Ashley Pearson - Plant Classification and Seeds

- *Green and Gorgeous*

  Oxfordshire
- Cut flowers
- Small amounts of veg still grown and sold locally

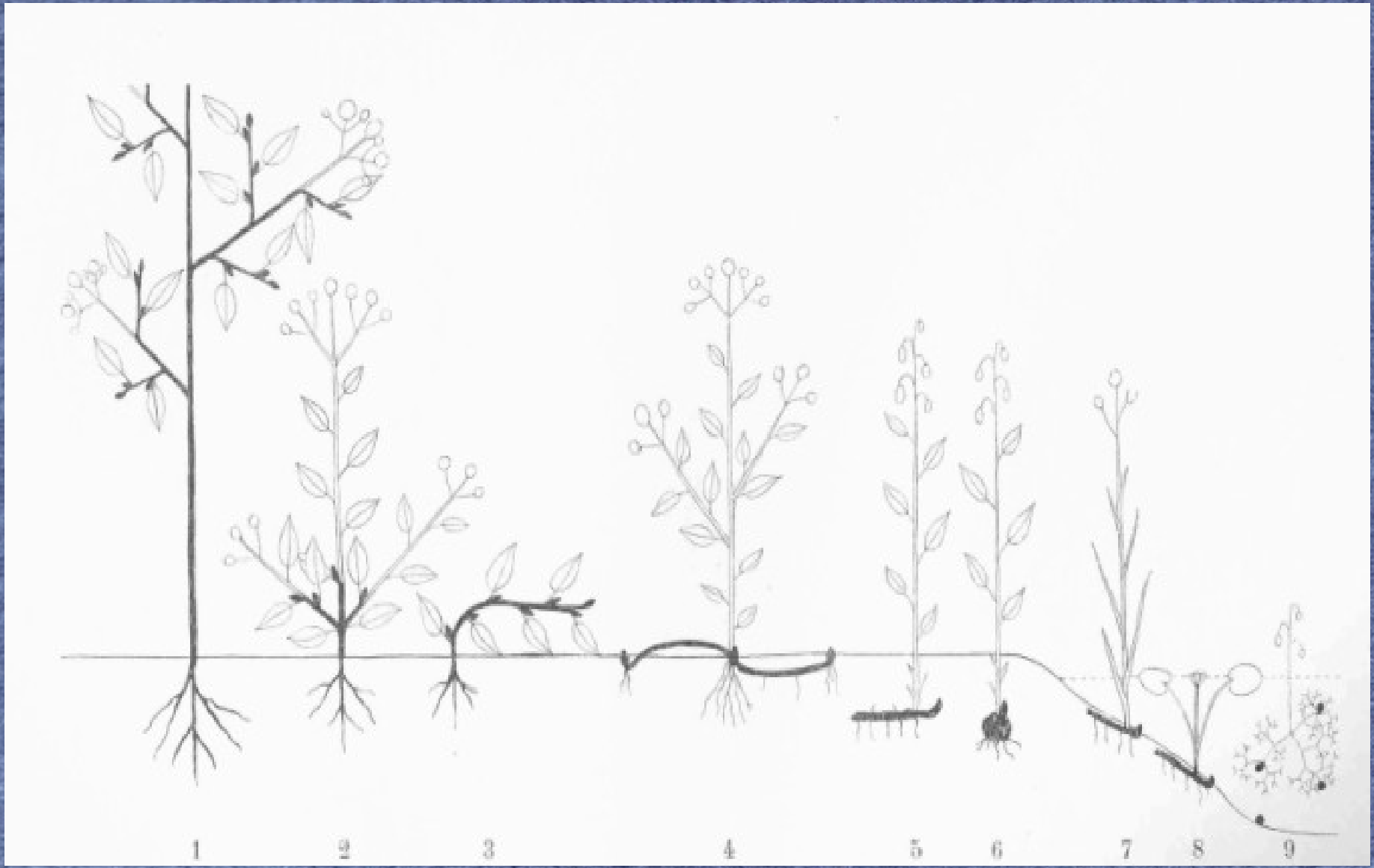
Different Classification Systems

Classification by Life Cycle : Ephemeral (6-8 wks)
Annual
Biennial
Perennial

Classification by Ecology: Mesophyte, Xerophyte, Hydrophyte, Halophyte, Cryophyte

Raunkiaers Life Form System: based on the resting stage

Raunkiaers Life Form System



Classification contd.

Classification by Plant Growth Patterns

Monocots vs. Dicots (NB. only applies to flowering plants - angiosperms)

