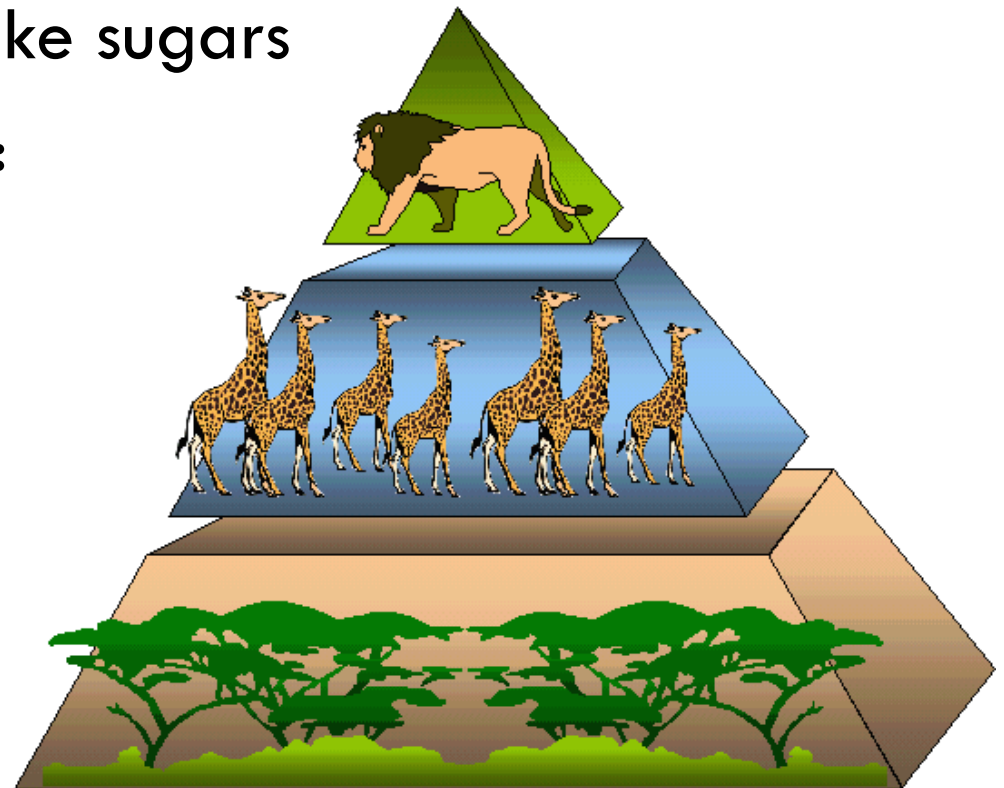


# GREEN ALGAE AND LAND PLANTS

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# Primary producers

- Start of the food chain
- Dominant source of C and E in the world
- Reduces CO<sub>2</sub> to make sugars
- Provide most of our:
  - ▣ Food
  - ▣ Fuel
  - ▣ Fibers
  - ▣ Building materials
  - ▣ medicine

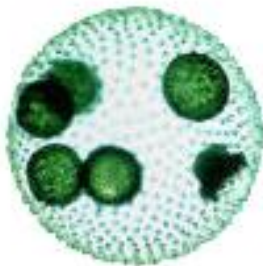


# Green Algae

- Key photosynthetic organisms in freshwater
- Traditionally considered protists
  - ▣ Closest living relatives to land plants
  - ▣ Aquatic to terrestrial life started with green algae



**Chlamydomonas**



**Volvox**



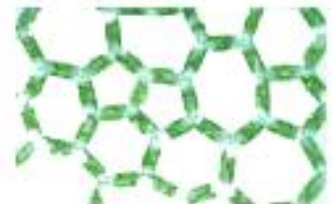
**Ulothrix**



**Frustuliella**

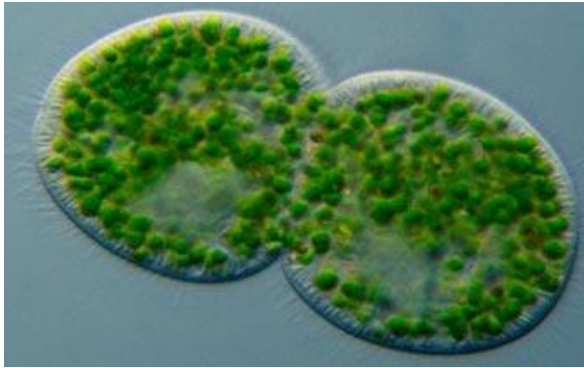


**Ulva**

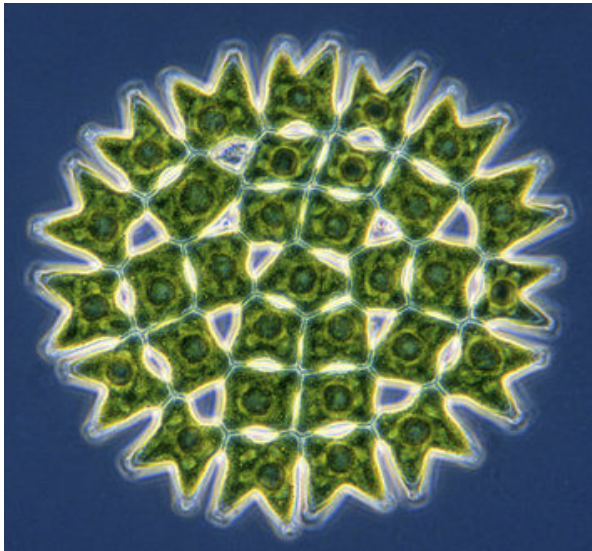


**Hydrodictyon**

# Green algae



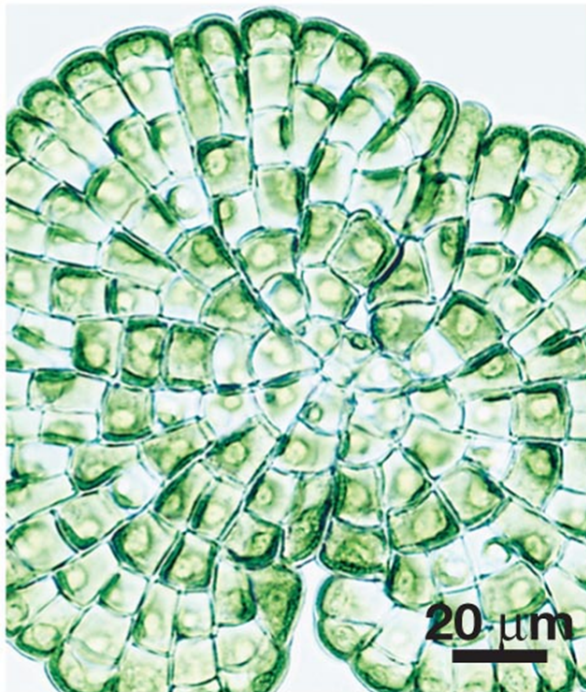
- Similarities with plants
  - Chloroplast
  - Cell wall
- Unicellular, colonial, multicellular
- Marine or freshwater



