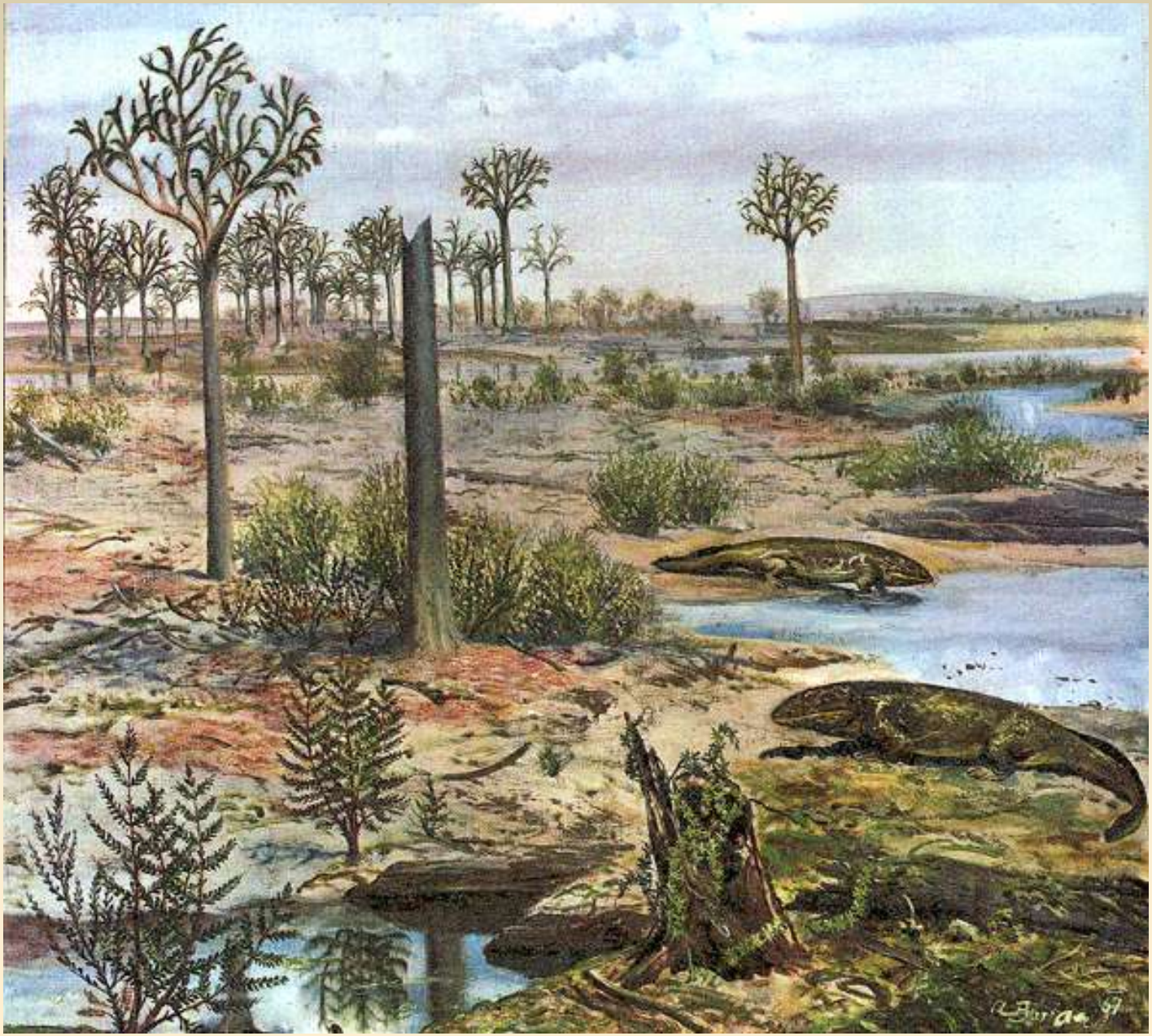
Ferns and Fern Allies
Vascular plants (Xylem, Phloem)
but no flowers, no seeds, reproduce by spores