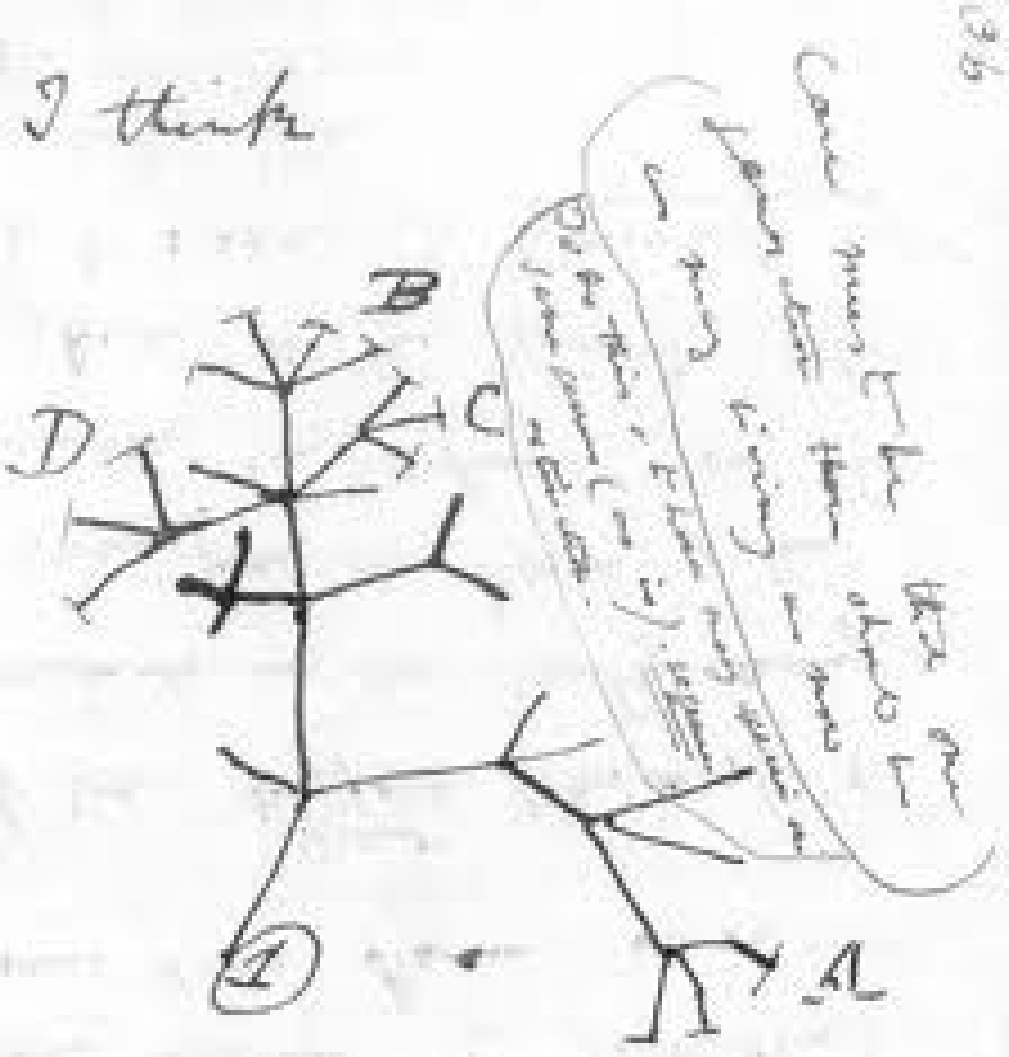
Binomial nomenclature

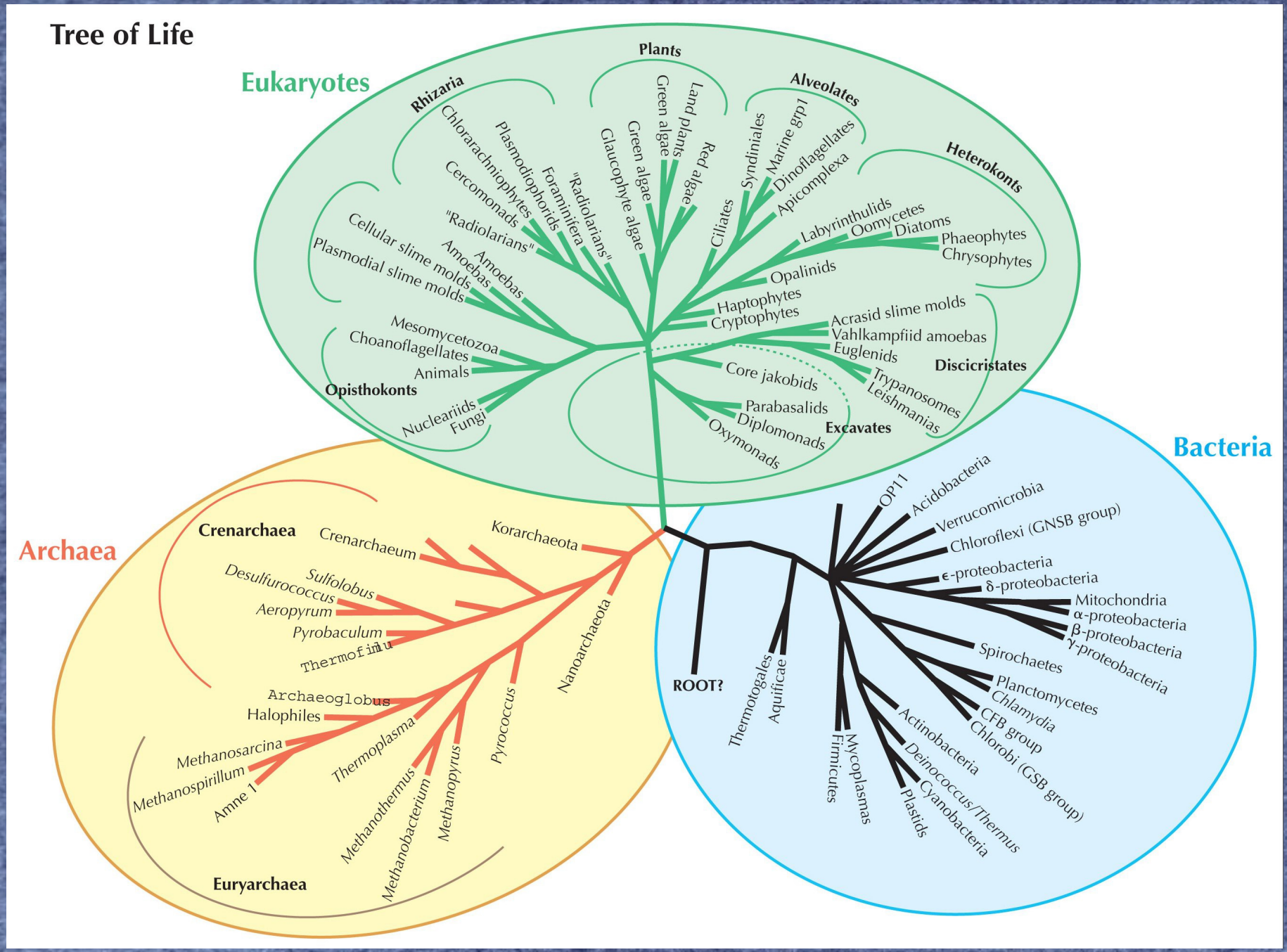
e.g., Beetroot = *Beta vulgaris*

Plantae, Angiosperms, Eudicots, Caryophyllales, Amaranthaceae, Betoideae, Beta, *Beta vulgaris*

After morphological characters, scientists used enzymes and proteins to classify plants and hence to determine how related they were via evolution (phylogeny)

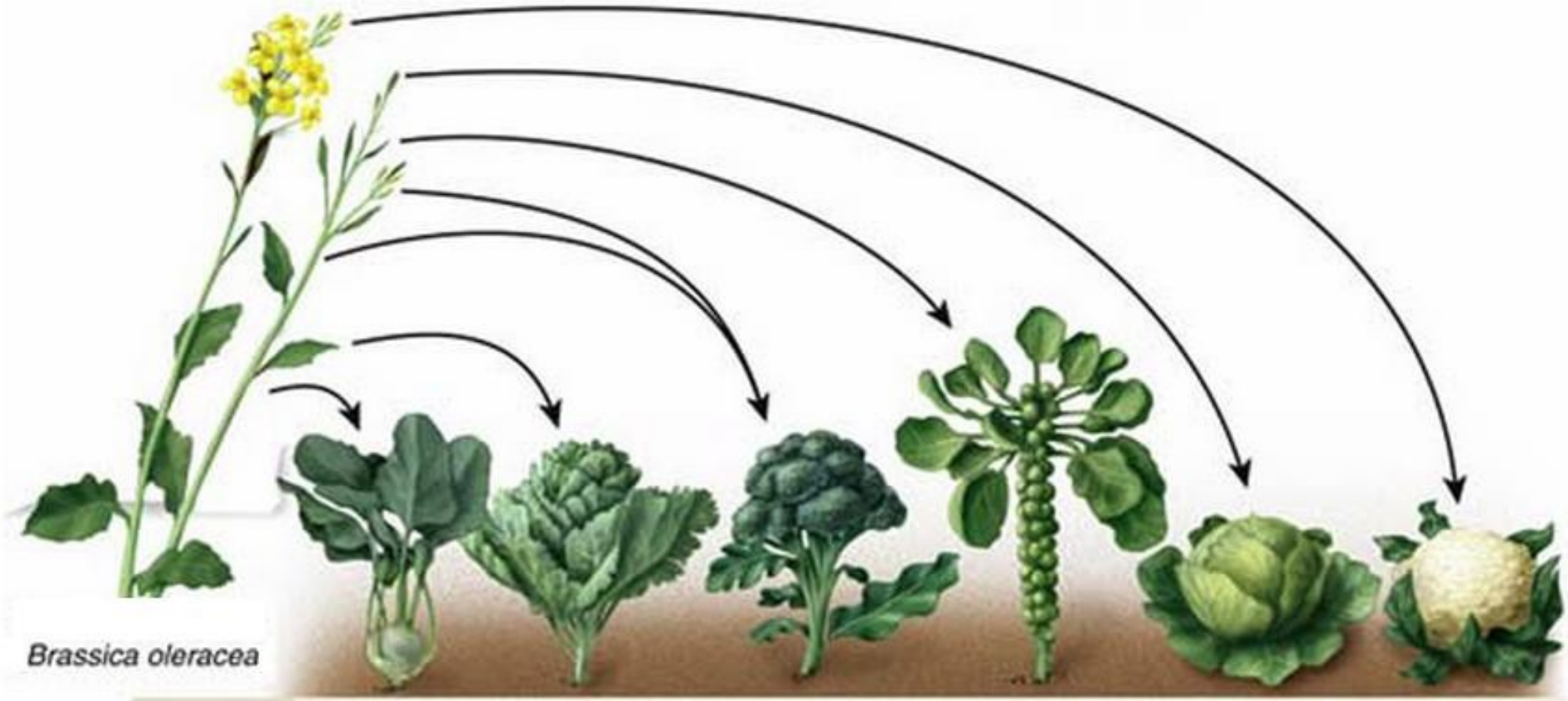
Present day we use genetic data (DNA, RNA, mDNA, even chloroplast DNA) to produce phylogenetic trees




Tree of Life
Eukaryotes
Plants
Land plants
Green algae
Red algae
Green algae
Glaucophyte algae
Rhizaria
Chlorarachniophytes
Plasmodiophorids
Foraminifera
"Radiolarians"
Cercomonads
"Radiolarians"
Amoebas
Amoebas
Cellular slime molds
Plasmodial slime molds
Mesomycetozoa
Choanoflagellates
Animals
Opisthokonts
Nucleariids
Fungi
Alveolates
Syndiniales
Marine grp1
Dinoflagellates
Apicomplexa
Ciliates
Heterokonts
Labyrinthulids
Oomycetes
Diatoms
Phaeophytes
Chrysophytes
Opalinids
Haptophytes
Cryptophytes
Acrasid slime molds
Vahlkampfiid amoebas
Euglenids
Discicristates
Trypanosomes
Leishmanias
Core jakobids
Parabasalids
Diplomonads
Oxymonads
Excavates
Archaea
Crenarchaea
Crenarchaeum
Korarchaeota
Sulfolobus
Desulfurococcus
Aeropyrum
Pyrobaculum
Thermofilum
Nanoarchaeota
Archaeoglobus
Halophiles
Methanosarcina
Methanospirillum
Amne 1
Thermoplasma
Methanothermus
Methanobacterium
Methanopyrus
Pyrococcus
Euryarchaea
Bacteria
ROOT?
Thermotogales
Aquificae
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)
Actinobacteria
Deinococcus/Thermus
Cyanobacteria
Plastids
Mycoplasmas
Firmicutes