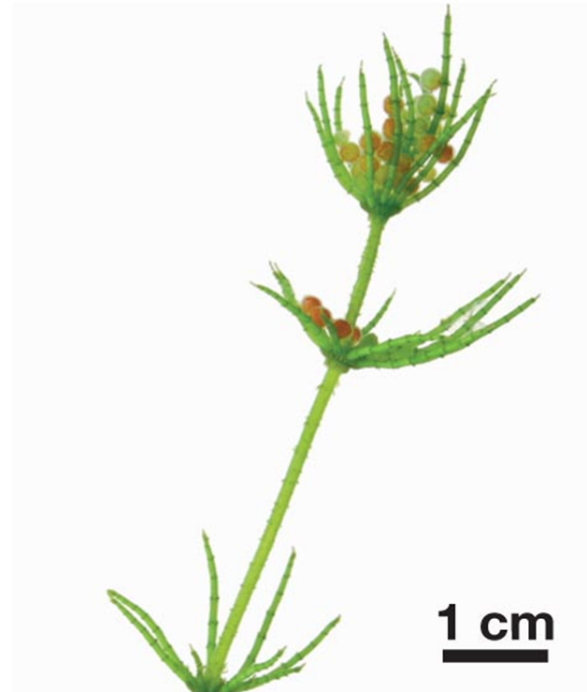


# Green algae

- Hypothesized closest related to plants



**Coleochaetophyceae**  
(coleochaetes)



**Charophyceae**  
(stoneworts)

# Early land plant adaptations

- Advantages

- ▣ More light and CO<sub>2</sub>

- Adaptation

- ▣ Prevention of water loss

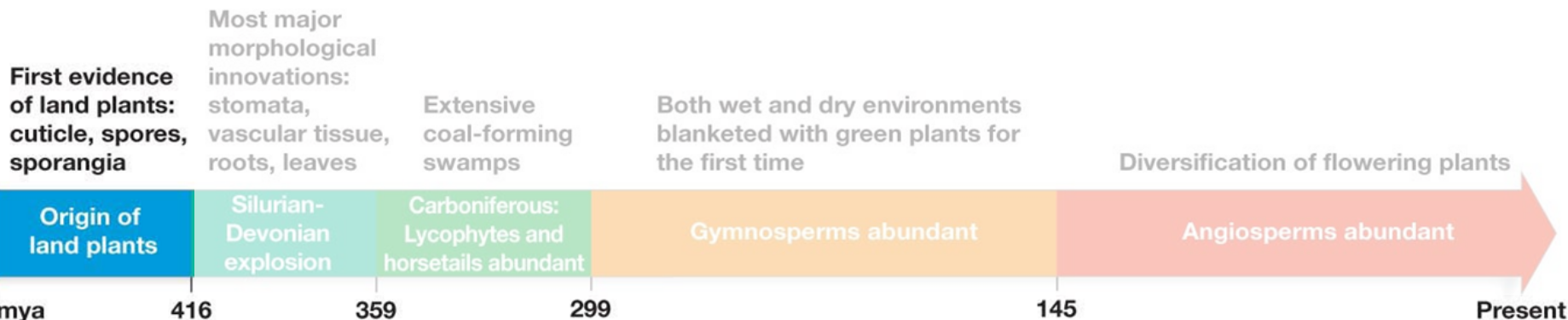
- Tissues of green algae dry out easily

- ▣ Transportation of water

# Origin of land plants

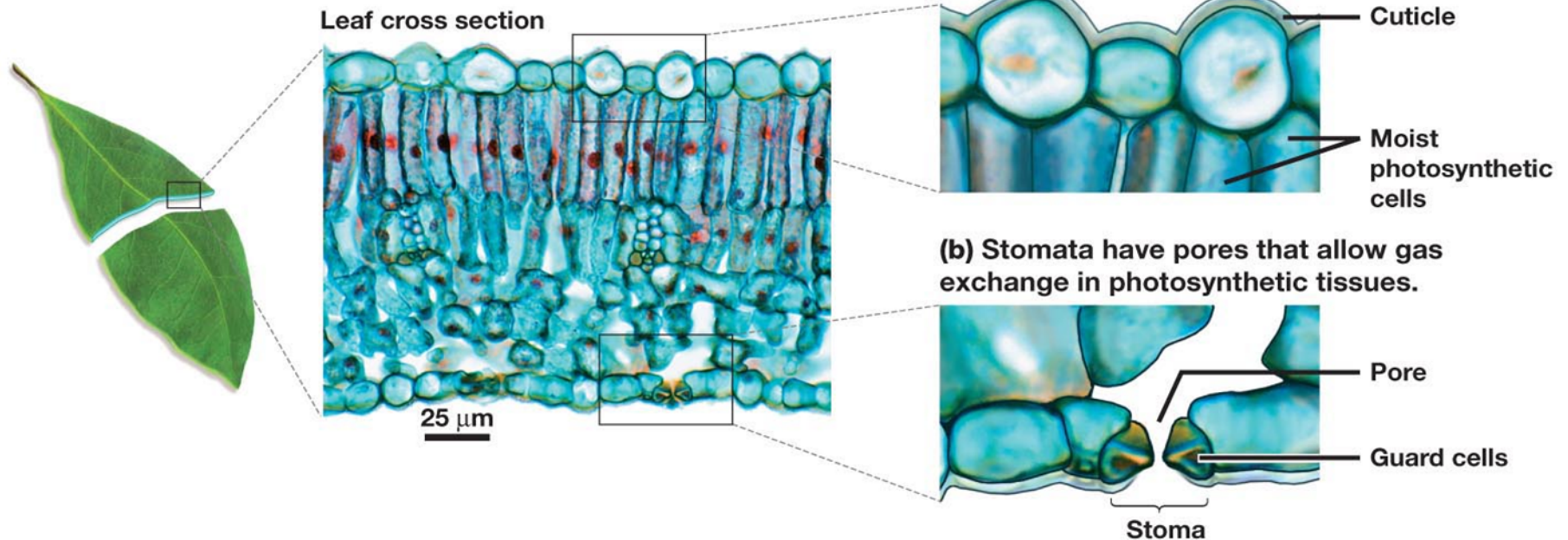


- Earliest land plants
  - Watertight cuticle developed
  - Stomata for “breathing”
  - Spores encased in protective coating