Devonian Forest Landscape



Carboniferous Forest – 300 mya

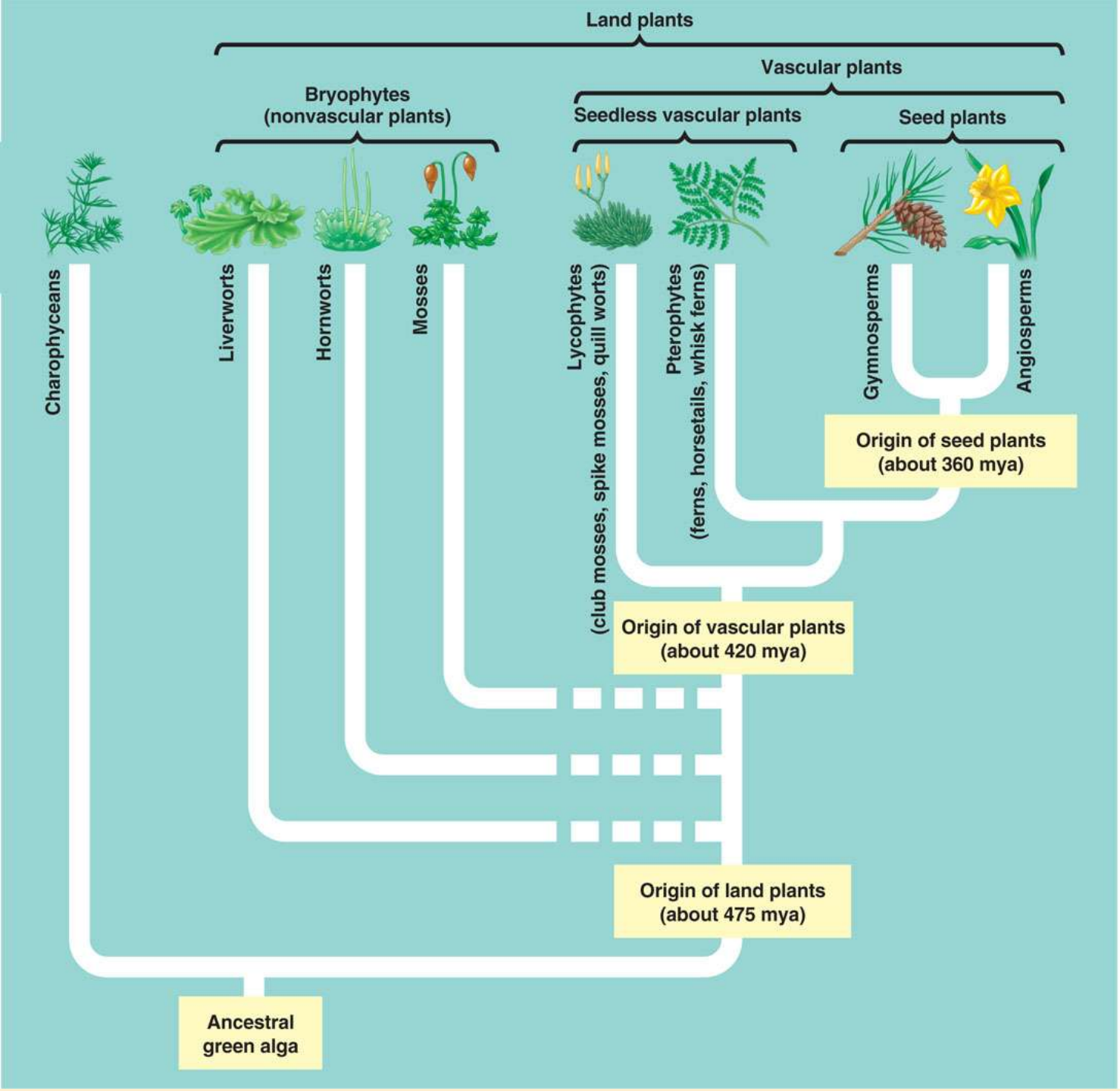
Equisetum

Lycopod

Fern life cycle - spores

Unit of dispersal = spores

- Produced by sporangia
- Sporangia clustered in sori (singular = sorus)
- Usually small button-like dots on backs of fronds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Advantages of seeds

- Provides protection and nourishment for developing embryo.
- Dispersal: seeds can be dispersed more widely than spores by enclosing them in a bribe (fruit) and having animals move them.
- Dormancy: the developing embryo is protected and can wait a long time to germinate when conditions are good.

