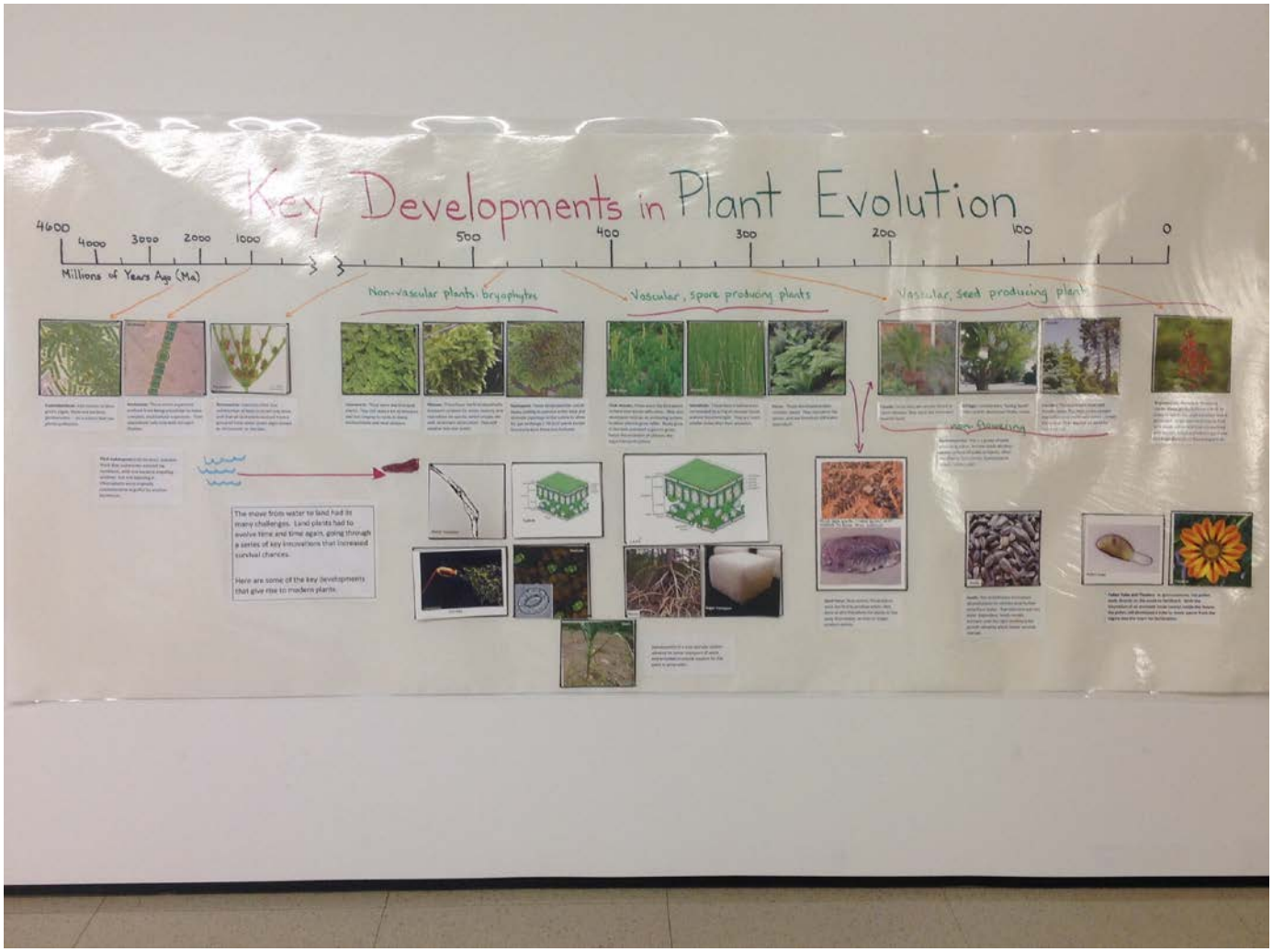
Constructing a Timeline of Plant Evolution



Use this photo as a guide to creating an interactive timeline.

Refer to Geologic Time Scale charts. A good resource is http://www.ucmp.berkeley.edu/help/timeform.php

Use the "Plant Timeline Cards" found at the end of this document. Attach pictures with Velcro to allow for manipulation by students, and to "build" the timeline in increments. Teachers will need to find and print photos for "seed ferns" or omit that step in the timeline.

Cut and paste the text below under each picture.

Cyanobacteria: Also known as blue-green algae, these are bacteria (prokaryotes – no nucleus) that can photosynthesize.

First eukaryotes (cell nucleus): Scientist think that eukaryotes evolved via symbiosis, with one bacteria engulfing another, but not digesting it. Chloroplasts were originally cyanobacteria engulfed by another bacterium.

Anabaena: These water organisms evolved from being unicellular to more complex, multicellular organisms. Their specialized cells help with nitrogen fixation.