# Land plant adaptations: *cuticle*

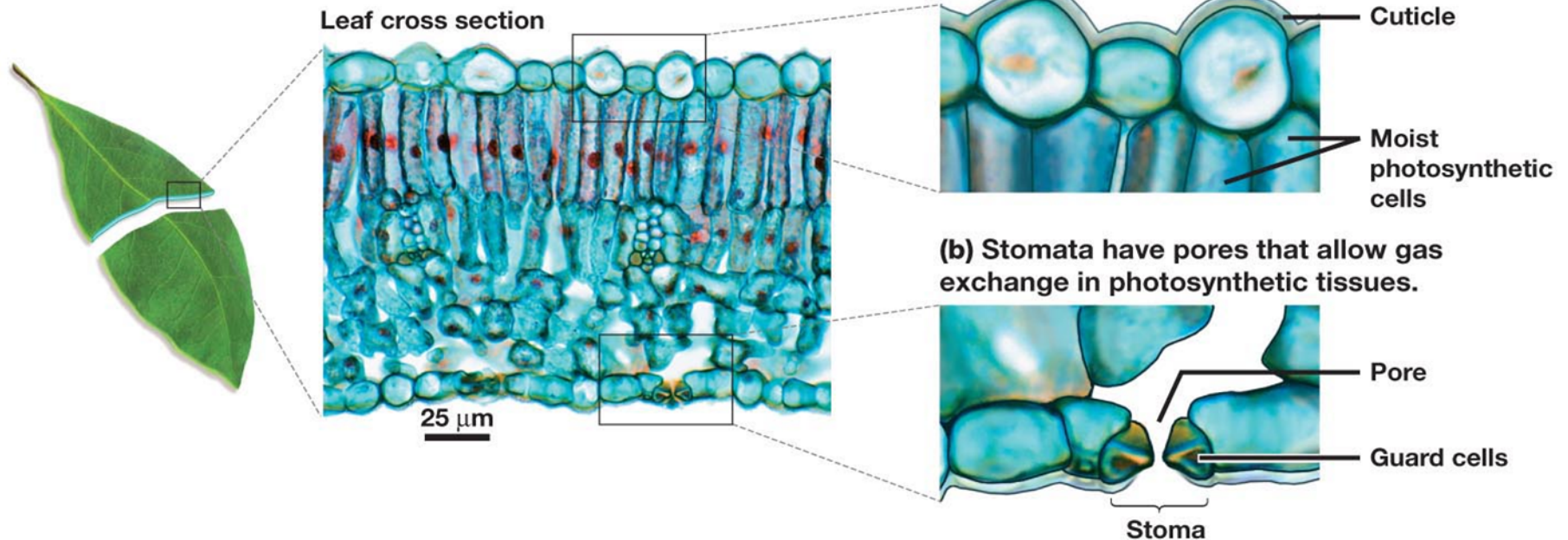
- ❑ Waxy, watertight layer
- ❑ Reduces water loss
- ❑ Inhibits gas exchange: no  $\text{CO}_2$





# Land plant adaptations: *stomata*

- Pores in leaf
- Promoting gas exchange
- Guard cells
  - Specialized cells

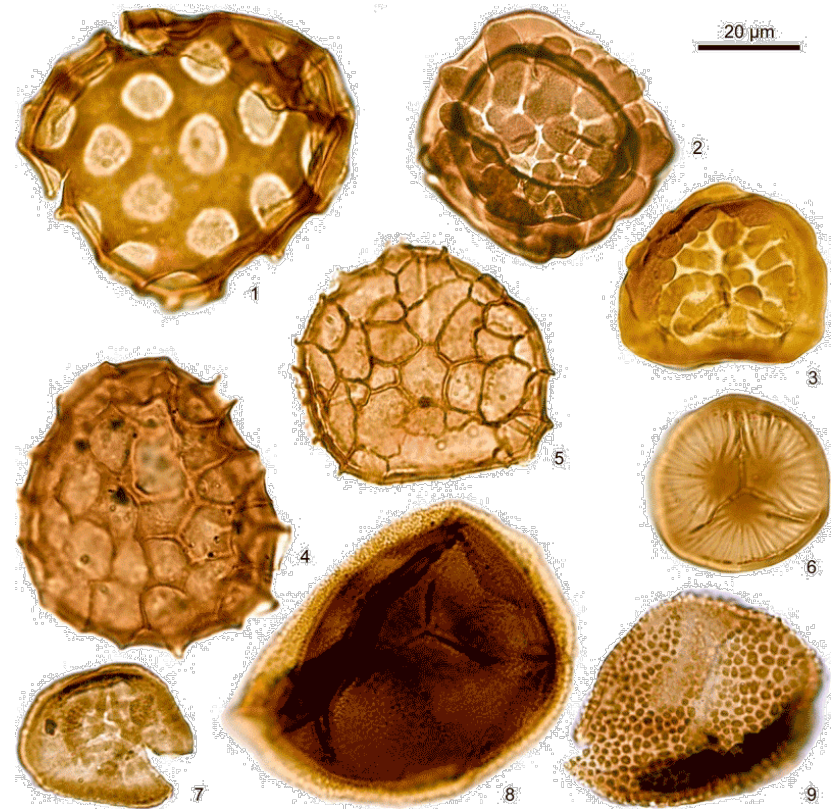


# Reproducing in dry environments

## □ Innovations

### ▣ Spores

- resist drying b/c encased in tough coat
- unicellular



# Non-vascular plants

- Bryophytes (aka non-vascular plants)
  - ▣ don't have a specialized group of cells for conducting water
  - ▣ Low growing
  - ▣ Very moist