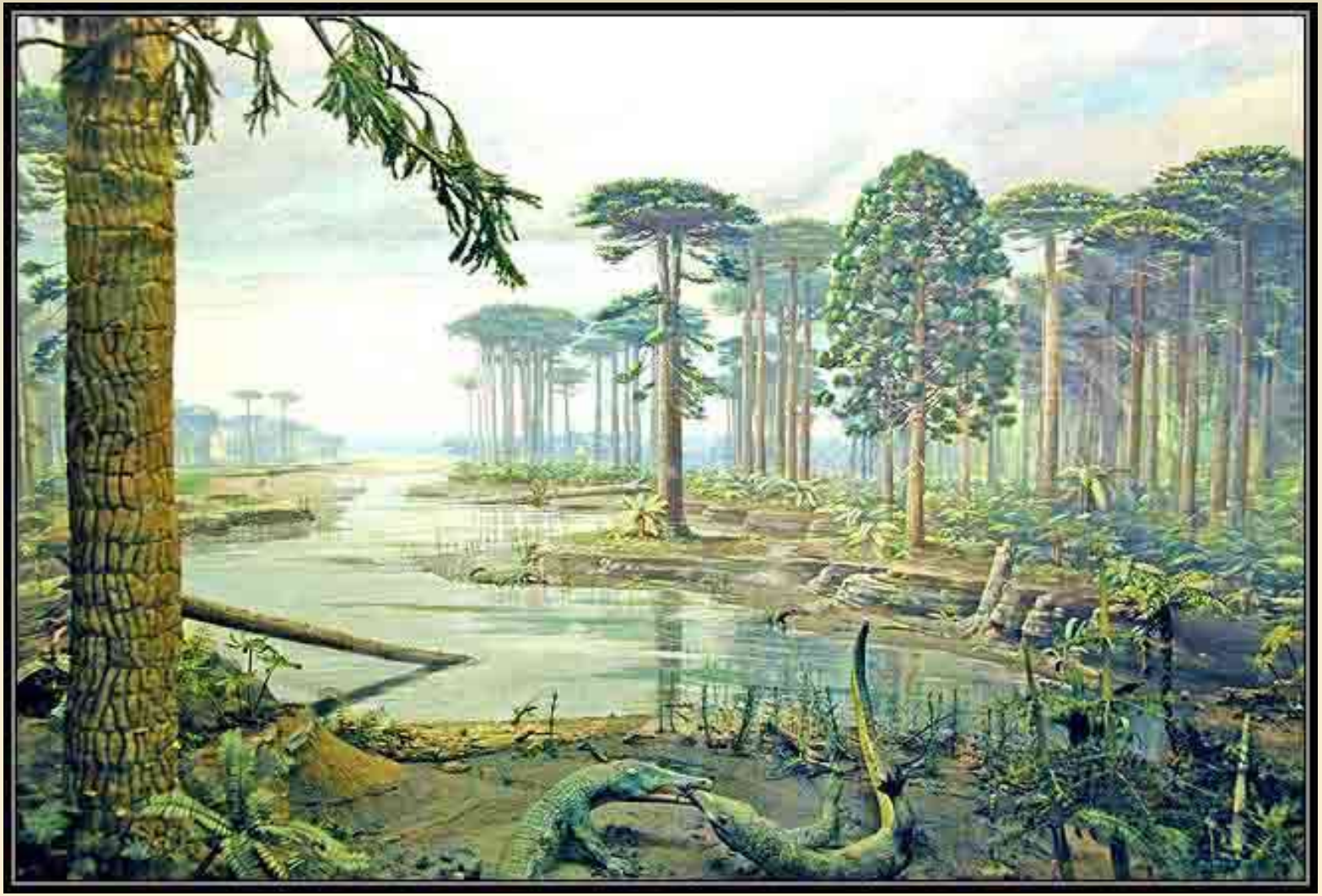
Gyymnosperms – “naked seed” plants
Have no flowers or fruit, seeds borne naked

