



Today's Class:

- 1. Evolution of Leaves**
- 2. Advantages and disadvantages of leaves**
- 3. Anatomy and some Function(s) of Leaves**



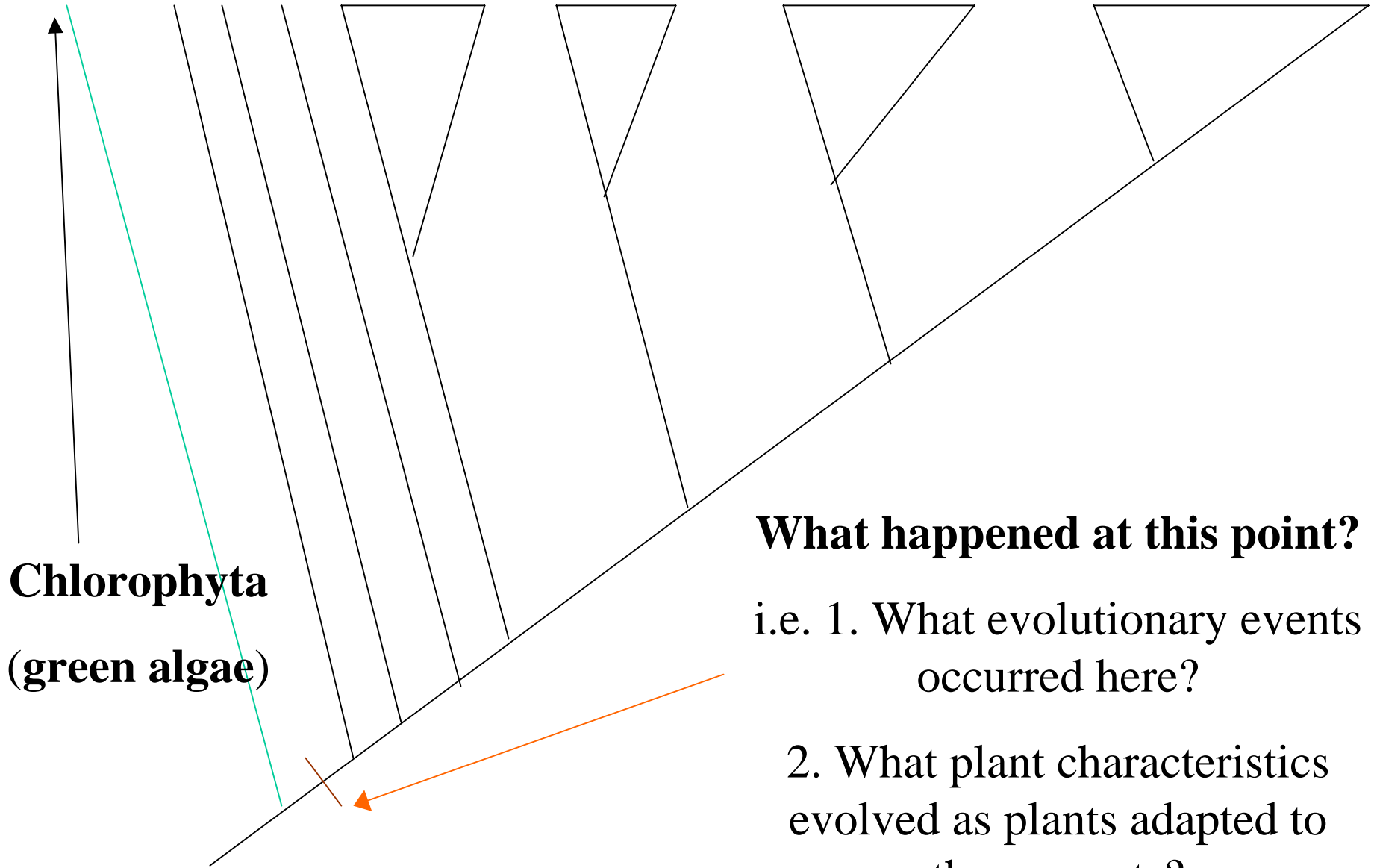
Bryophytes

Lycophytes

Pteridophytes

Gymnosperms

Angiosperms



**Chlorophyta
(green algae)**

What happened at this point?

i.e. 1. What evolutionary events occurred here?