Plant part modifications

- Brassica genus
-
- Roots (swede, turnips)
- Stems (kohl rabi)
- Leaves (cabbages, Brussels Sprouts-buds)
- Flowers (cauliflower, broccoli)
- Seeds (mustards, oil seed rape)



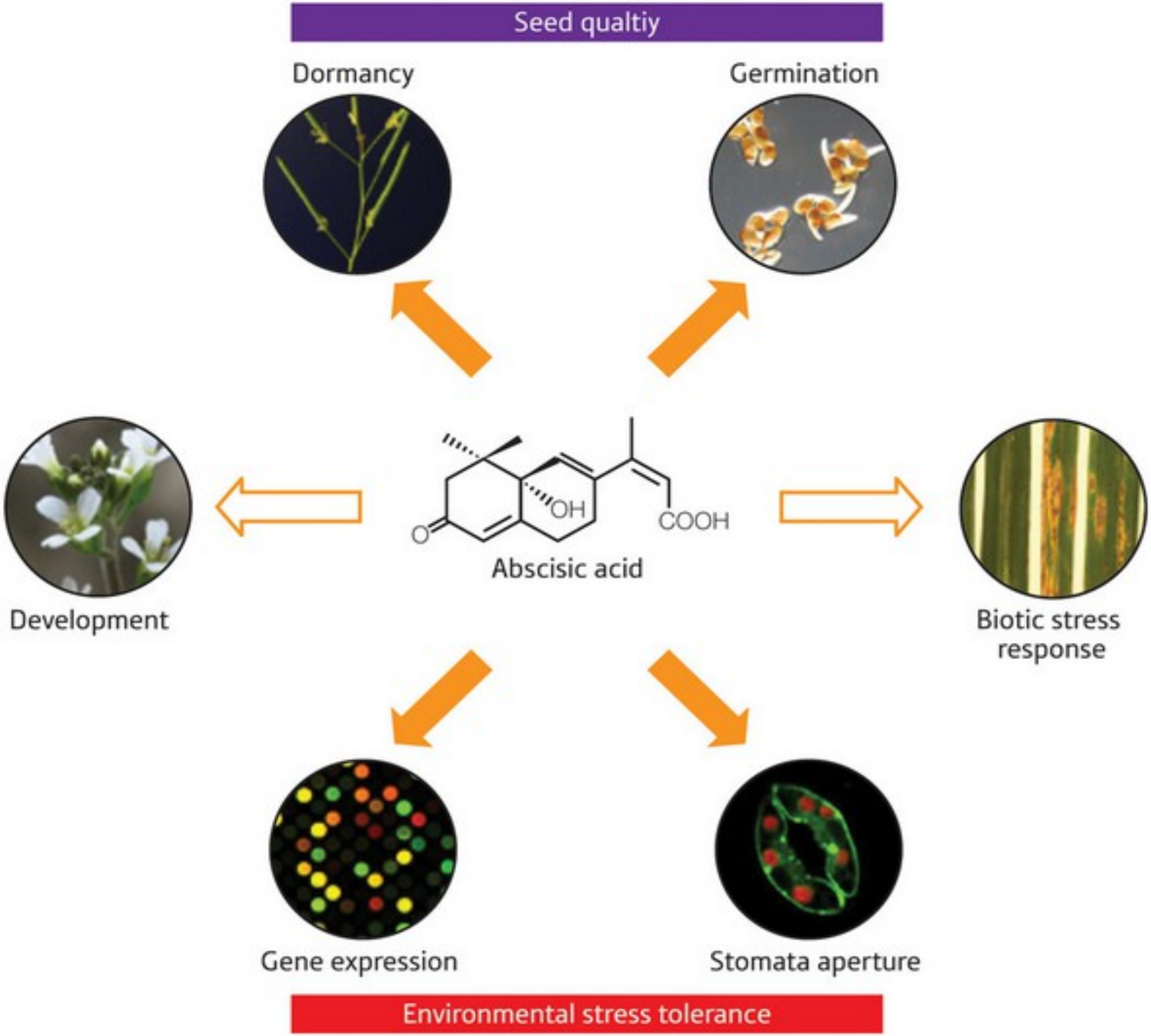
Strain	Kohlrabi	Kale	Broccoli	Brussels sprouts	Cabbage	Cauliflower
Modified trait	Stem	Leaves	Flower buds and stem	Lateral leaf buds	Terminal leaf bud	Flower buds

Plant hormones / PGR's / phytohormones

- Chemicals present in very low concentrations that promote and influence the growth, development, and differentiation of cells and tissues.
- NB. differences to animal hormones! (no glands, no nervous system, no circulatory system, no specific mode of action)
- Not all plant cells respond to hormones, but those that do are programmed to respond at specific points in their growth cycle
- Five main classes of PGR's
-

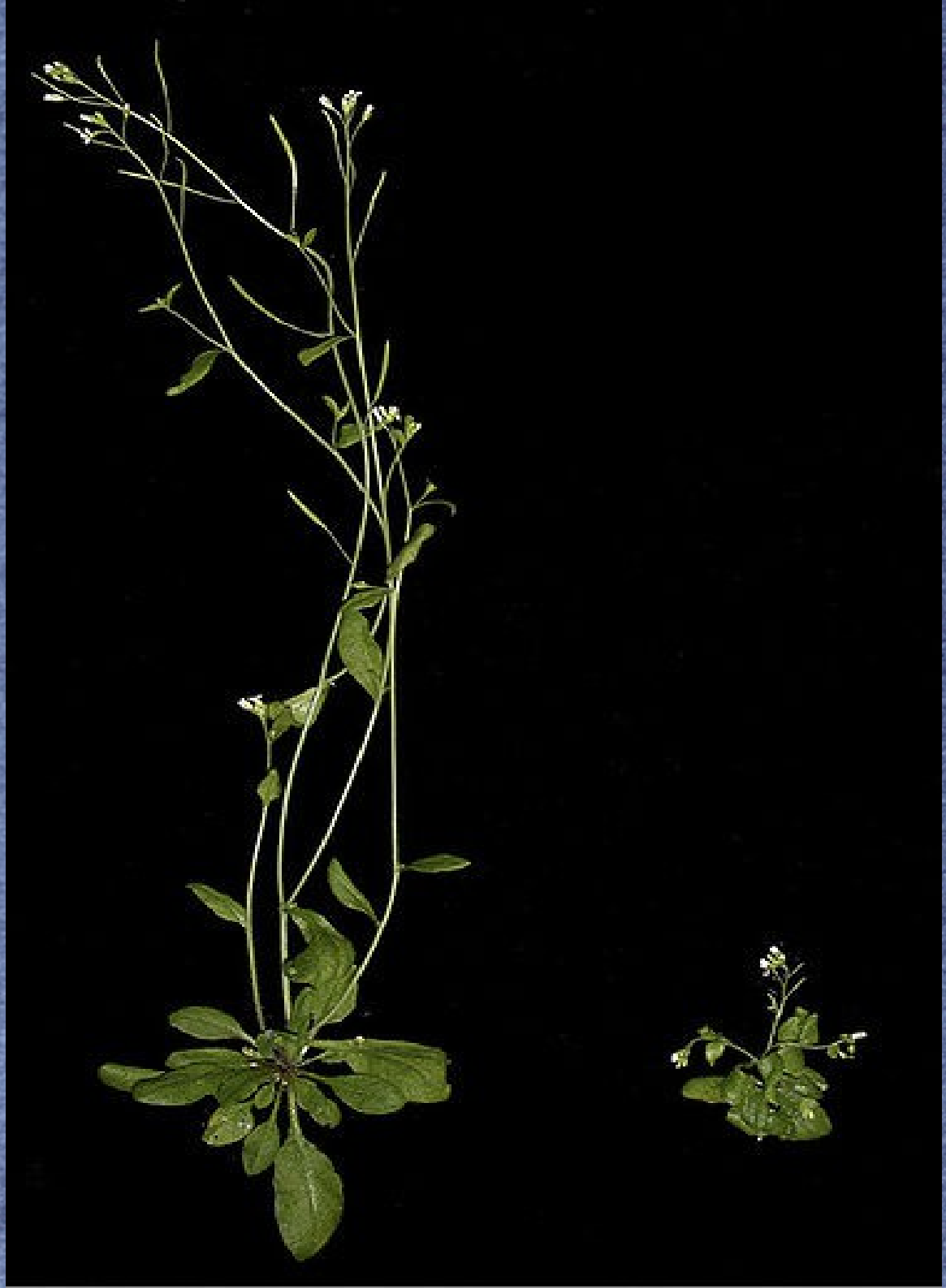
Abscisic acid (ABA)