Radiation of Gymnosperms

- Gymnosperms underwent adaptive radiation during the Carboniferous and Permian periods (360-245 mya).

- Gymnosperms were the dominant plants during the Age of Dinosaurs (Mesozoic 245-65 mya).

Triassic plants were mainly seed plants - conifers and cycads.

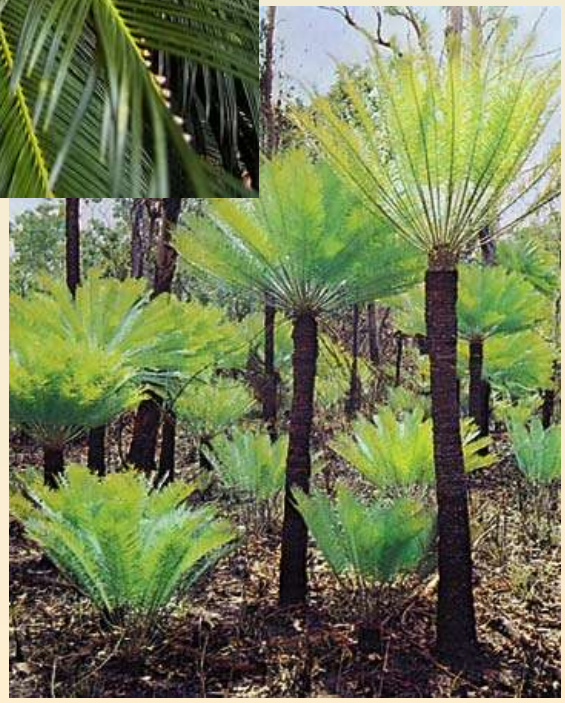


Triassic Araucariad Forest
From Petrified Forest National Park Museum

Jurassic Gymnosperm Conifer Forests

Cycads

- 130 species
- New and Old World tropics
- Large palm-like leaves and large cones.
- Dioecious
- Large seeds
- Motile sperm cells



Cycads – gymnosperm seed plants

Ginkgo

- 1 species
- Unknown in wild, previously widespread
- Seed coat is fleshy.
- Widely planted street tree

Conifers

- 600 species in 7 families
- Most important gymnosperms
- Pine, spruce, fir, cedar, etc.
- Complex seed cones
- Needled leaves reduce water loss

Gnetophytes

- 90 species,

  3 genera
- Double fertilization
- Transition to angiosperms?