Stoneworts: Scientists think that colonization of land occurred only once, and that all land plants evolved from a group of fresh water green algae known as stoneworts or charales.

Liverworts: These were the first land plants. They still need a lot of moisture and live clinging to rocks in damp environments and near streams.

Mosses: These have the first identifiable transport systems for water (xylem), and reproduce via spores, which encase sex cells to prevent desiccation. They still need to live near water.

Hornworts: These developed the cuticle (waxy coating to prevent water loss) and stomata (openings in the cuticle to allow for gas exchange.) All land plants except liverworts have these two features.

Development of a true vascular system allowed for better transport of water and provided structural support for the plant to grow taller.

Club mosses: These were the first plants to have true leaves with veins. They also developed roots as an anchoring system to allow plant to grow taller. Roots grow in the dark and need sugars to grow; hence the evolution of phloem, the sugar transport system.

Horsetails: These have a hollow stem surrounded by a ring of vascular tissue, and are therefore light. They are much smaller today than their ancestors.

Ferns: These developed proper, complex leaves. They reproduce via spores, and are therefore still water dependent.

Seed Ferns: Now extinct, these plants were the first to produce seeds. (Not ferns at all!) This allows for plants to live away from water, as they no longer produce spores.

Seeds: This evolutionary innovation allowed plants to colonize land further away from water. Reproduction was not water dependent. Seeds remain dormant until the right conditions for growth, allowing plants better survival chances.

Gymnosperms: This is a group of seed producing plants, but the seeds develop on the surface of scales or leaves, often modified to form cones. Gymnosperm means “naked seed.”

Cycads: Today they are usually found in warm climates; they were the dinosaurs’ favorite food!

Ginkgo: Considered a “loving fossil”, these plants developed fleshy cones.

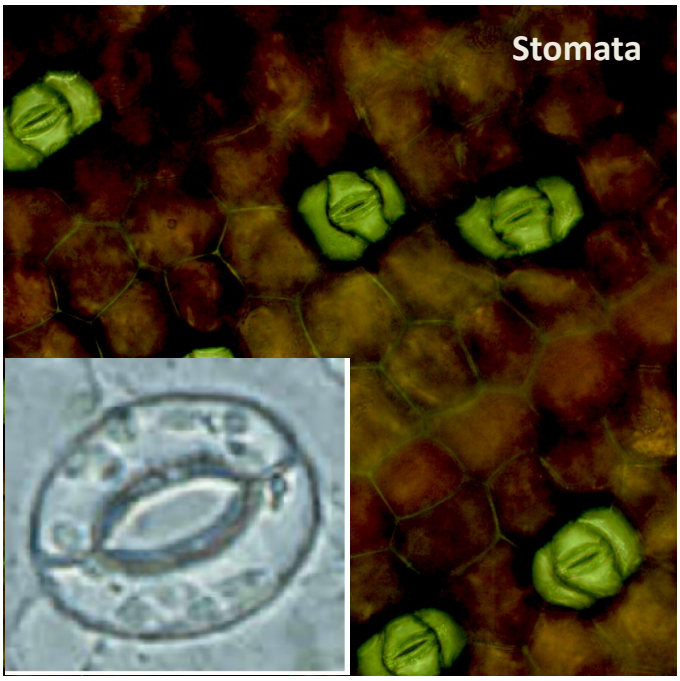
Conifers: These produce male and female cones. The male cones contain the pollen, and the female cones contain the ovules. They depend on wind for reproduction.

Angiosperms: Known as flowering plants, these produce flowers with an ovary in which the seed develops and is protected. Angiosperms produce fruit with seeds within and they co-evolved with insects. Insect pollination gave rise to a huge diversity of flowering plants.

The move from water to land had its many challenges. Land plants had to evolve time and time again, going through a series of key innovations that increased survival chances.

Here are some of the key developments that give rise to modern plants.

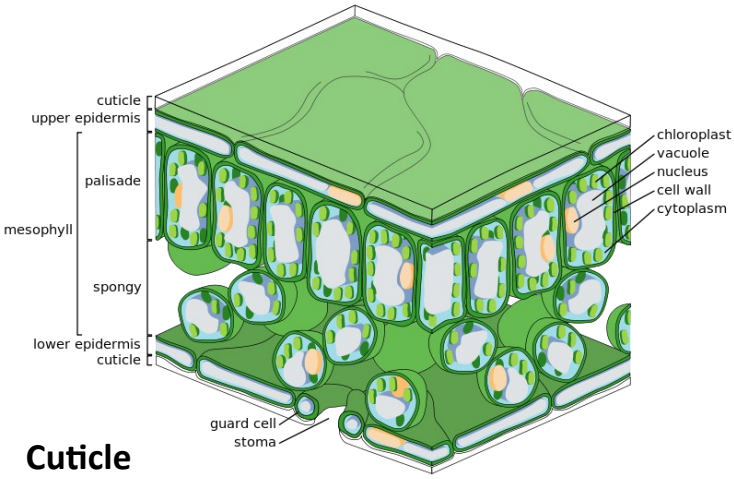
Pollen Tube and Flowers: In gymnosperms, the pollen lands directly on the ovule to fertilize it. With the innovation of an enclosed ovule (ovary) inside the flower, the pollen cell developed a tube to move sperm from the stigma into the ovary for fertilization.