- Role in abscission, winter bud dormancy (dormin)
- ABA-mediated signalling also plays an important part in plant responses to environmental stress and plant pathogens
- ABA is also produced in the roots in response to decreased water potential. ABA then translocates to the leaves, where it rapidly alters the osmotic potential of stomatal guard cells, causing them to shrink and stomata to close
- Inhibits seed germination (in antagonism to Gibberellins), produced in maturing seeds > dormancy


Seed qualtiy
Dormancy
Germination
OH
COOH
O
Abscisic acid
Development
Biotic stress response
Gene expression
Stomata aperture
Environmental stress tolerance

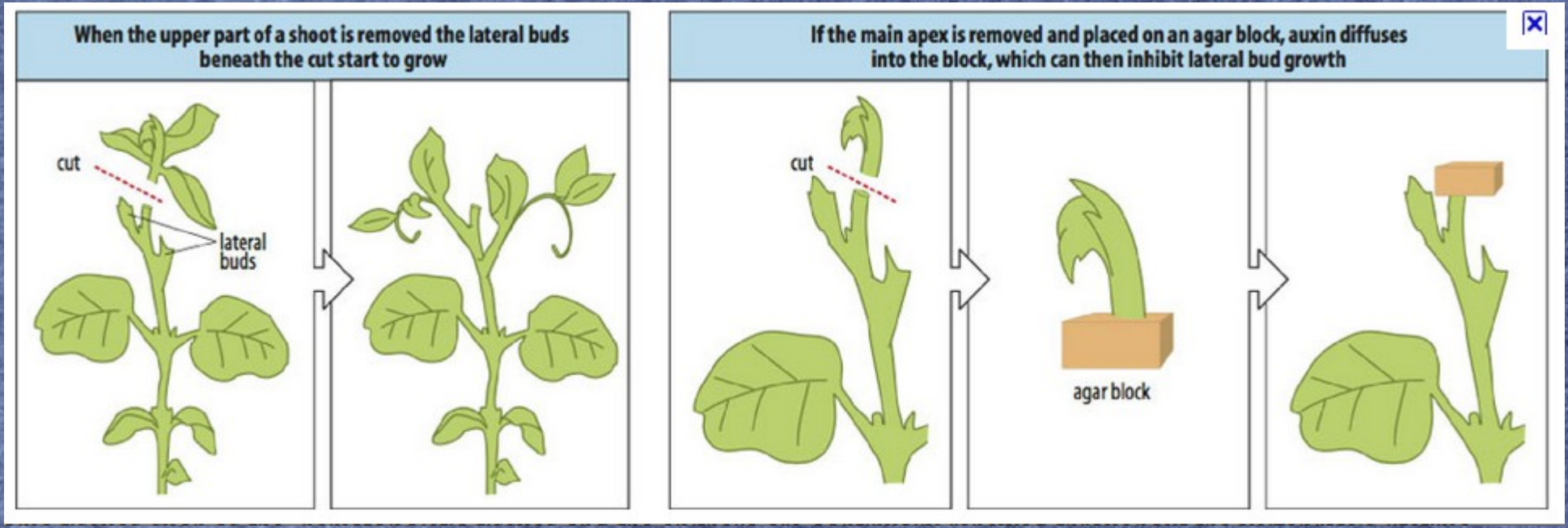
Auxins

- Involved in growth, often in conjunction with or in opposition to other PGR's
- The gradient of auxin concentration is important in producing growth responses such as gravitropism.Actively transported from cell to cell around the plant, via polar auxin transport
- e.g., herbicides and Agent Orange (2,4D) as synthetic auxins (dicots more sensitive to auxins than grasses)
- Promotes lateral and adventitious root development (e.g., IBA in root cutting powder)



Apical dominance

- Inhibition of buds lower down the stem via auxin
- After removal of auxin, cytokinins stimulate lateral bud growth and removal of apical dominance



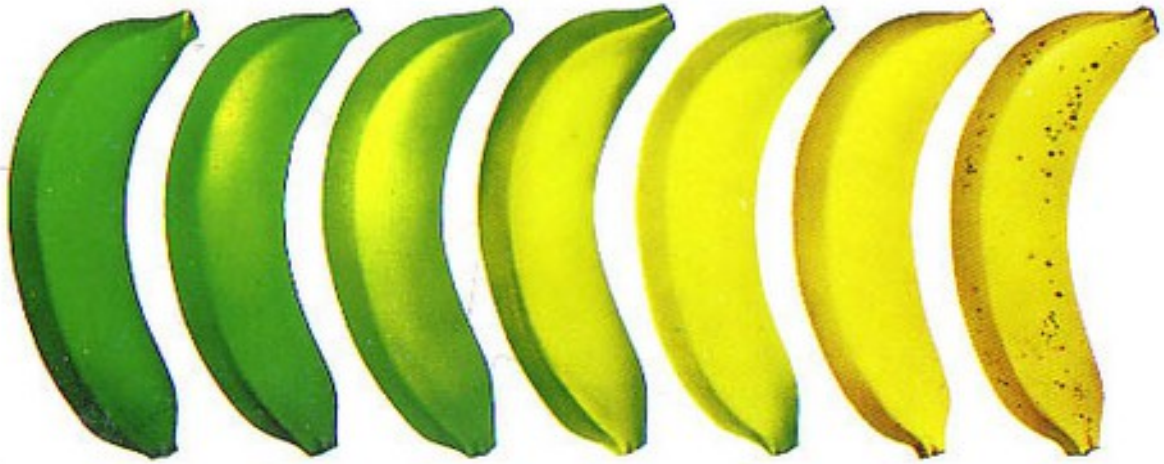
Ethylene (C_2H_4)

- A gas that has an important role in fruit ripening and senescence
- Egyptians would gash figs to induce ripening, wound response
- Growth responses in growing shoots and obstacles, flooding response (hyponasty)
- Ethylene causes tomatoes, bananas, apples to ripen – induces climacteric rise in respiration in some fruit which causes a release of additional ethylene
- Ethylene will shorten the shelf life of cut flowers and potted plants by accelerating floral senescence and floral abscission.

Suggested Guide for Banana Ripening

Pulp Temperatures °F

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
4 Day Schedule	ETHYLENE 64°	64°	62°	60°				
5 Day Schedule	ETHYLENE 62°	62°	62°	62°	60°			
6 Day Schedule	ETHYLENE 62°	62°	60°	60°	60°	58°		
7 Day Schedule	ETHYLENE 60°	60°	60°	60°	60°	58°	58°	
8 Day Schedule	ETHYLENE 58°	58°	58°	58°	58°	58°	58°	58°



Color Index No.	1	2	3	4	5	6	7
Peel Color	Green	Green – trace of yellow	More green than yellow	More yellow than green	Green tip	All yellow	Yellow – flecked with brown

Notes:

- Temperatures are °F
- Temperatures are PULP not AIR
- Proper temperature, humidity, time, air circulation, mature bananas and ethylene are required for ripening.
- Use the Super-Ripening Center® and Ethy-Gen® II to hasten ripening.
- Maintain 100-150 ppm of ethylene until color breaks.
- After 24 hour ripening initiation period, vent room for 15-20 minutes with fan on.
- For delayed shipment hold at 58°F.

Fresh Forever (For Household Use)

Ethylene Gas is given off naturally by fruits and vegetables as a signaling mechanism in order to coordinate uniform ripening. However, once concentrated in your refrigerator or other storage areas, the presence of ethylene gas continues to speed up ripening and hasten spoilage.