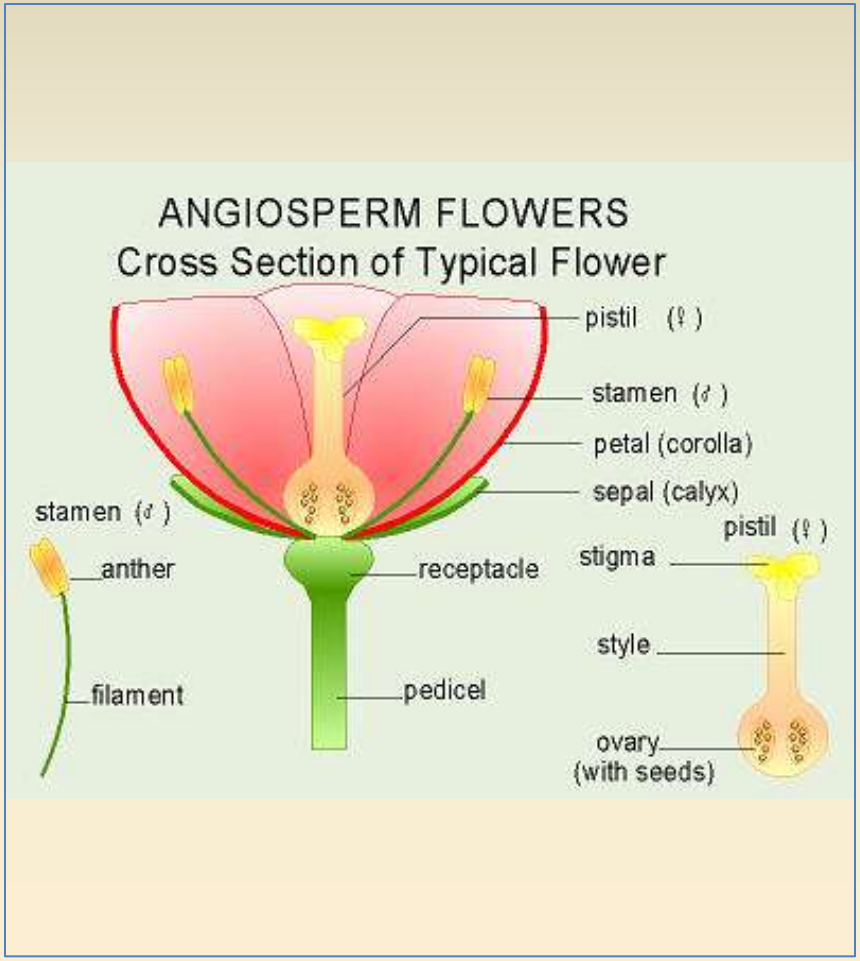
Ephedra

Welwitschia

Gnetum

Angiosperms

Angiosperms appear in the Cretaceous

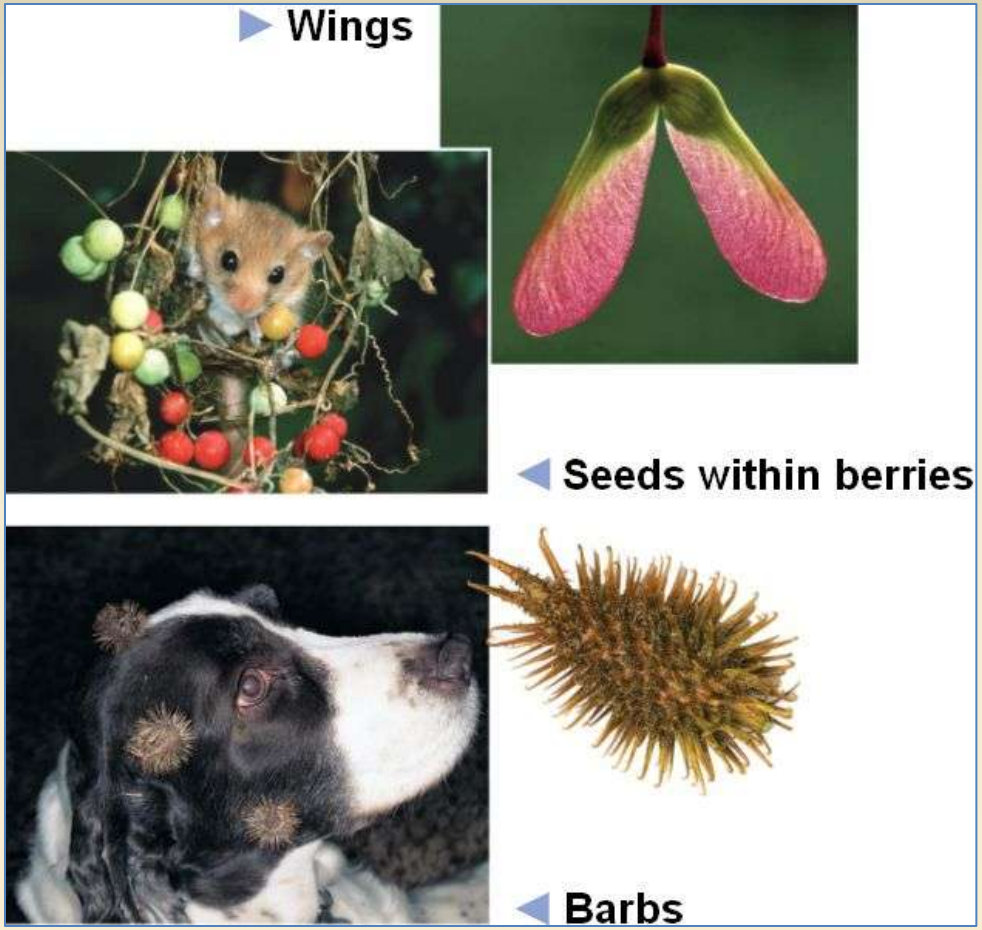


- Angiosperm plants are those that have flowers, seeds enclosed in carpels
- Major change in plant life – insects are now the pollinators

Flowers and fruit

- The key to the success of the Angiosperms has been that they have evolved flowers and fruit.
- Fruit protects the seeds and aids in their dispersal.