2. What plant characteristics evolved as plants adapted to these events?

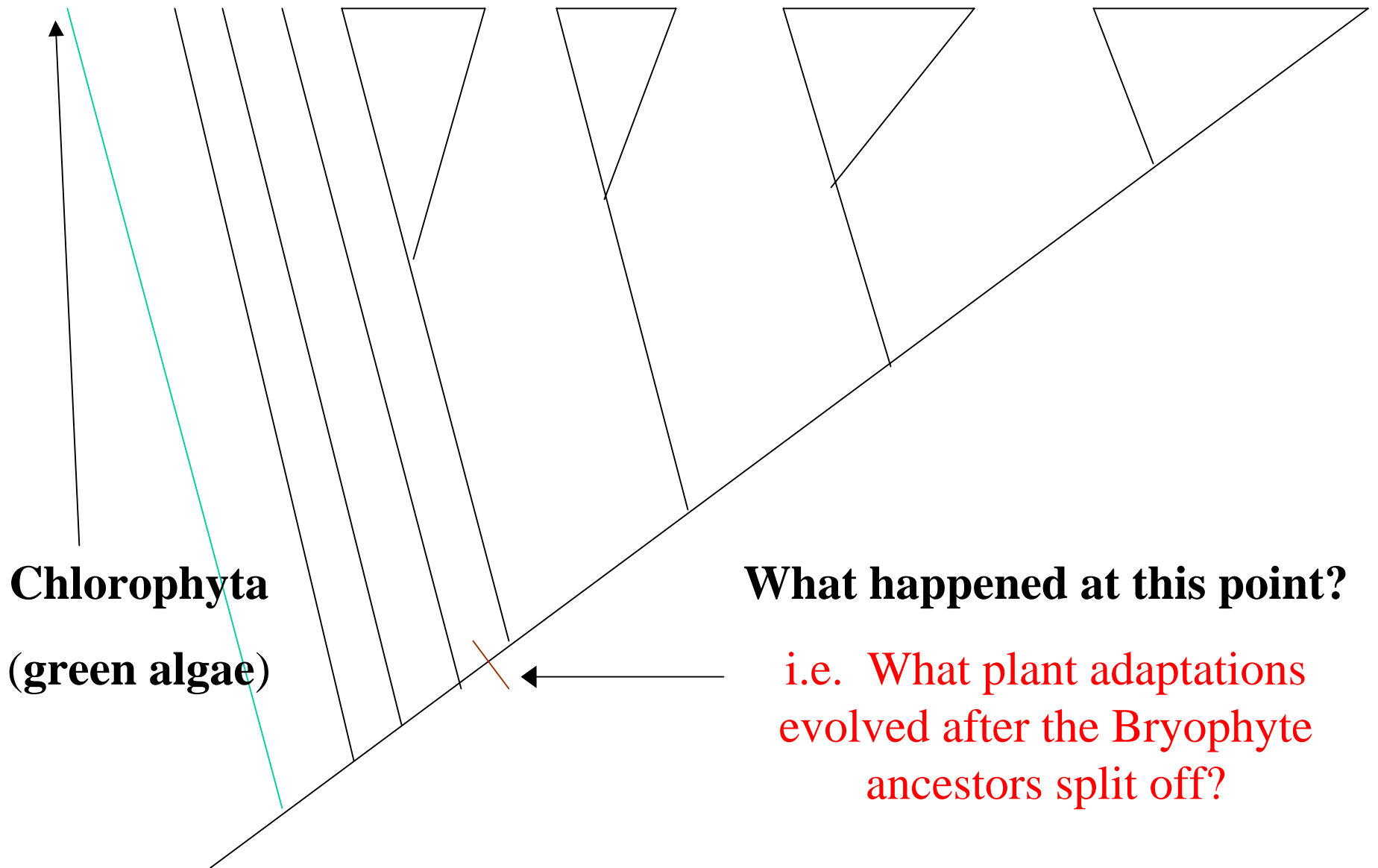
Bryophytes

Lycophytes

Pteridophytes

Gymnosperms

Angiosperms



**Chlorophyta
(green algae)**

What happened at this point?

i.e. What plant adaptations evolved after the Bryophyte ancestors split off?

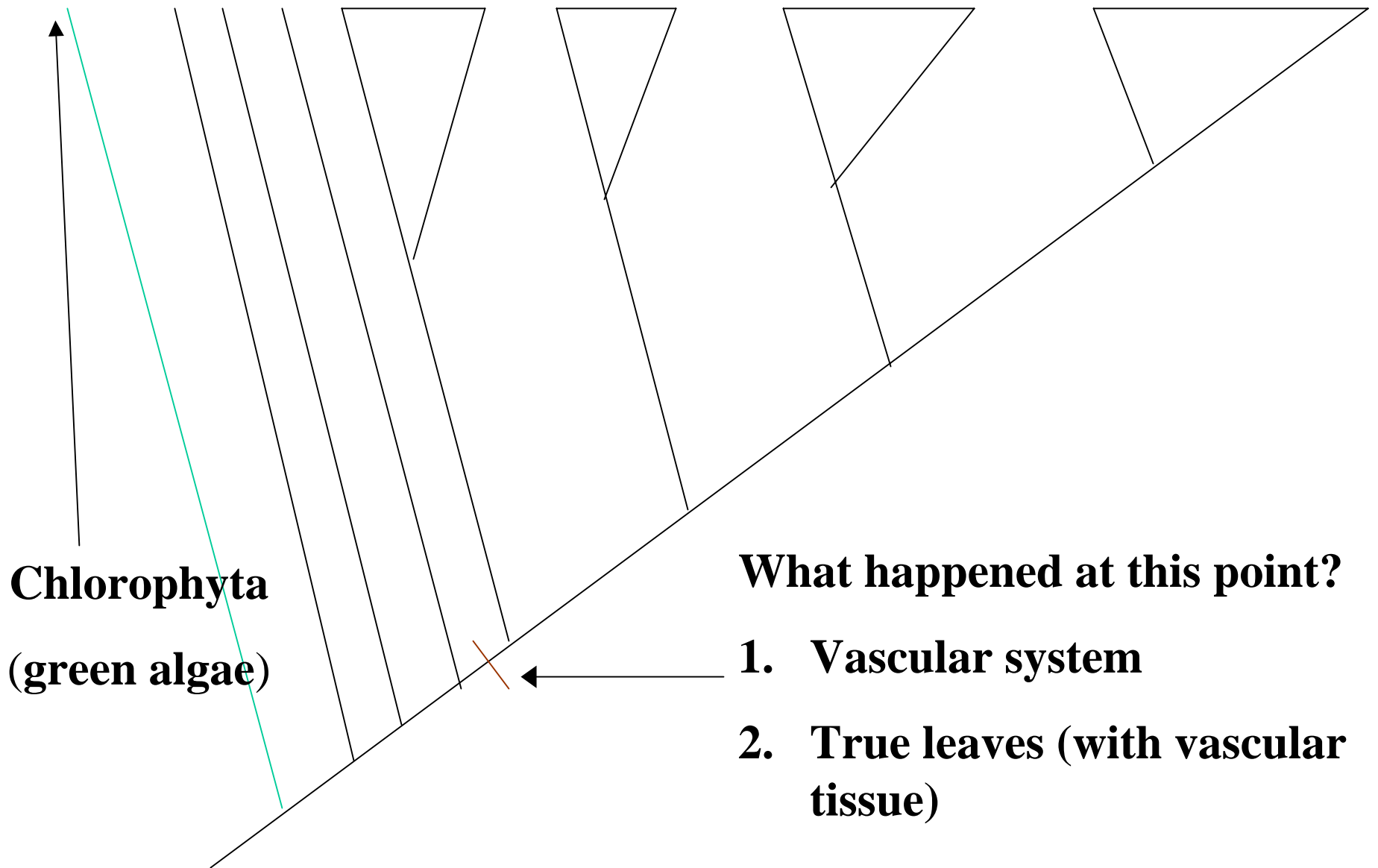
Bryophytes

Lycophytes

Pteridophytes

Gymnosperms

Angiosperms



Chlorophyta
(green algae)

What happened at this point?