Moss



Liverworts



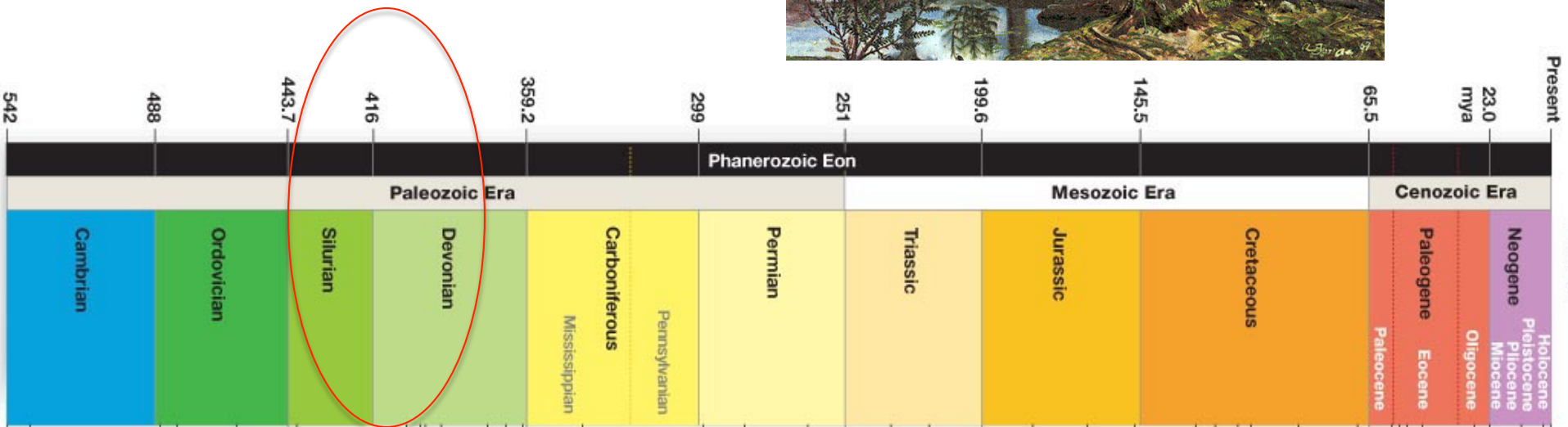
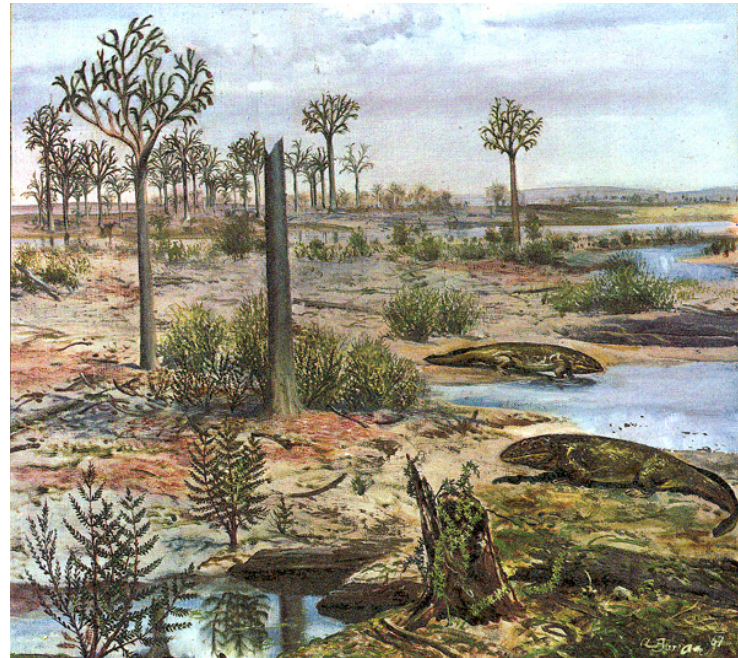
# Land plant adaptations: *vascular tissue*

- Advantages of upright growth
  - ▣ Early plants grew low to ground
    - Taller plants would dry out
  - ▣ Intense competition for light
- Challenges of upright growth
  - ▣ Transporting water against gravity
  - ▣ Lack of rigidity



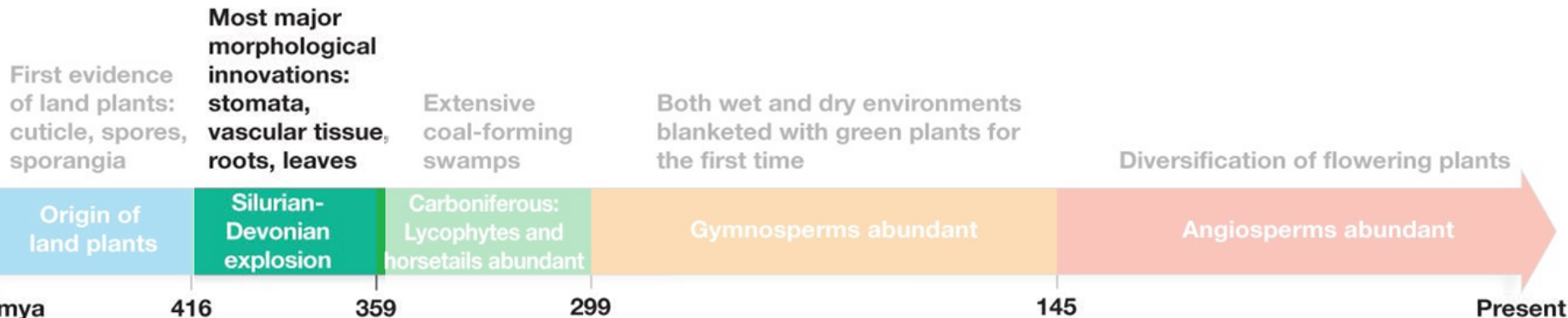
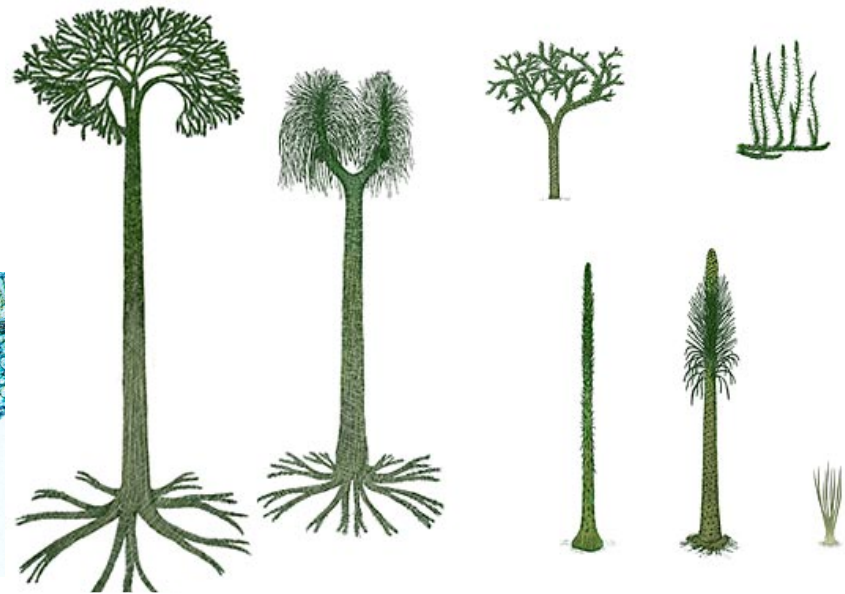
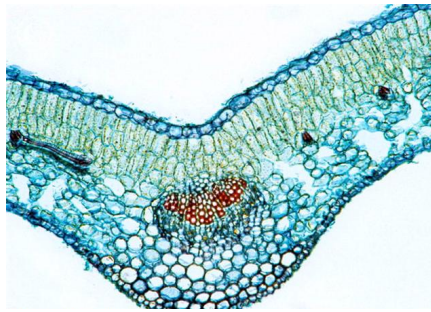
# Silurian-Devonian explosion

- Defined by the rise of terrestrial plants



# Silurian-Devonian Explosion

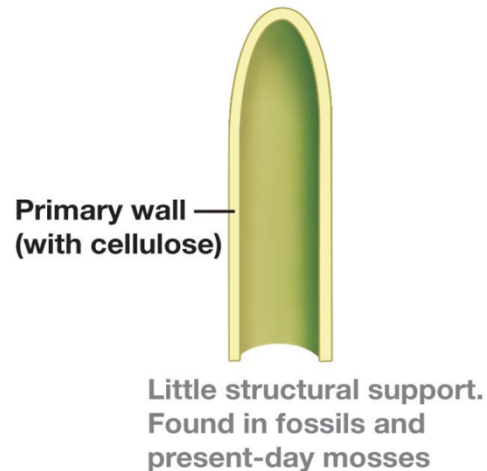
- All major plant adaptations for terrestrial habitat develop
  - Water-conducting tissue
  - Roots
  - Stomata
  - leaves