Fresh Forever is designed to provide effective ethylene gas absorption for 1 month in a typical home refrigerator produce bin or storage container. The active ingredient does not "wear out" but continues to absorb ethylene until it has reached its capacity.

Zoom

Giberellins

- Seed germination and growth after germination
- Dormancy breaking via starch hydrolysis
- Bolting response

Gibberellins in agriculture and horticulture

Dwarf Tall

High yielding semi-dwarf rice has reduced endogenous gibberellin

-GA

+GA

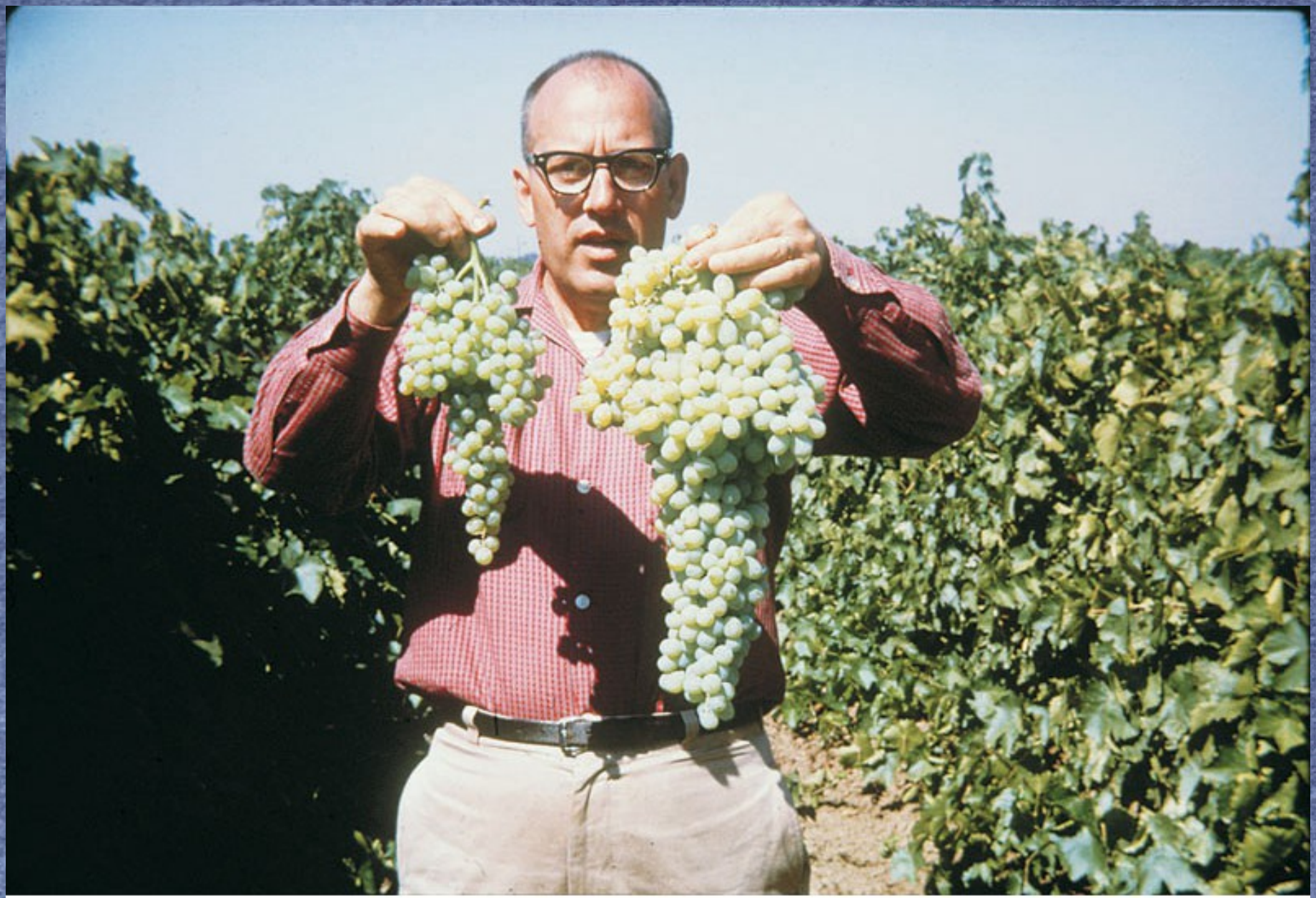
Fewer flowers and larger fruit

Delayed fruit harvest

Increased fruit size

GAs are used commercially to increase fruit size in table grapes and to regulate citrus flowering and rind maturation

Seedless grapes require GA application to reach proper size



Cytokinins

- Role in cell division (cytokinesis)
- Counter apical dominance induced by auxins
- CK:auxin ratios can determine shoot vs. root formation, e.g., in tissue culture
- Originally isolated from coconut milk
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“Plants are not just free salads for animals”

- Plant breeding has removed a lot of characteristics that protect plants in order to suit us, but lots remain
- Vernalization, a cold requirement before flowering
- phytochrome mediated responses to neighbours and green light (red absorbed by neighbours) = shade response
- Secondary metabolites/compounds that disrupt herbivory (exploited using nicotine, pyrethrins, Azadirachtin (neem)
- Semiochemicals to attract beneficial predators
-

A consideration of bolting

- Premature flowering when WE don't want it
- Stress in general, drought, disturbance, temperature
- Fennel, root disturbance and good hydration
- Onion sets – not too large
- Day length, e.g., spinach is a LD plant

Tropisms (growth responses)

Strictly a growth response (heliotropism doesn't count or photo-orientation of chloroplasts)

- Geotropism / gravitropism – roots grow downwards, shoots upwards, mediated by auxins. Root cap contains starch grains that settle and promote auxin production. In shoots, increasing the local concentration of auxin promotes cell expansion; *this has opposite effect in root cells!*
- Phototropism – auxins on the dark side of the stem cause cell elongation
- Thigmotropism – growth response to touch, auxin-mediated, e.g., legume tendrils
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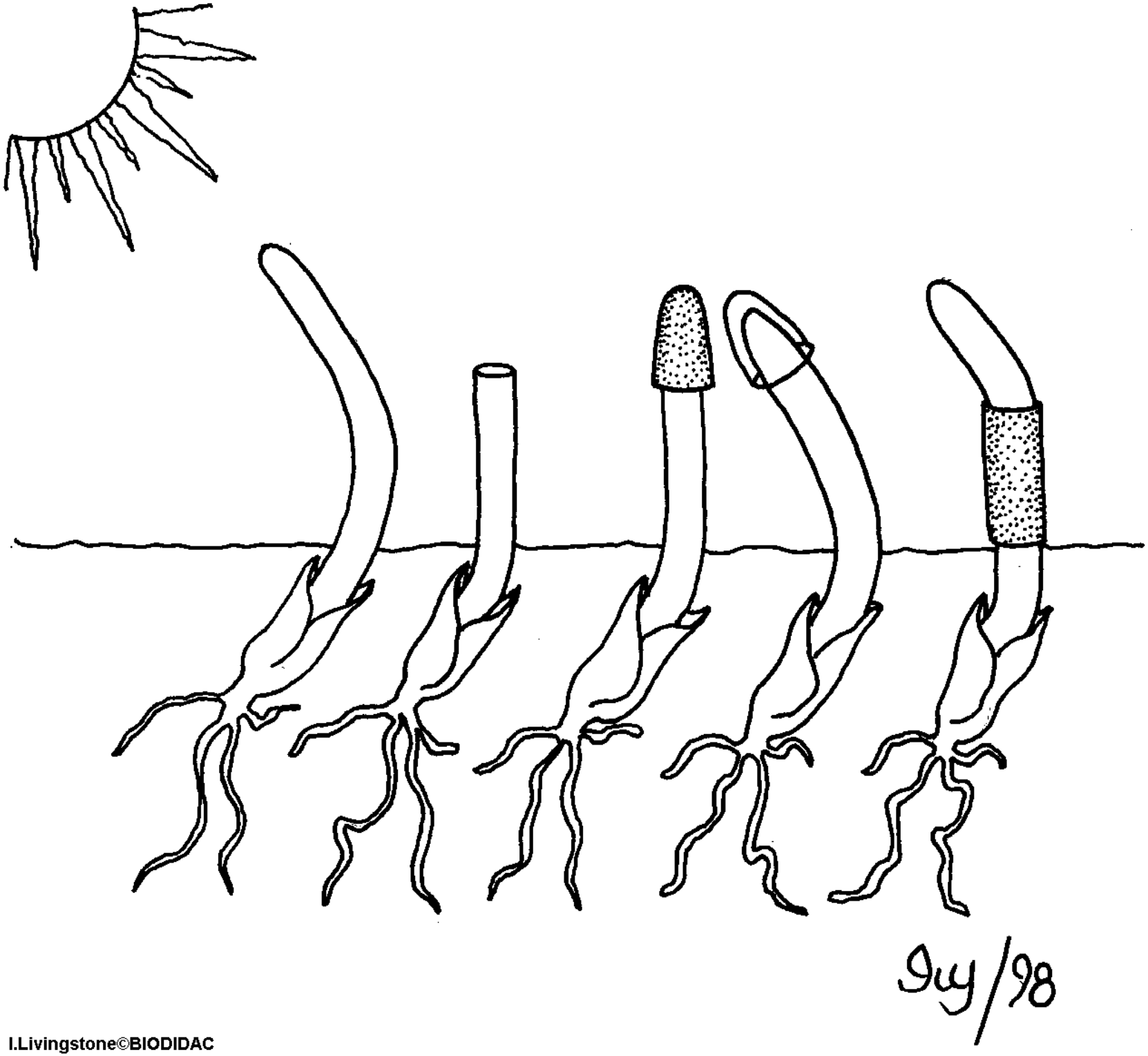