- Some fruits are a bribe to attract animals. Animals eat the fruit and spread the seeds.

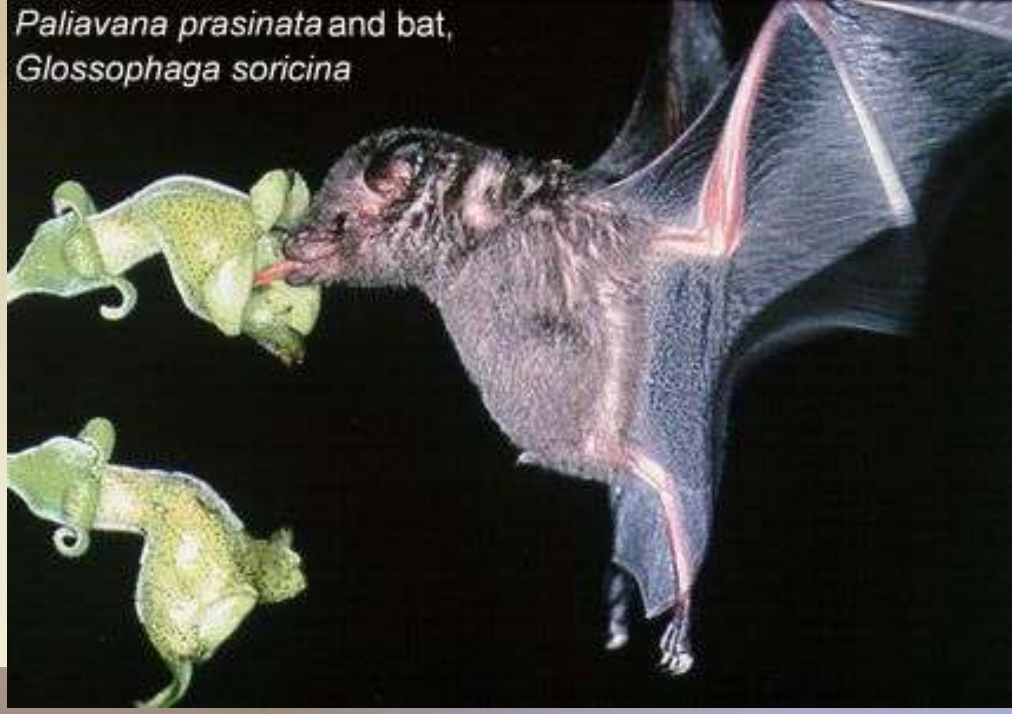
Fruits



Flowers and pollination

- A major advantage of flowers is that they have allowed angiosperms to use other organisms to move their pollen about.

- Bees, bats, birds and others all transport pollen. They are attracted to flowers by the nectar and pollen [bribes] provided by the plant and when they visit multiple flowers they move pollen from one to the next


Paliavana prasinata and bat,
Glossophaga soricina

End