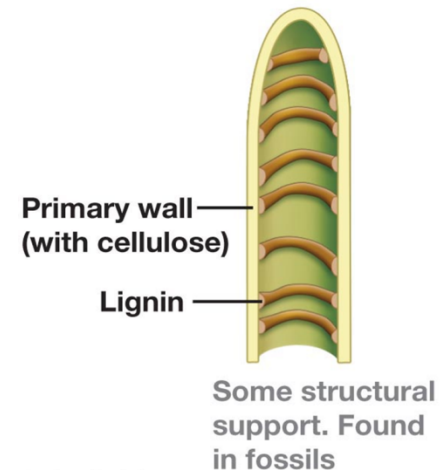
# Evolution of vascularity

- Vascularity evolved in a series of steps
- Primary adaptation for upright growth
  - ▣ Scaffolding the transporting cell
  - ▣ Lignin

(a) Simple water-conducting cells



(b) First vascular tissue

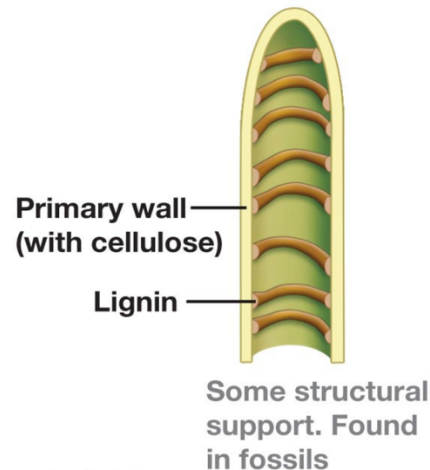


# Evolution of vascularity

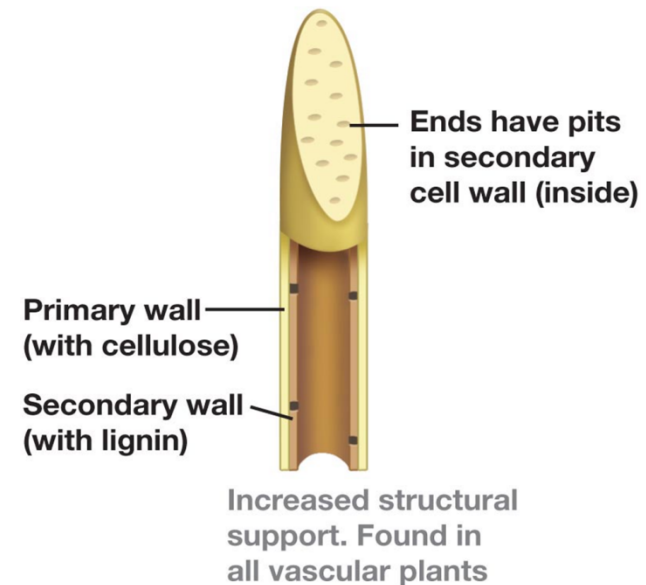
## □ Tracheids

- Long, thin tapering water-conducting cells
- 2 cell walls: extra support
- Pits at ends
- All vascular plants

(b) First vascular tissue



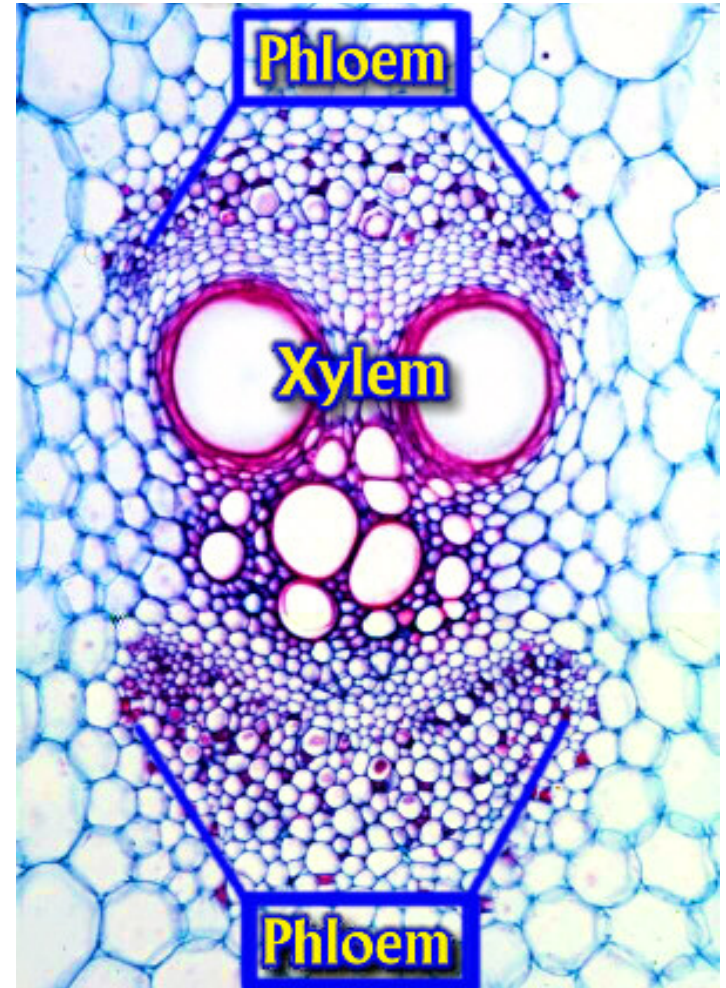
(c) Tracheids





# Vascular tissues

- Xylem
  - ▣ Carries water up
- Phloem
  - ▣ Carries sugars down



# Seedless vascular plants

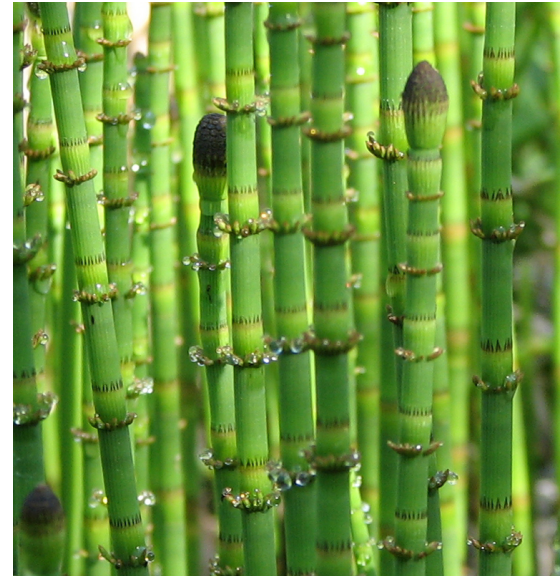
- Have vascular tissue (water and sugars are conducted)
  - ▣ Allows plants to grow further off ground
- Spores