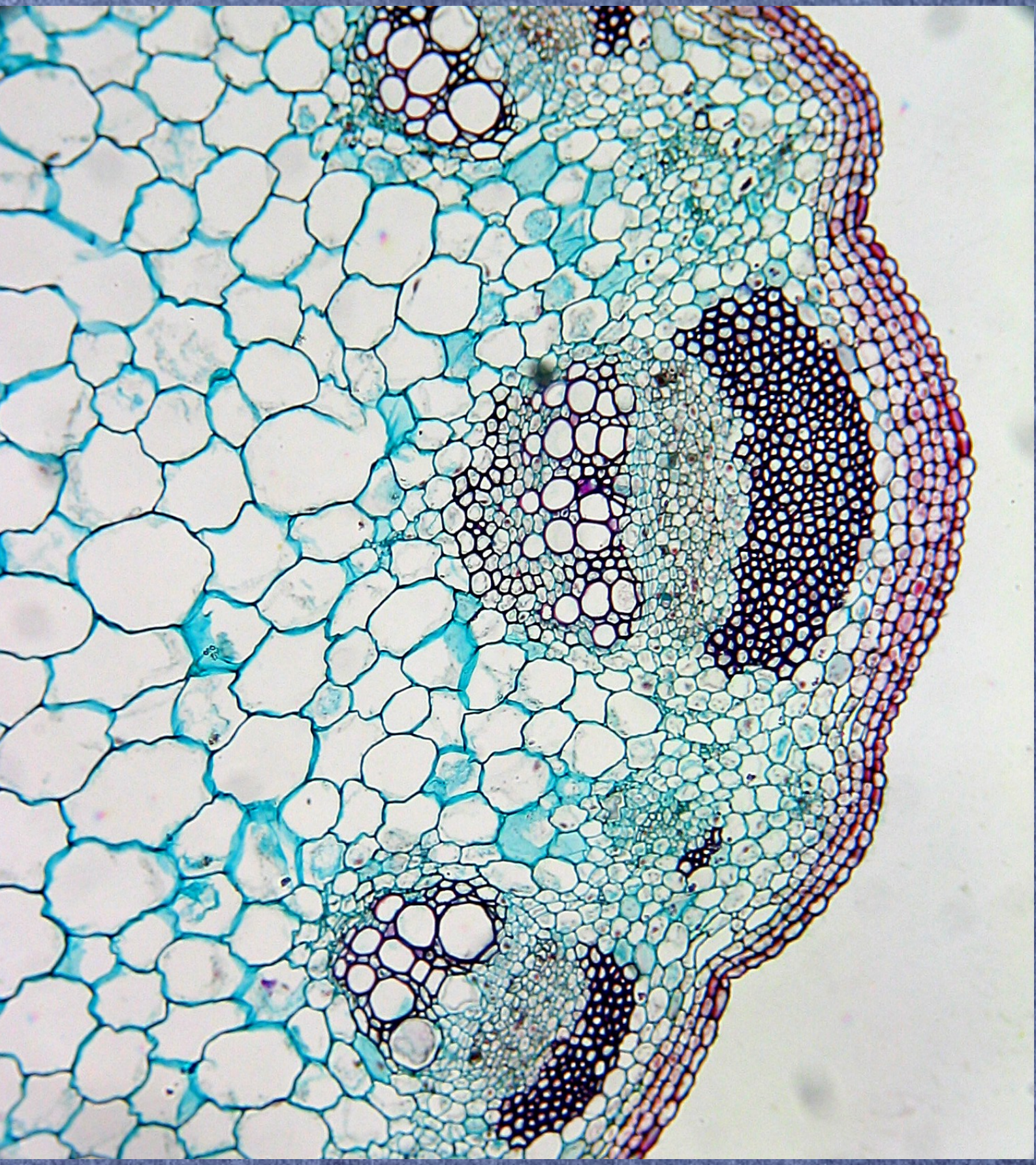
Nastic movements

- Responses to non-directional stimuli, such as temperature, humidity
- Photonasty – opening and closing of flowers
- Thigmonasty – faster responses to touch mediated by cell turgor or bistable mechanisms