- 1. Vascular system**
- 2. True leaves (with vascular tissue)**

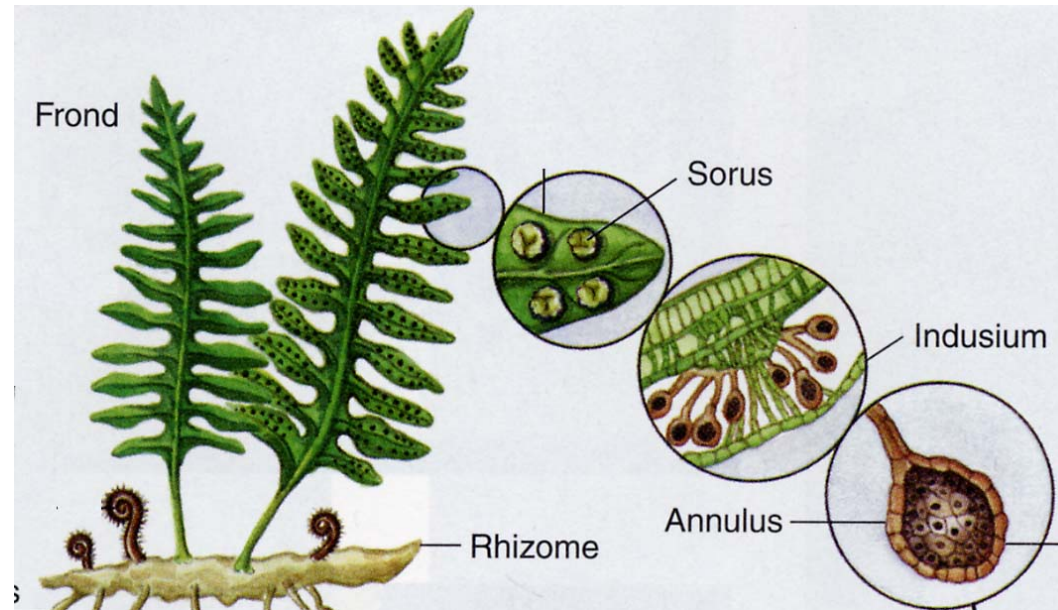
Lycophytes: Club Mosses, etc.

True leaves with one vascular bundle in each



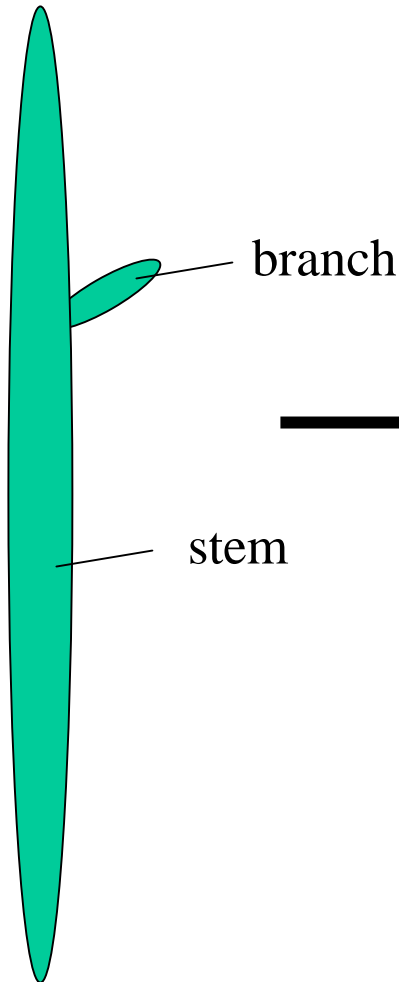
Pteridophytes: Ferns, etc.

True leaves with branched vascular tissues

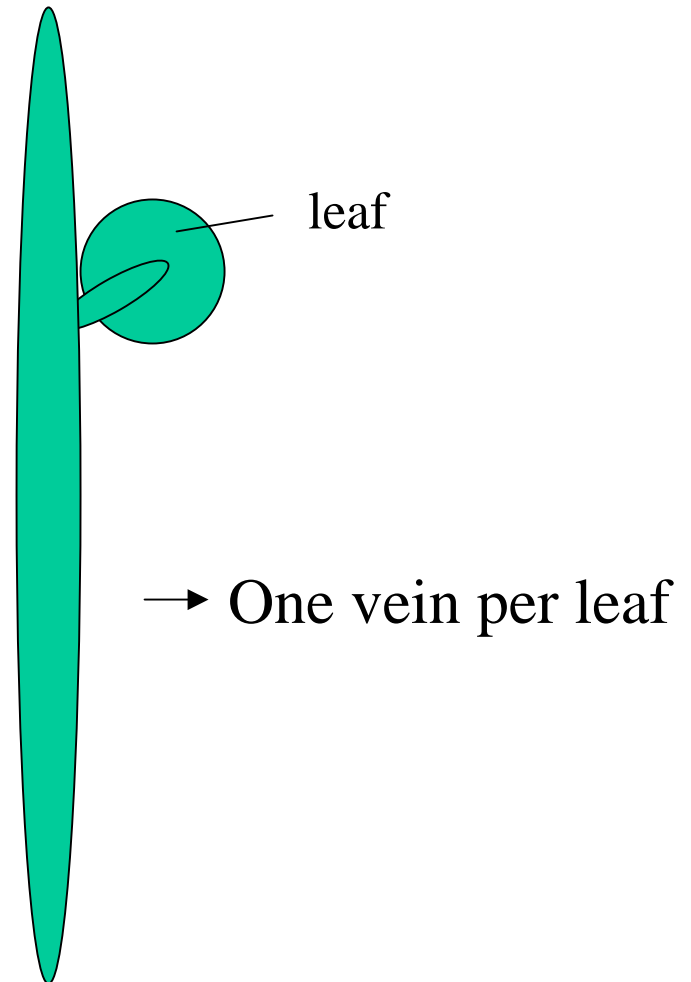


Leaf Evolution in Lycophytes: Club Mosses, etc.