Whisk ferns



Ferns

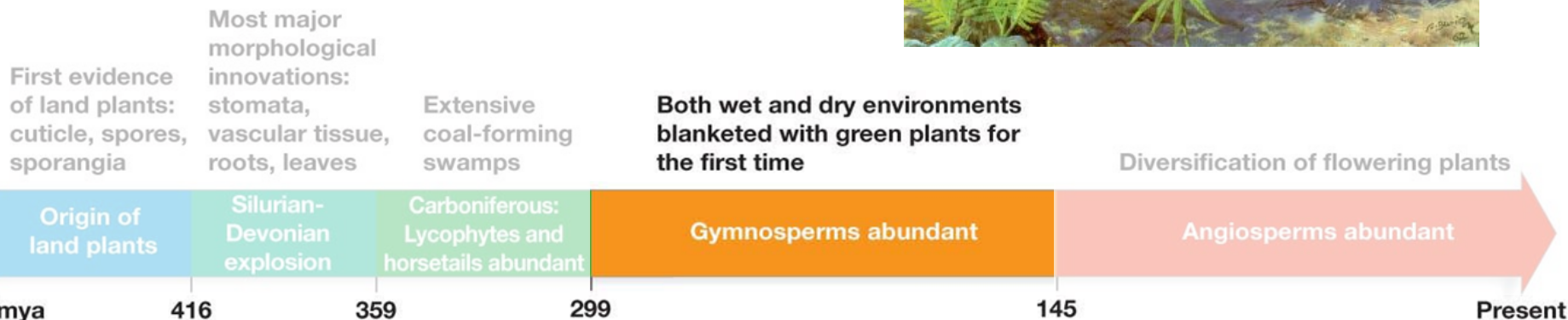
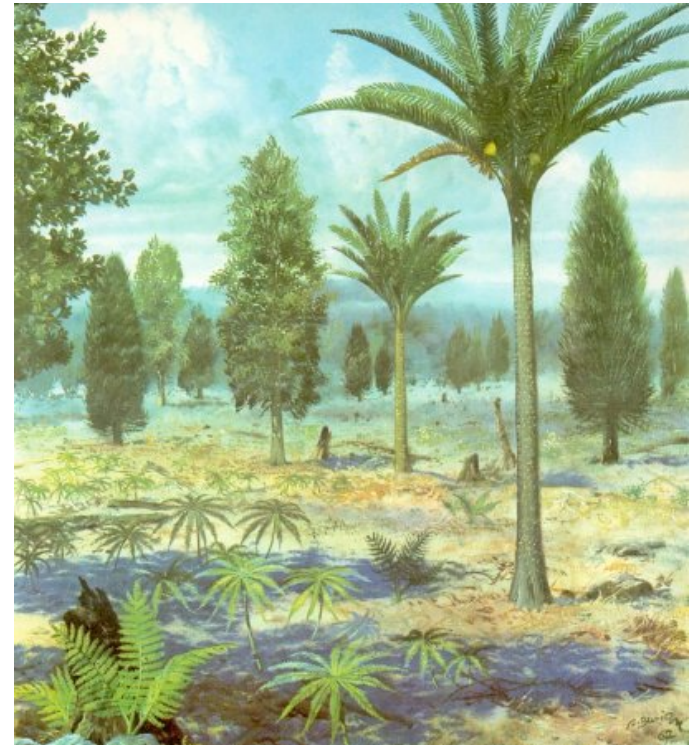


Horsetails



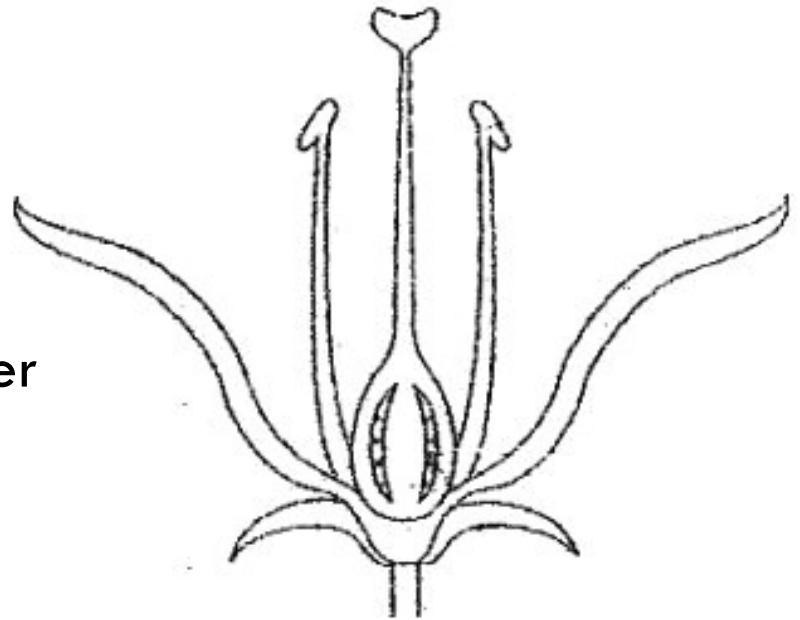
# Seed plants

- Age of the gymnosperms
- Major developments
  - ▣ Seeds
    - Multicellular
    - Functions
      - Nutrition
      - Dispersal