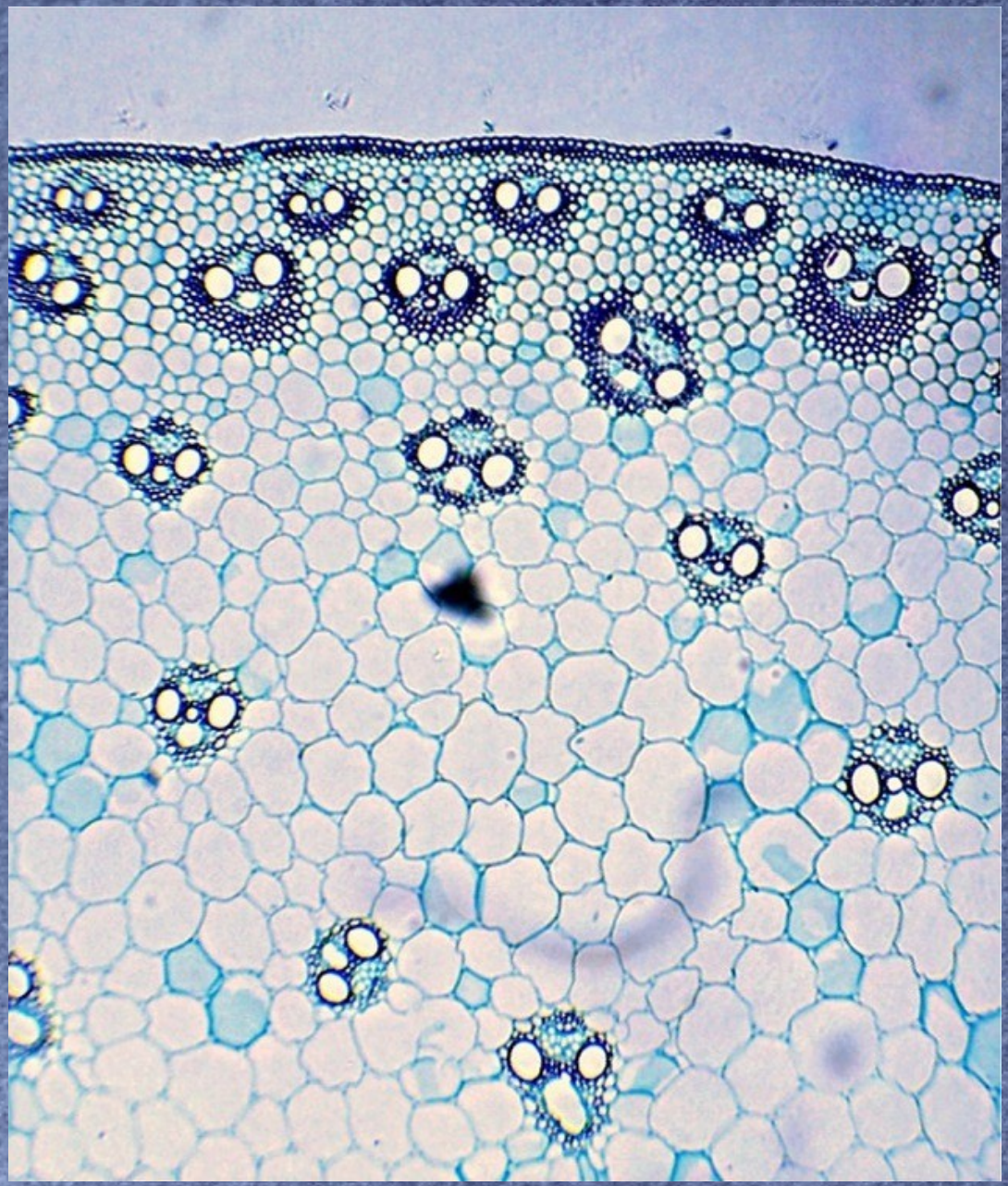
Plant structure in flowering plants

- Monocots vs. Dicots

Quindio wax palm

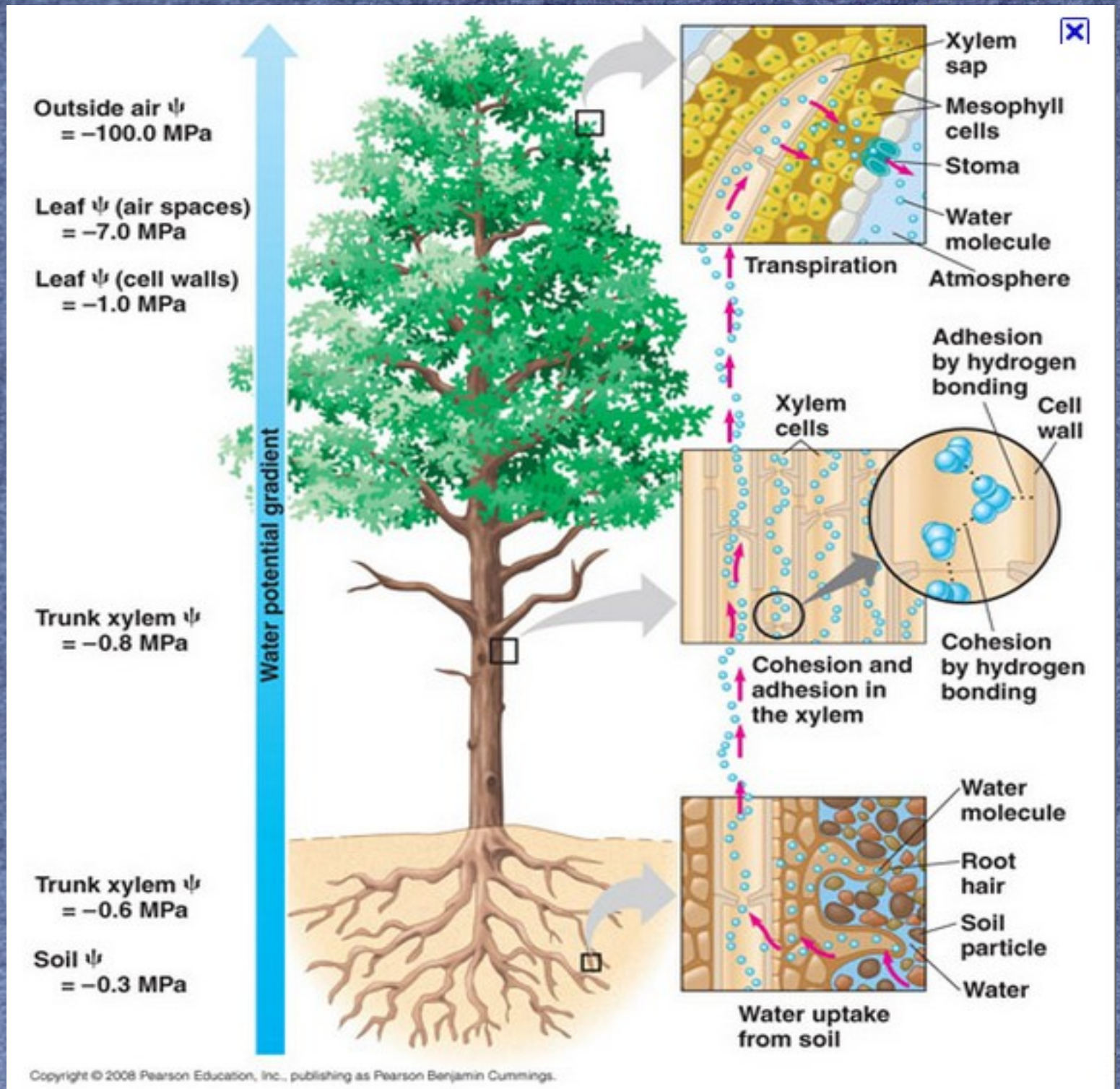


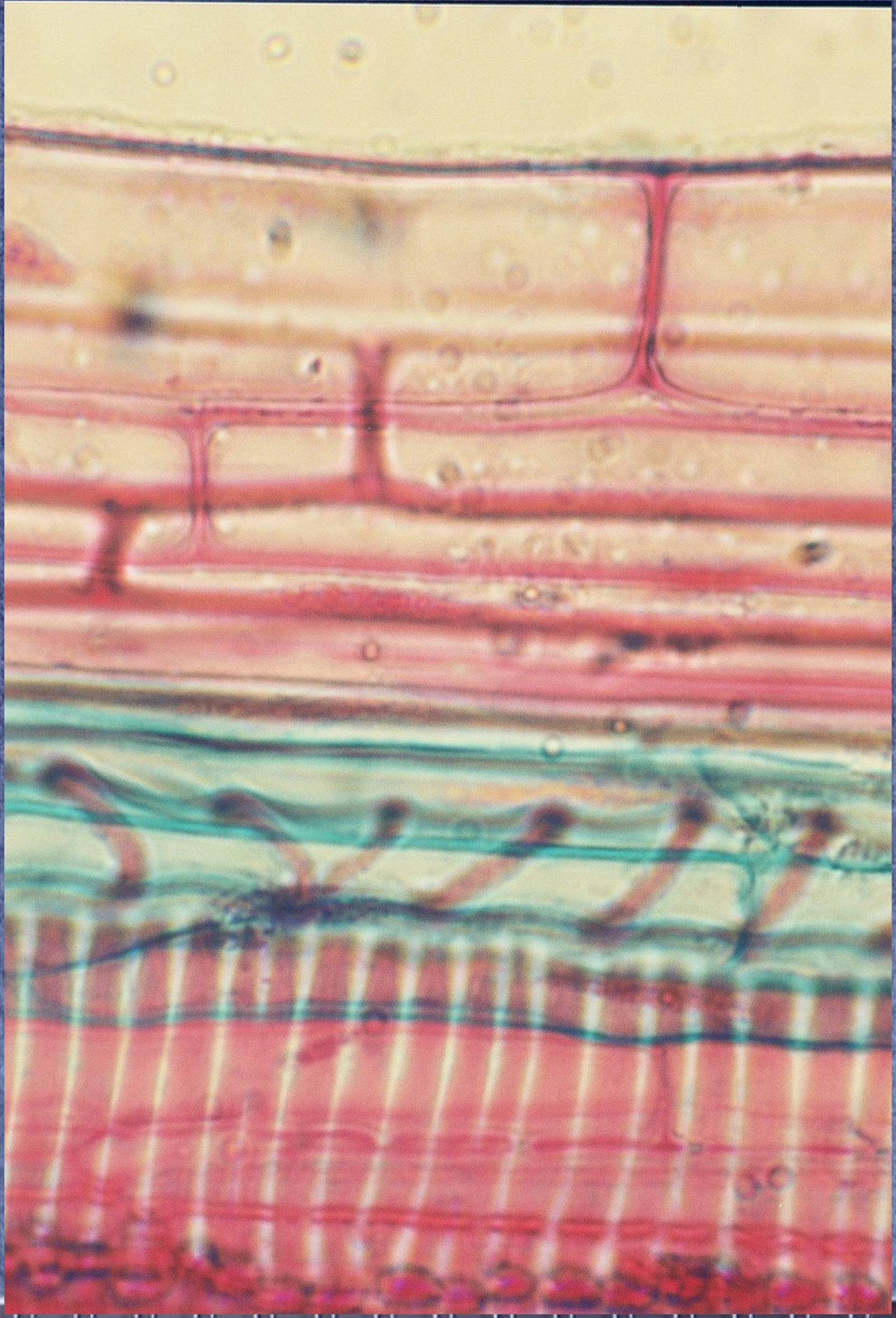
Maize



Xylem and the transpiration stream

- Xylem vessels transport water and soluble minerals from the roots to the stem via bulk flow
- Vessels are dead with no living contents
- Transpiration is the evaporation of water from the leaf mesophyll and air spaces, pulling water upwards
- High surface tension of water and thin xylem vessels help maintain unbroken 'column of water'
- Root pressure is the 'push from below', caused by water moving into roots by osmosis
- This can be observed when sap is forced from the leaf (guttation)