1. Stem forms branches

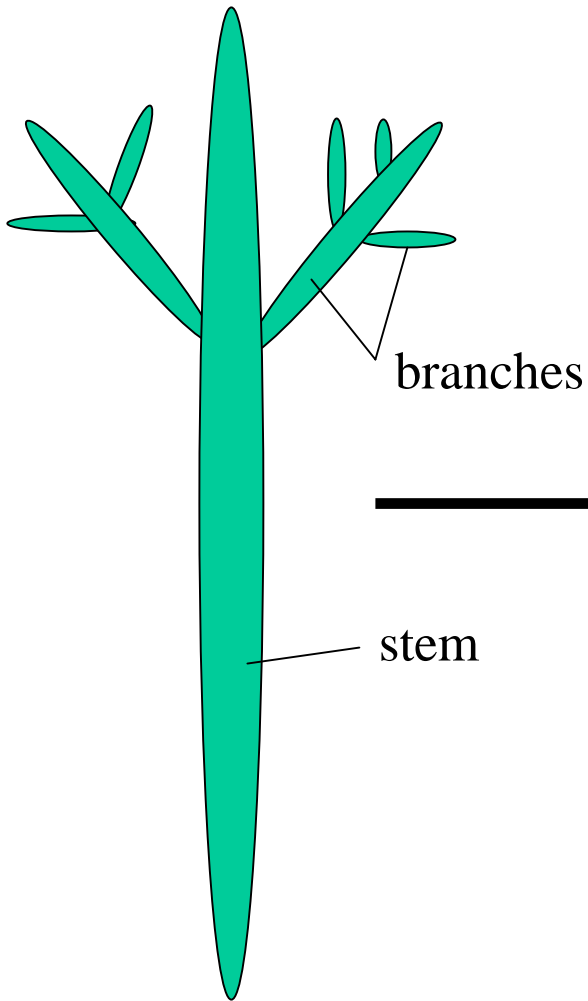


2. Webbing develops over single branch

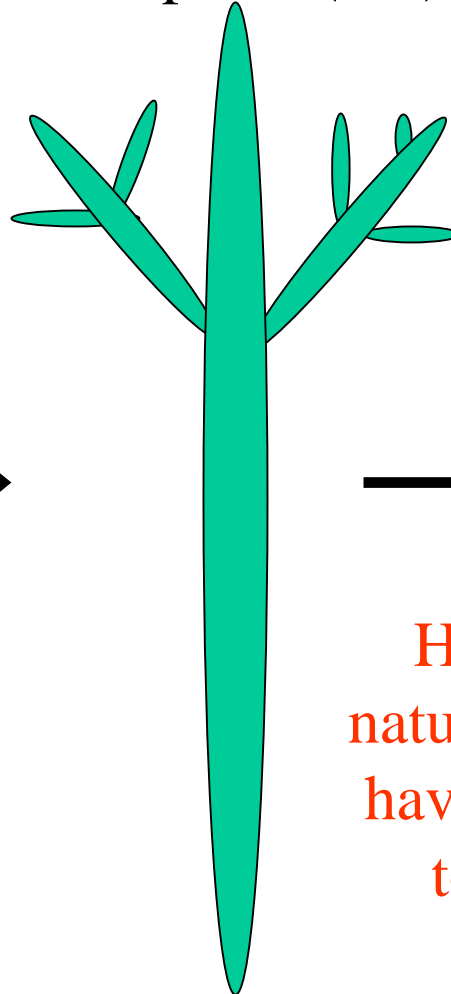


Leaf Evolution in Pteridophytes: Ferns, etc.

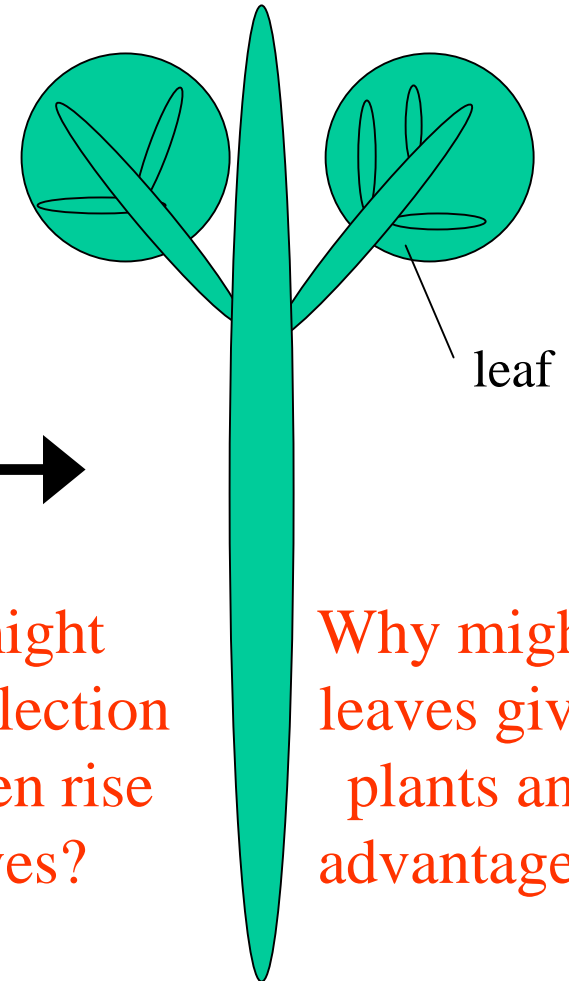
1. Stem forms branches



2. Branches are in same plane (flat)



3. Webbing develops over a group of branches



How might natural selection have given rise to leaves?

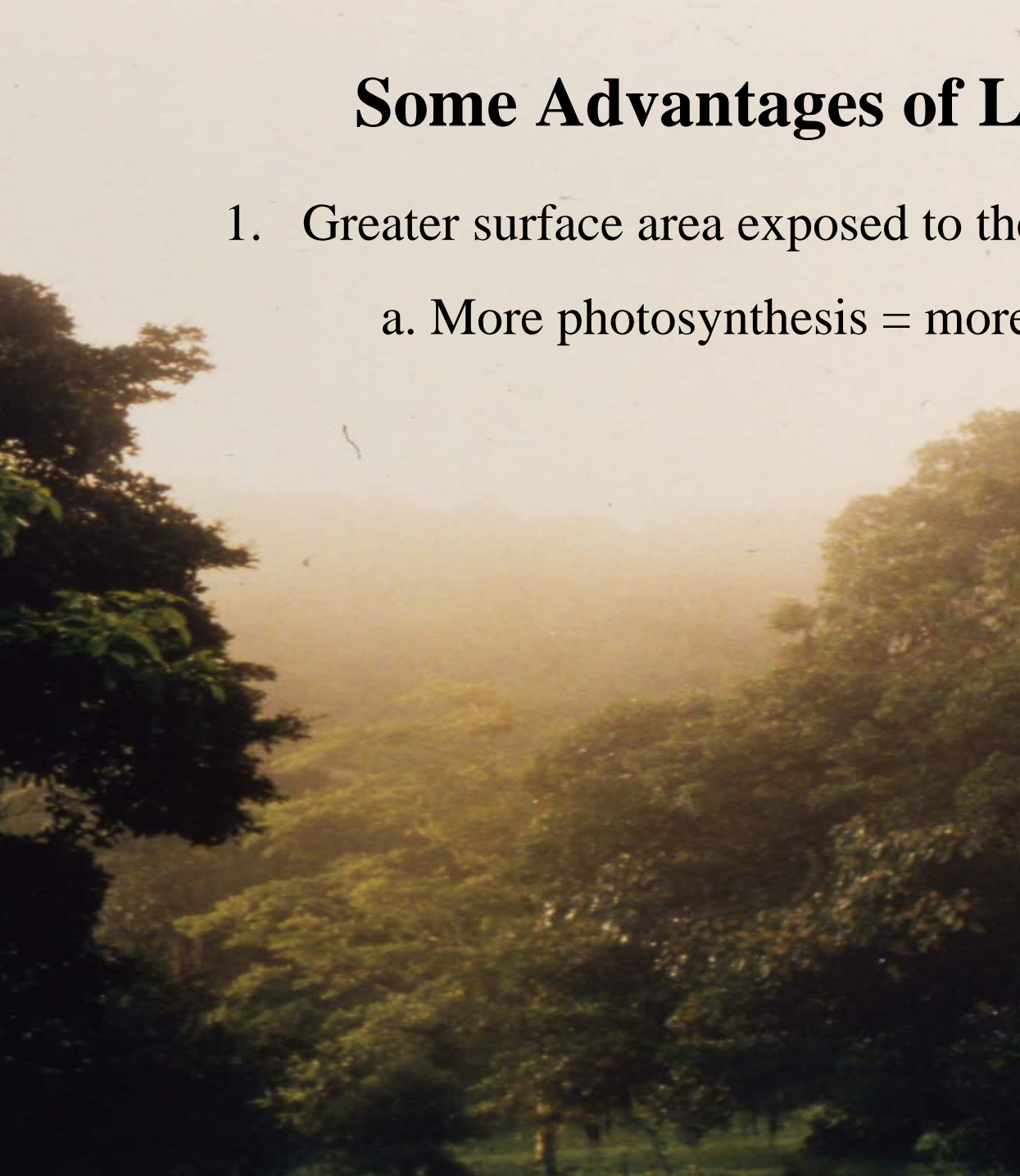
Why might leaves give plants an advantage?