# Seed plant groups

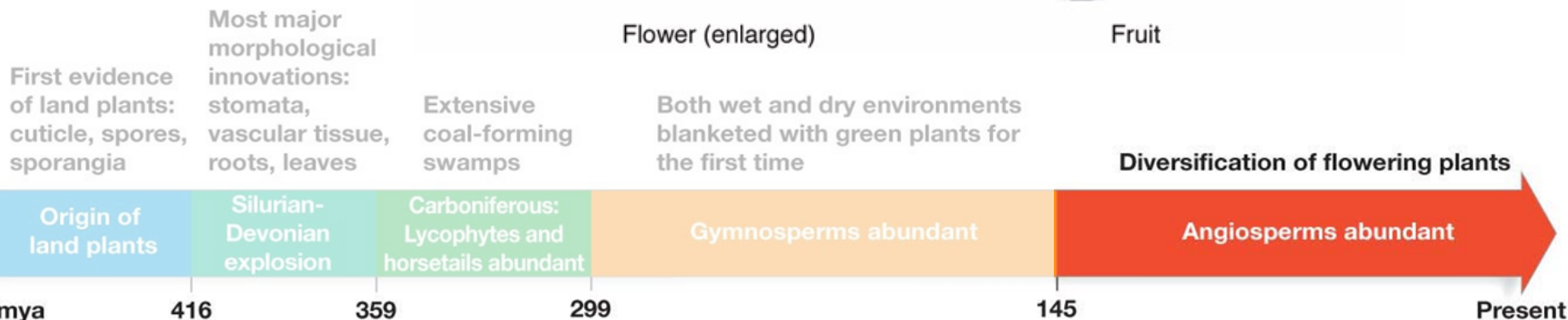
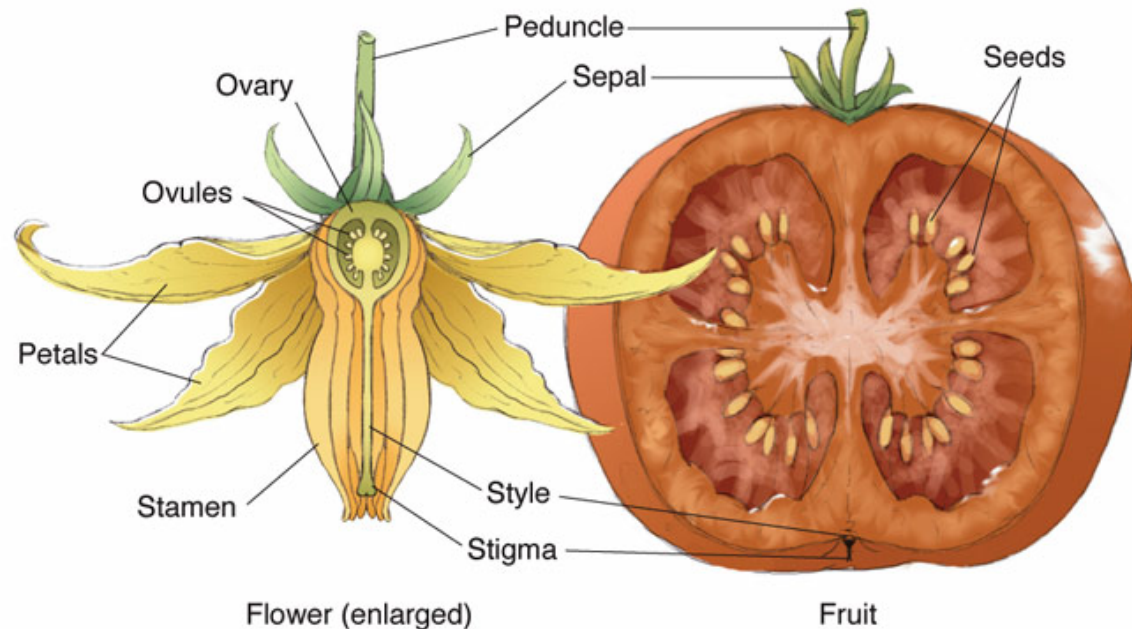
- Gymnosperms
  - ▣ “Naked seeds”
  - ▣ Seeds not enclosed within a floral structure
- Angiosperms
  - ▣ “vesselled seeds”
  - ▣ Flowering plants
  - ▣ Seeds inside *carpel*
    - Protective structure of the flower



# Age of Angiosperms

## □ Time of rapid diversification

- ▣ Grasses
- ▣ Orchids
- ▣ Daisies
- ▣ Oaks
- ▣ Roses



# Seed dispersal

- Advantageous for offspring to be far from parent plant
  - ▣ Avoid competition for light, water, & nutrients



# Seed dispersal

## How Seeds Travel

### by the wind



milkweed



dandelion



maple

### by animals



beggar-ticks



sandbur



blackberry

### by water

lotus



cattail



coconut

### by bursting

violet



jewelweed



witch hazel

### by humans



bean



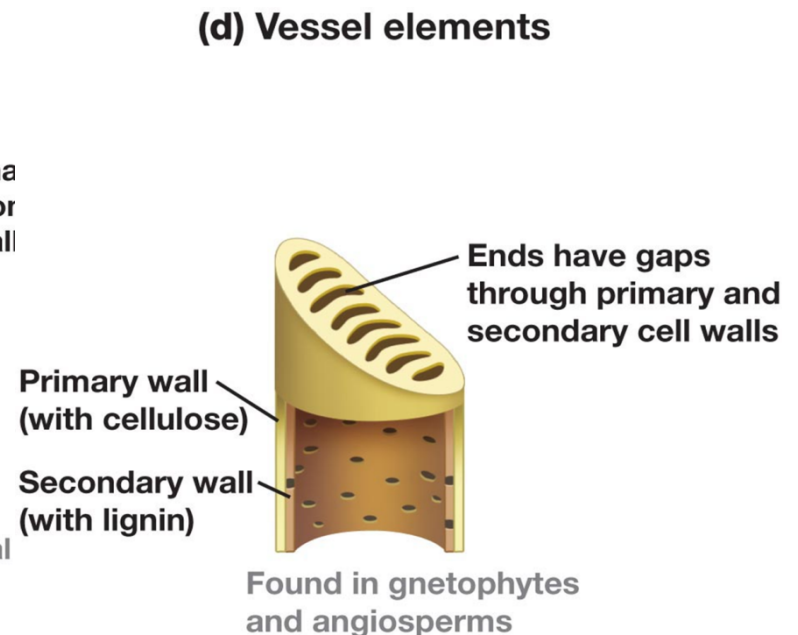
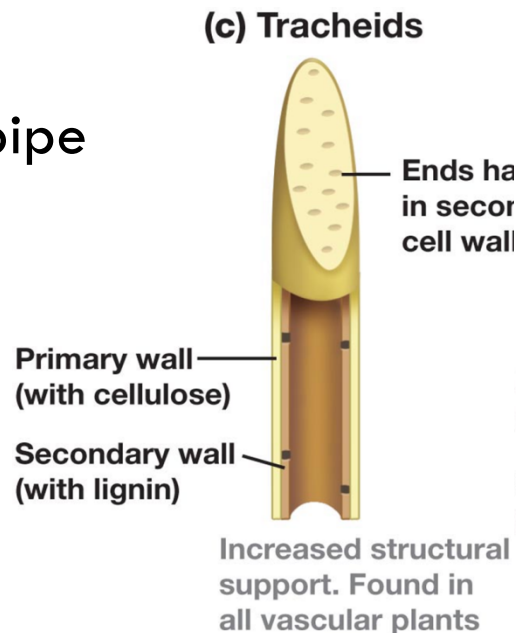
wheat