Seeds

Pollen tube

Roots



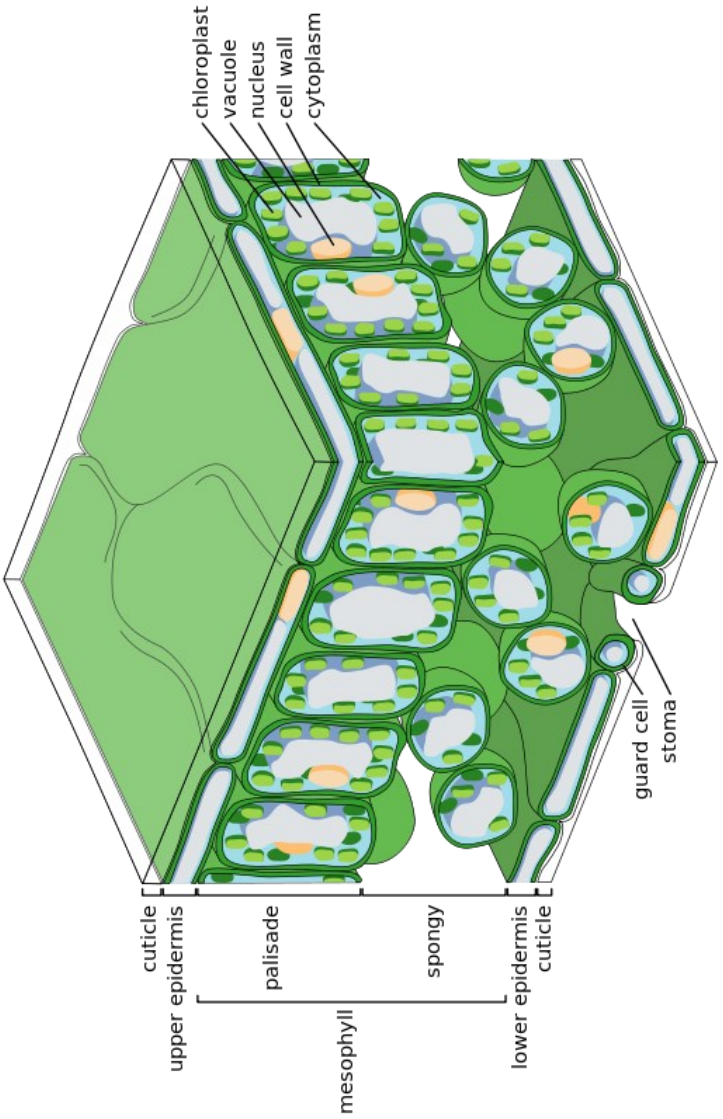
Cuticle

Sugar transport


Stem


Water transport


Flowering plants


chloroplast
vacuole
nucleus
cell wall
cytoplasm
guard cell
stoma
cuticle
upper epidermis
palisade
spongy
lower epidermis
cuticle
mesophyll

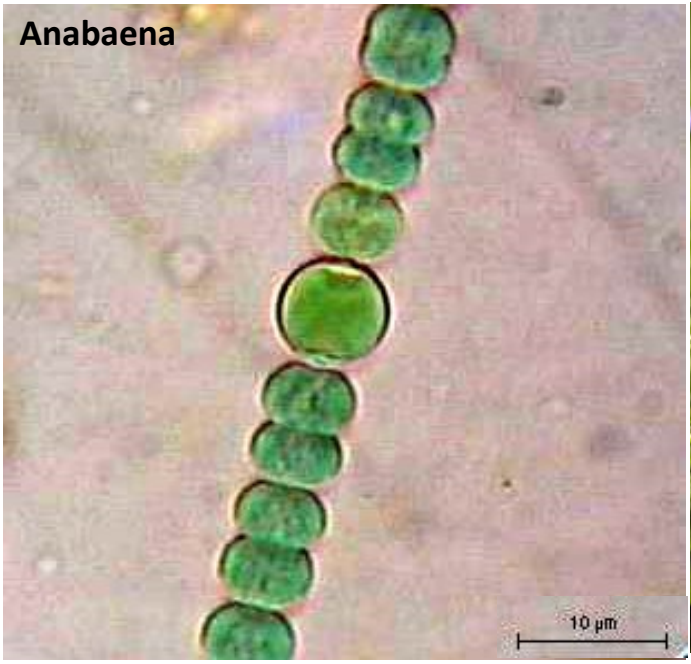

Flowers


Cyanobacteria


Hornwort


Liverwort


Stonewort
~1 mm


Anabaena
10 µm


Moss


Club moss


Horsetails


Fern


Cycad


Ginko


Conifer