Some Advantages of Leaves

1. Greater surface area exposed to the sun
 - a. More photosynthesis = more food for the plant

Trees produce
1000's of leaves

What can plants do
to make leaves more
effective for
capturing light?



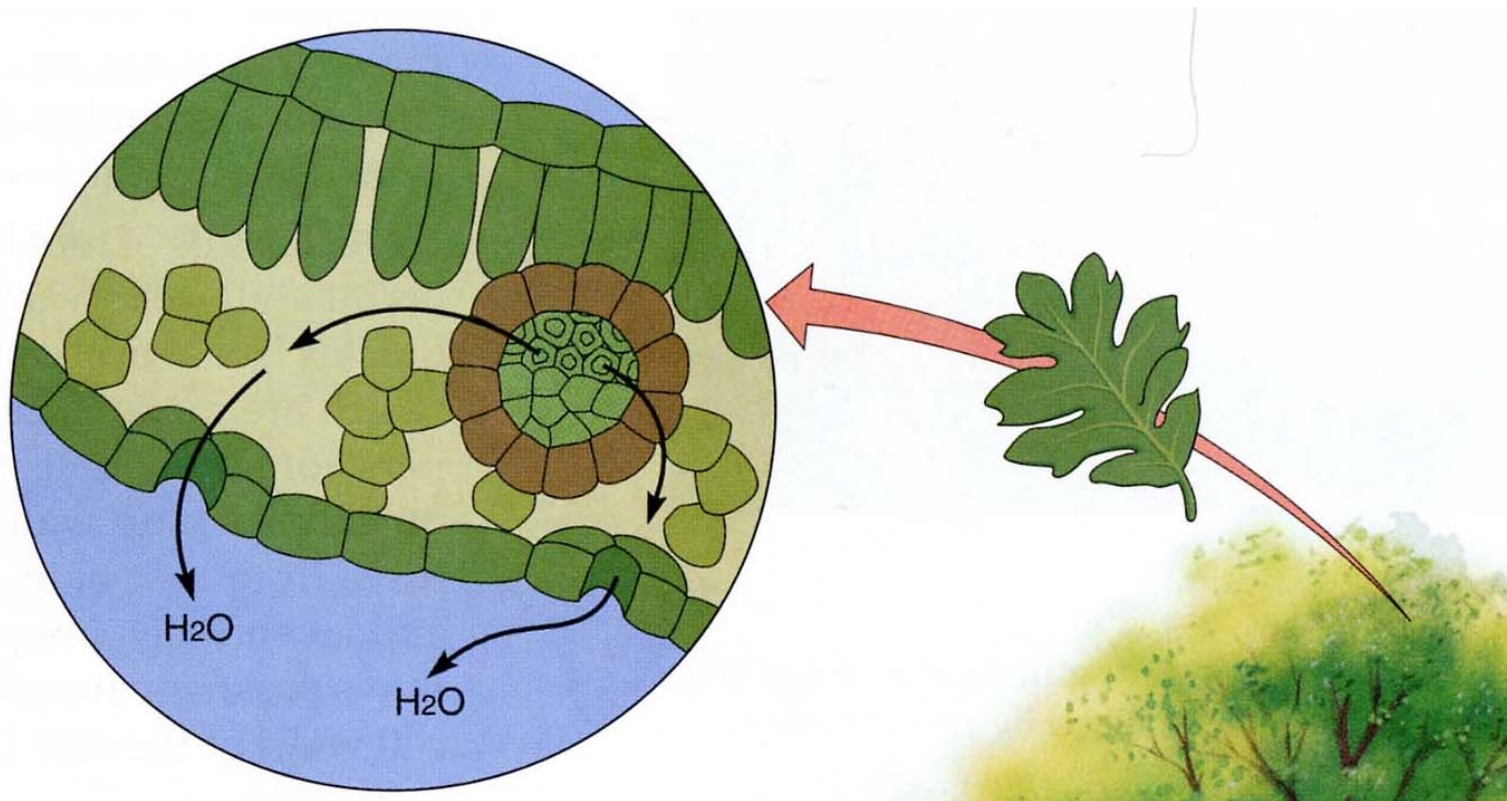
ways leaves can be more effective

1. Add more leaves
2. Angle the leaves to catch more sun
3. Make bigger leaves
4. Increase leaf lifespan

What are disadvantages of
having leaves?

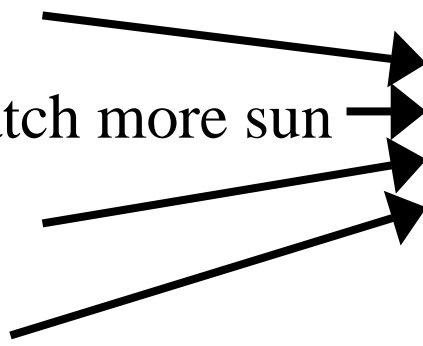
Transpiration

Water lost through stomata due to **evaporation**



Also, temperatures inside leaves can be really high!
this leads to more transpiration.

ways leaves can be problematic

1. Add more leaves
 2. Angle the leaves to catch more sun
 3. Make bigger leaves
 4. Increase leaf lifespan
- 
- More water loss
and (often) higher
leaf temperatures!!**

This means that **increasing** the amount of photosynthesis can lead to **decreasing** the amount of water conserved...

This is called a **tradeoff**—something that is advantageous in one way can be disadvantageous in another way.