cherry

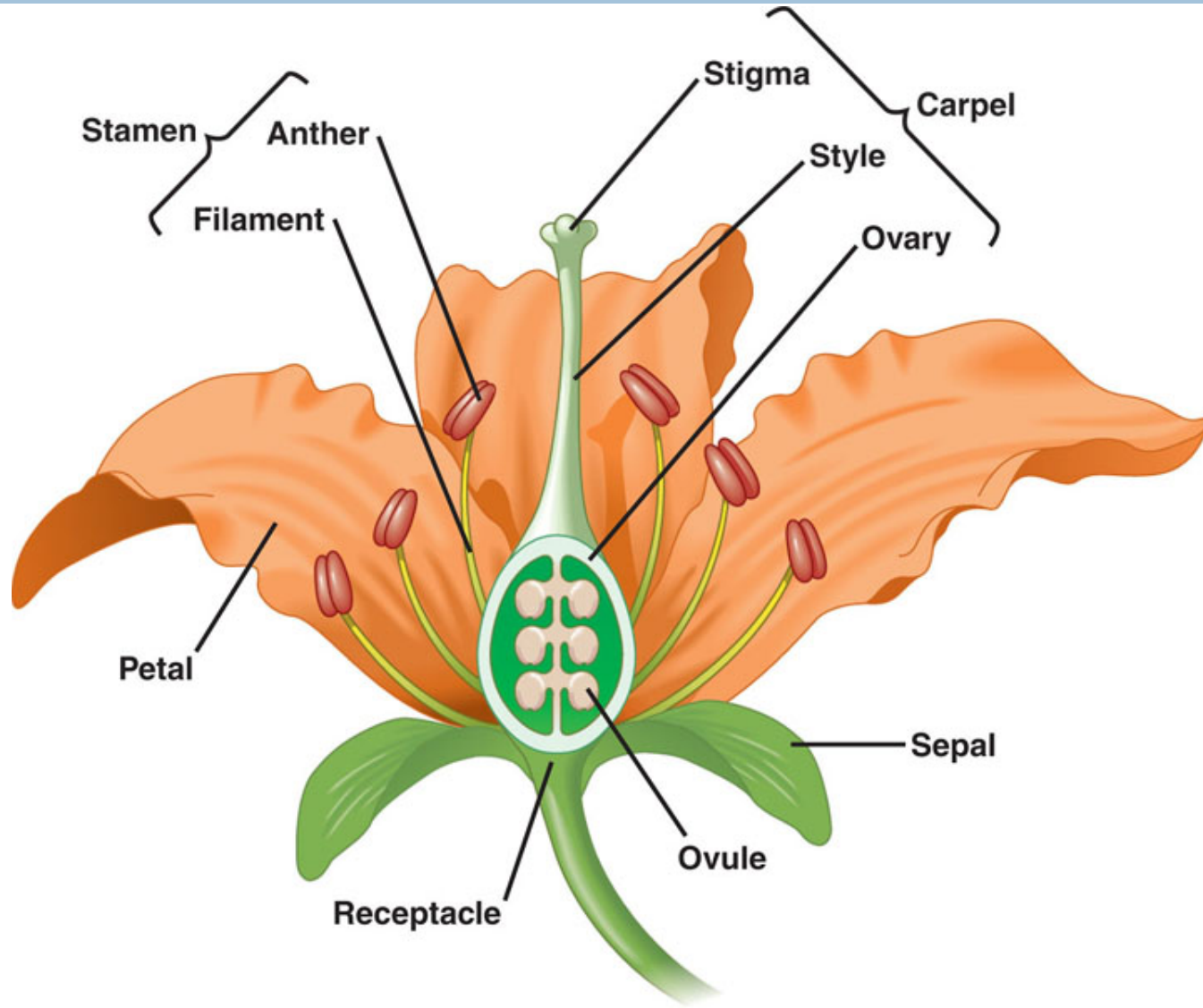
# Evolution of vascularity

- Vessel elements
  - ▣ Shorter, wider than tracheids
  - ▣ Gaps on both ends
    - More efficient
  - ▣ Line up
    - Forming pipe





# Parts of a flower





# Pollination associations

## Carrion flowers

- ▣ Look & smell like rotting meat



## Hummingbird flower

- Red
- tubular



## Bee flowers

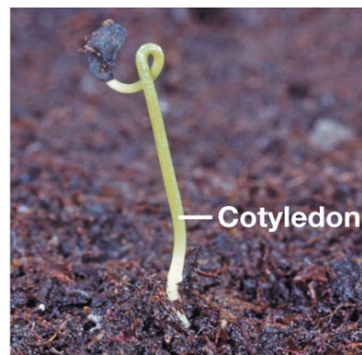
- Purple
- Blue
- Landing pads



# Monocots vs. Dicots

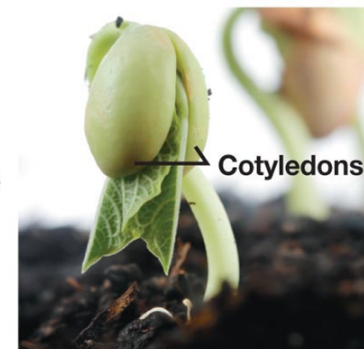
- Two main groups of Angiosperms
  - Monocotyledon
    - One cotyledon
    - Scattered vascular tissue
    - Parallel veins
    - Petals multiple of three
  - ▣ Dicotyledon
    - Two cotyledons
    - Circular vascular tissue
    - Branching veins
    - Petals multiple of 4 or 5

MONOCOTS



One cotyledon

DICOTS

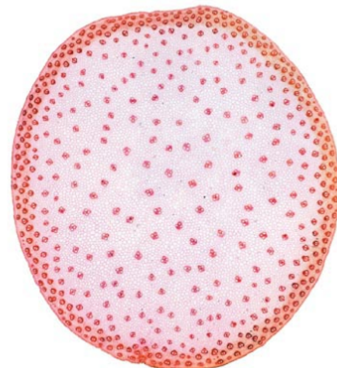


Two cotyledons

# Monocots vs. Dicots

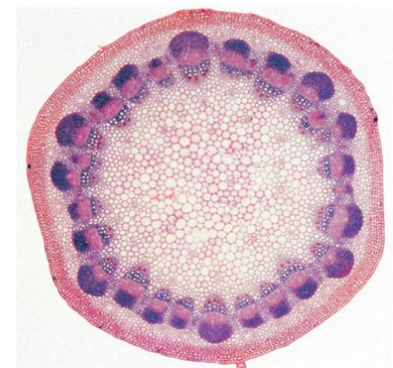
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    - Two cotyledons
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    - Branching veins
    - Petals multiple of 4 or 5

**MONOCOTS**



Vascular tissue scattered throughout stem

**DICOTS**



Vascular tissue in circular arrangement in stem

# Monocots vs. Dicots

- Two main groups of Angiosperms

- Monocotyledon

- One cotyledon
    - Scattered vascular tissue
    - Parallel veins
    - Petals multiple of three

**MONOCOTS**



Parallel veins in leaves  
(bundles of vascular tissue)

- Dicotyledon

- Two cotyledons
    - Circular vascular tissue
    - Branching veins
    - Petals multiple of 4 or 5

**DICOTS**



Branching veins in leaves

# Monocots vs. Dicots

- Two main groups of Angiosperms

- Monocotyledon

- One cotyledon
    - Scattered vascular tissue
    - Parallel veins
    - Petals multiple of three



**MONOCOTS**

Petals in multiples of 3

- ▣ Dicotyledon

- Two cotyledons
    - Circular vascular tissue
    - Branching veins
    - Petals multiple of 4 or 5



**DICOTS**

Petals in multiples of 4 or 5