Evolution has left plants with different ways of maximizing the benefits while minimizing the problems...

Trade-offs: two examples

Oak leaves

1. Large
2. Seasonal
when water is
most
available

High rate of
photosynthesis
(for less time)

High water loss

Shorter exposure

Pine leaves (needles)

1. Small
2. Function all year

Lower rate of
photosynthesis
(for more time)

Lower water loss

Longer exposure



Trade-offs: a third example

Ocotillo (a desert plant)

1. Small leaves
2. Seasonal (wetter season)

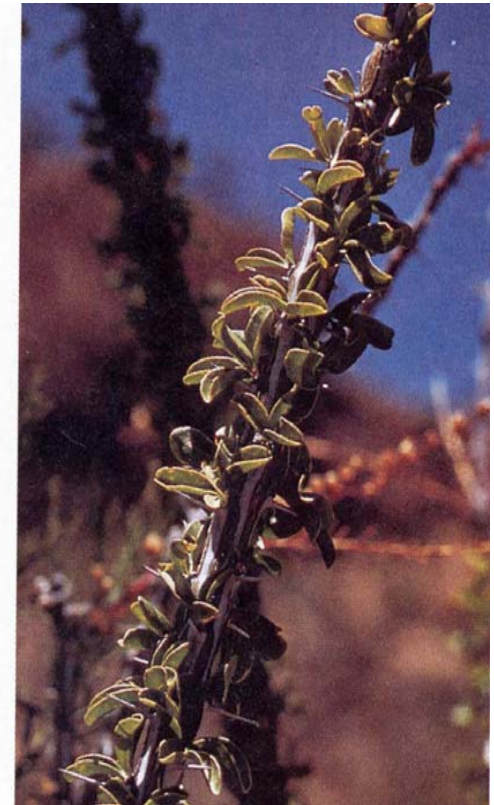
Lower water loss

Lower rate of photosynthesis

Short leaf exposure time



Ocotillo



Also, leaves (as well as stems)
are protected by **spines**
(which are also modified leaves)

What type of
photosynthesis might
this plant have?

Trade-offs: one more example

Thick leaves:

store water—less water loss

but their photosynthesis is less efficient

-light mainly hits cells near upper
leaf surfaces

Because bulkier leaves use up more
plant resources

this is more costly to plants

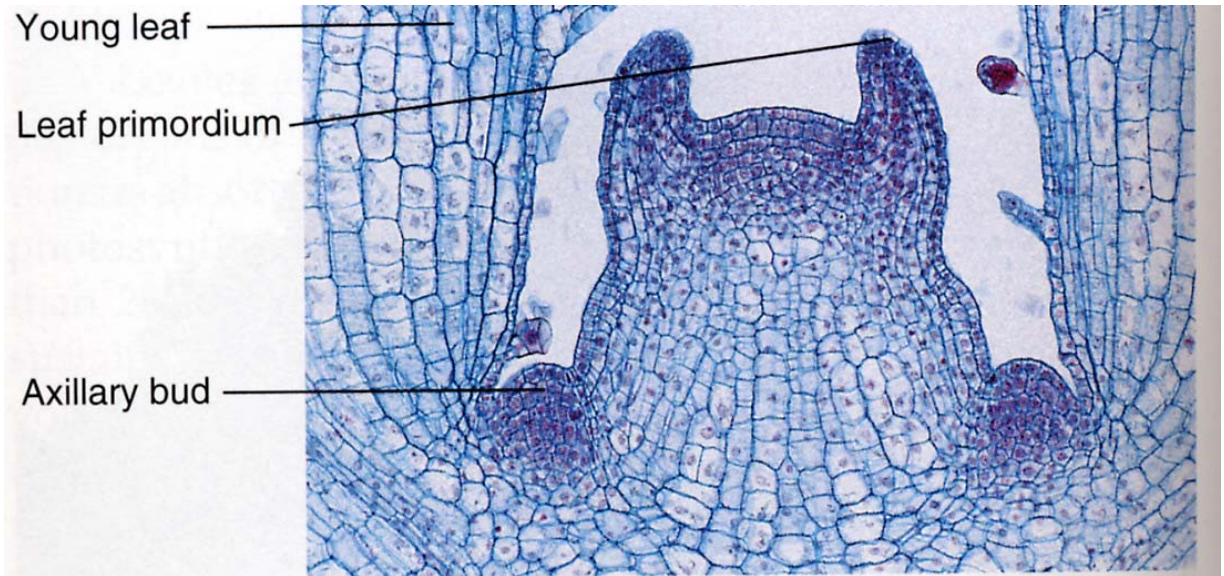
Thus, plants with thicker leaves may lose less water,
but get less photosynthesis per amount of leaf



Kalanchoe: has thicker
leaves

Leaf Anatomy

Leaves are produced by meristems!



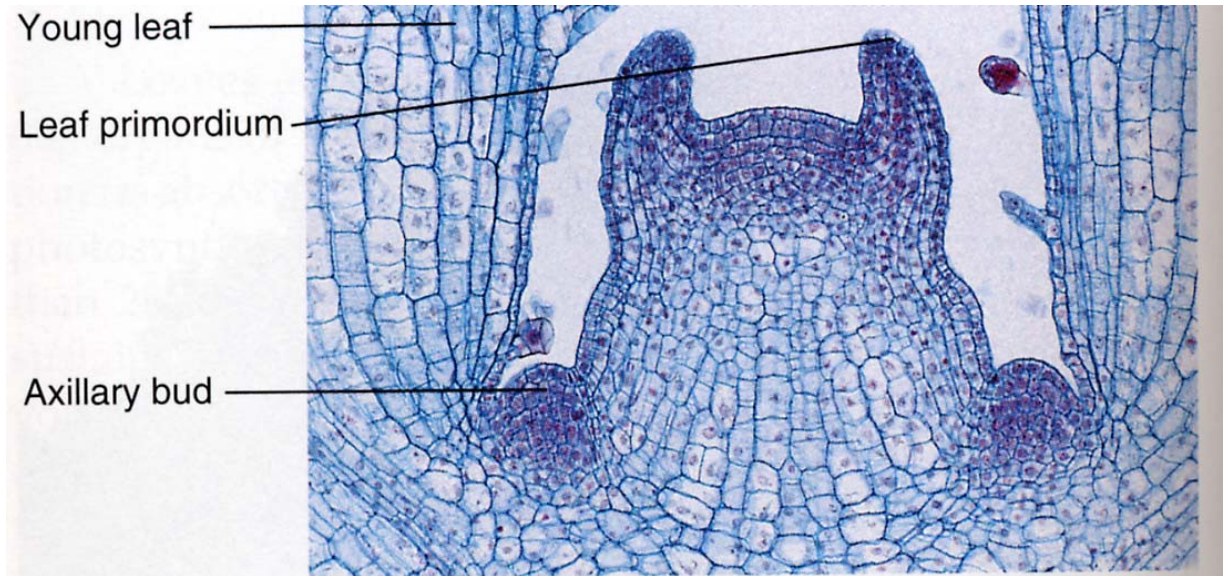
Why are axial buds important?

Fully formed leaves have mainly 3 types of tissue in them:

1. **Epidermis**
2. **Ground**
3. **Vascular**

Leaf Anatomy

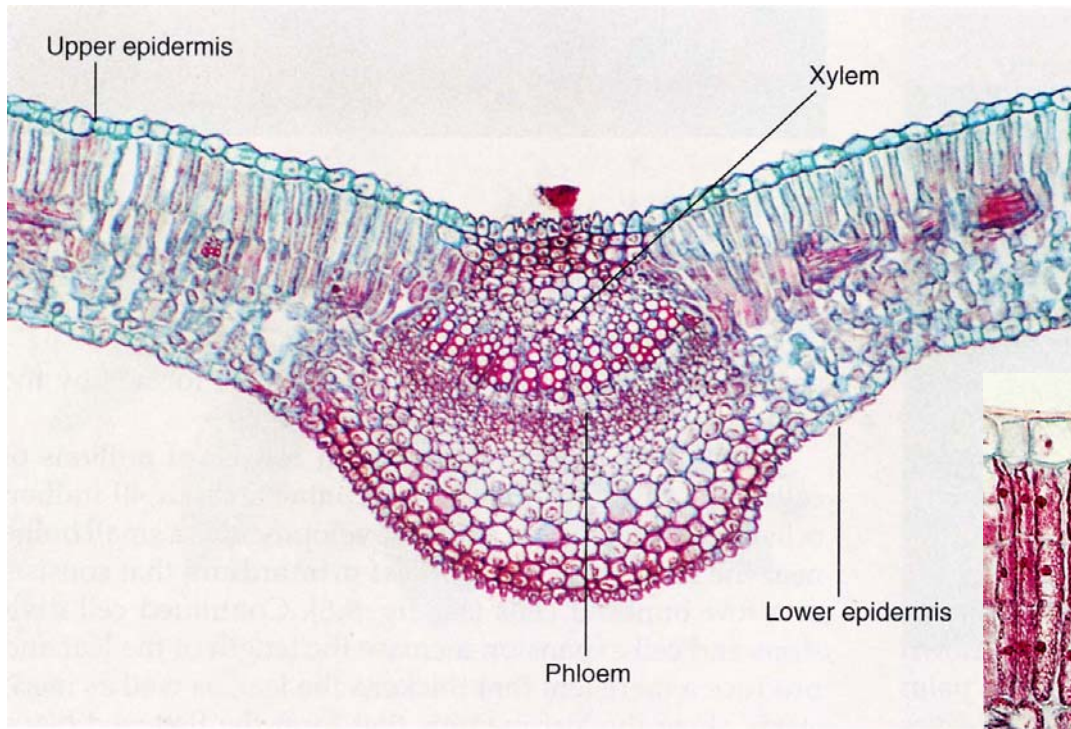
Leaves are produced by meristems!



Fully formed leaves have mainly 3 types of tissue in them:

1. **Epidermis**—forms outside cell layer and cuticle—protects leaf
2. **Ground**—does most of the photosynthesis, and gas exchange
3. **Vascular**—allows for water and sugar transport

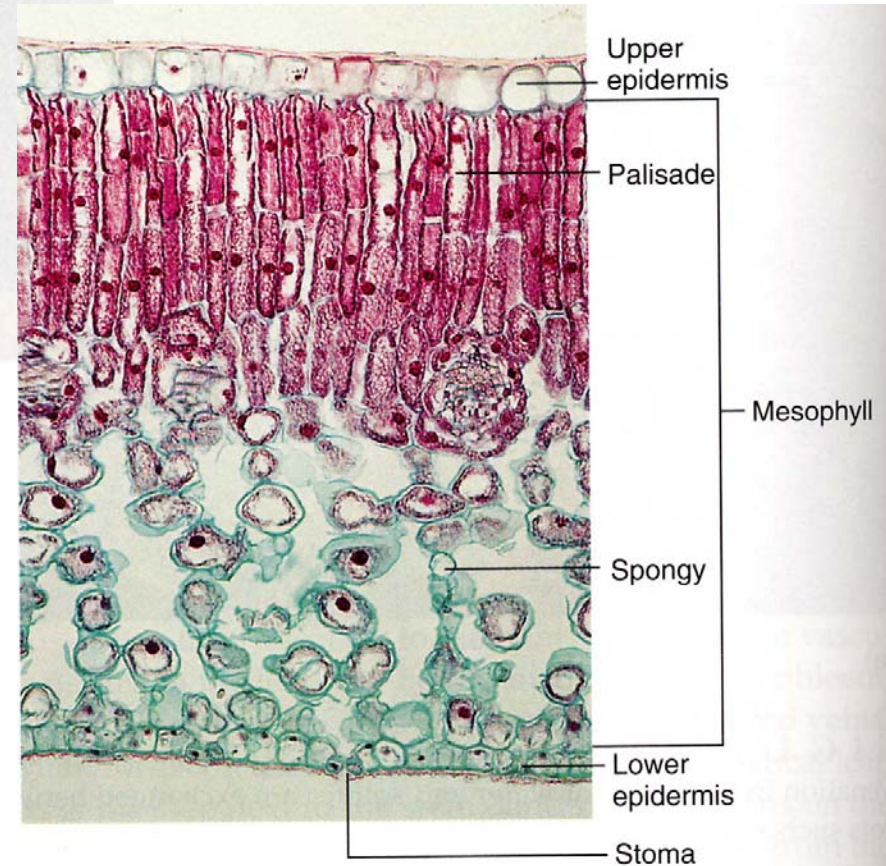
Leaf Anatomy

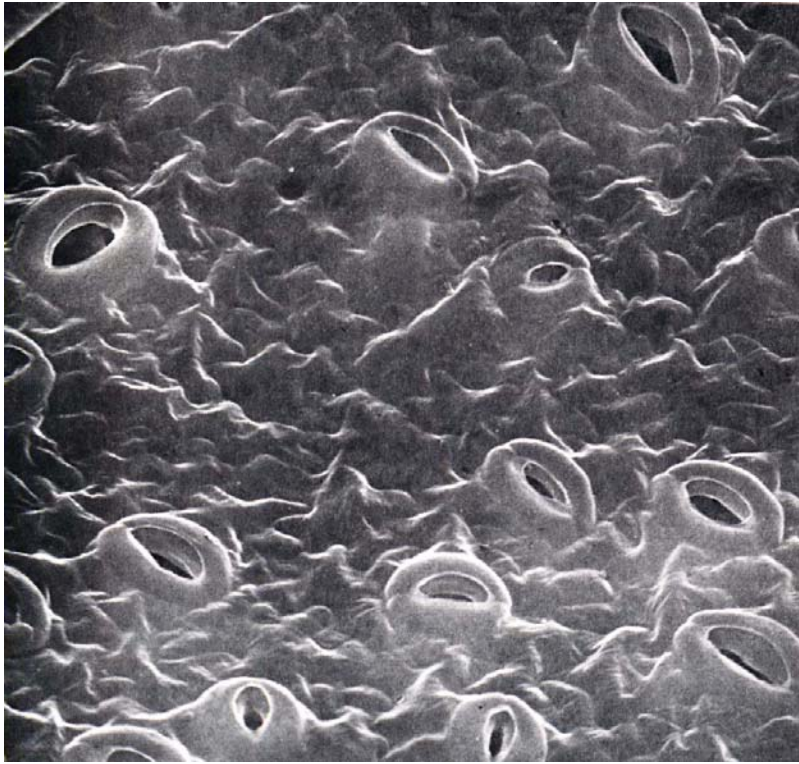


Vascular bundles—Xylem (on top) and phloem (on bottom)

Ground—

Palisade parenchyma cells do most of the photosynthesis
Spongy parenchyma cells have spaces between them, allowing for gas exchange





Stomata

Openings in the plant epidermis

1. let in CO_2
2. Let out O_2 (and water!)

Occur mostly on the **undersides** of leaves

why might this be?

Plants can often control when stomata are open

why is this important?

How Stomata Work

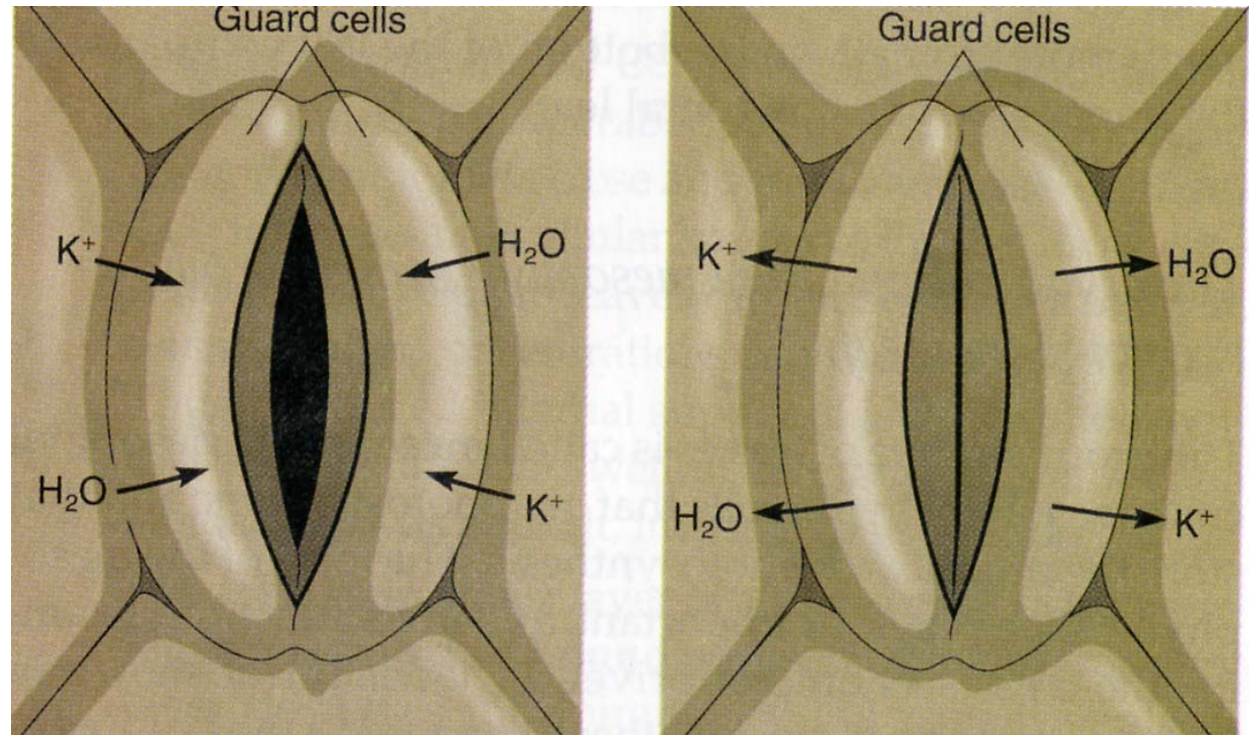
Often open when stimulated by light

(when is this not true??)

To open a stoma:

Guard cells

1. K^+ moves in
2. Water follows
(by osmosis)
3. Filled guard cells bend
aside



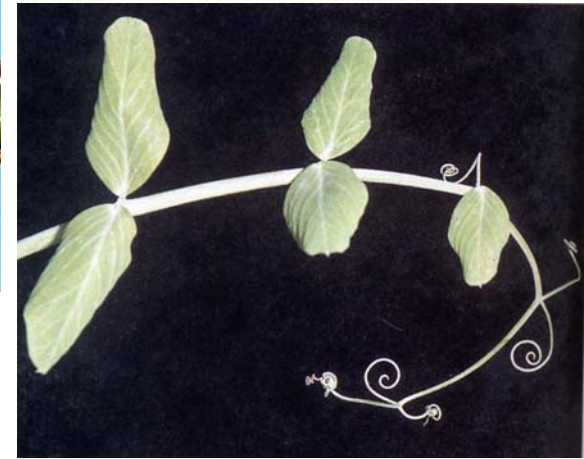
Other (more specialized) functions of Leaves



Attracting pollinators



Asexual reproduction



Climbing (**why climb?**)

Also store water

Other (more specialized) functions of Leaves



Catching insects (**why?**)

Catching nutrient-rich
debris—roots
grow into the debris



Summary

1. Clubmosses and Ferns each evolved leaves in different ways
2. Leaves increase **both** photosynthesis and water loss
3. This is a **trade-off**—where something that is advantageous on one way can be disadvantageous in another
4. Leaf arrangement, anatomy, and other adaptations (type of photosynthesis) can help plants balance between getting more food and losing more water.
5. Leaves can have more specialized (and sometimes unusual) functions...