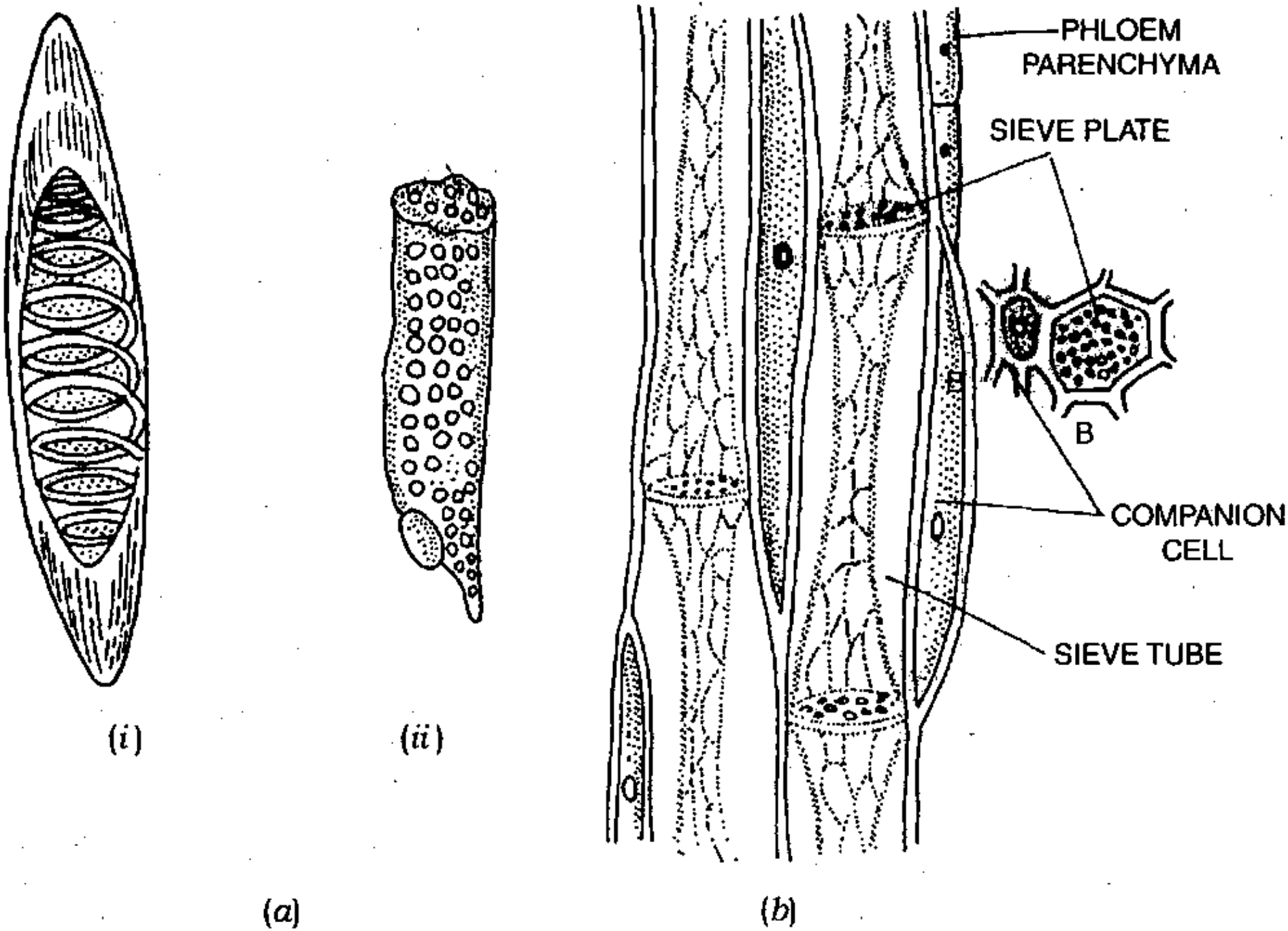
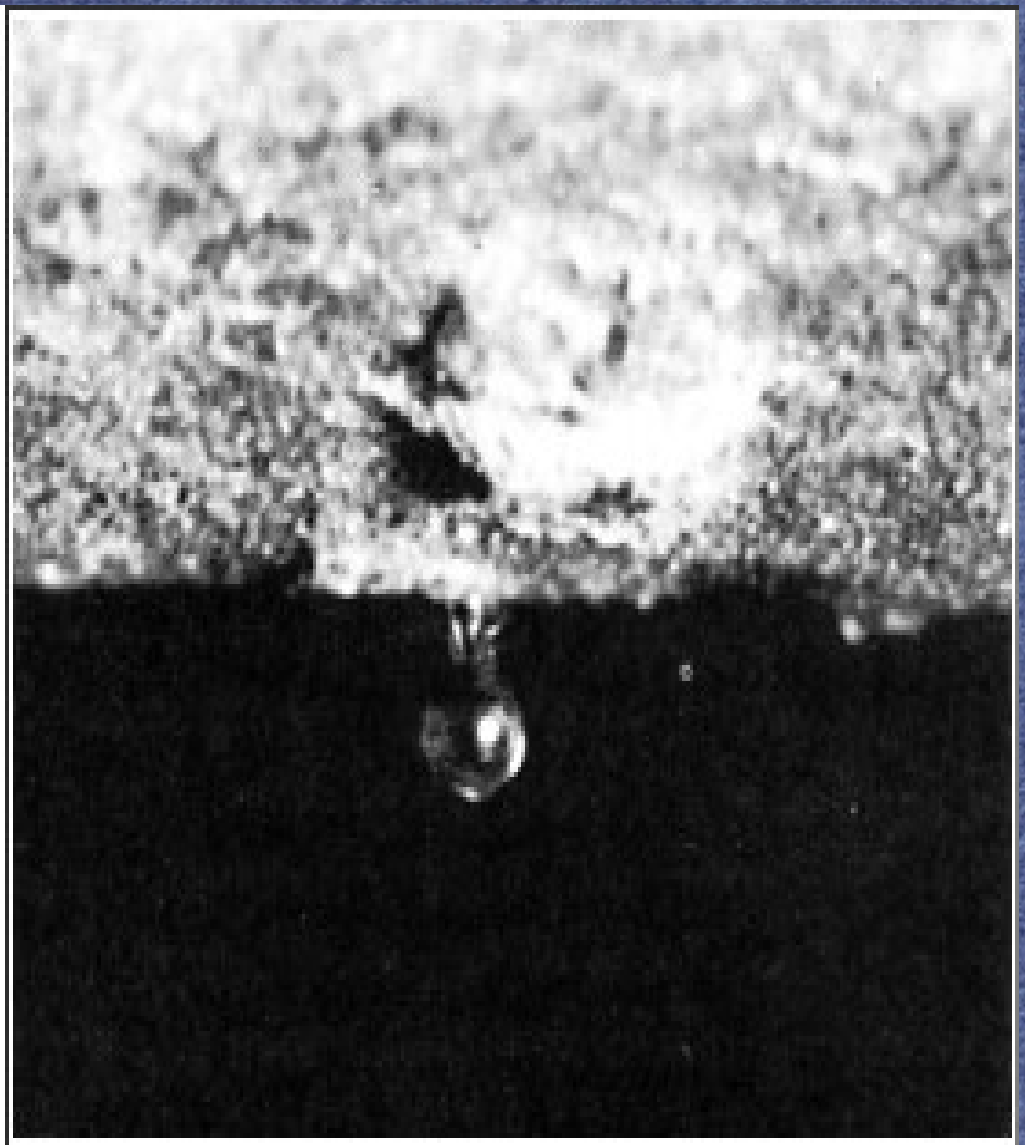


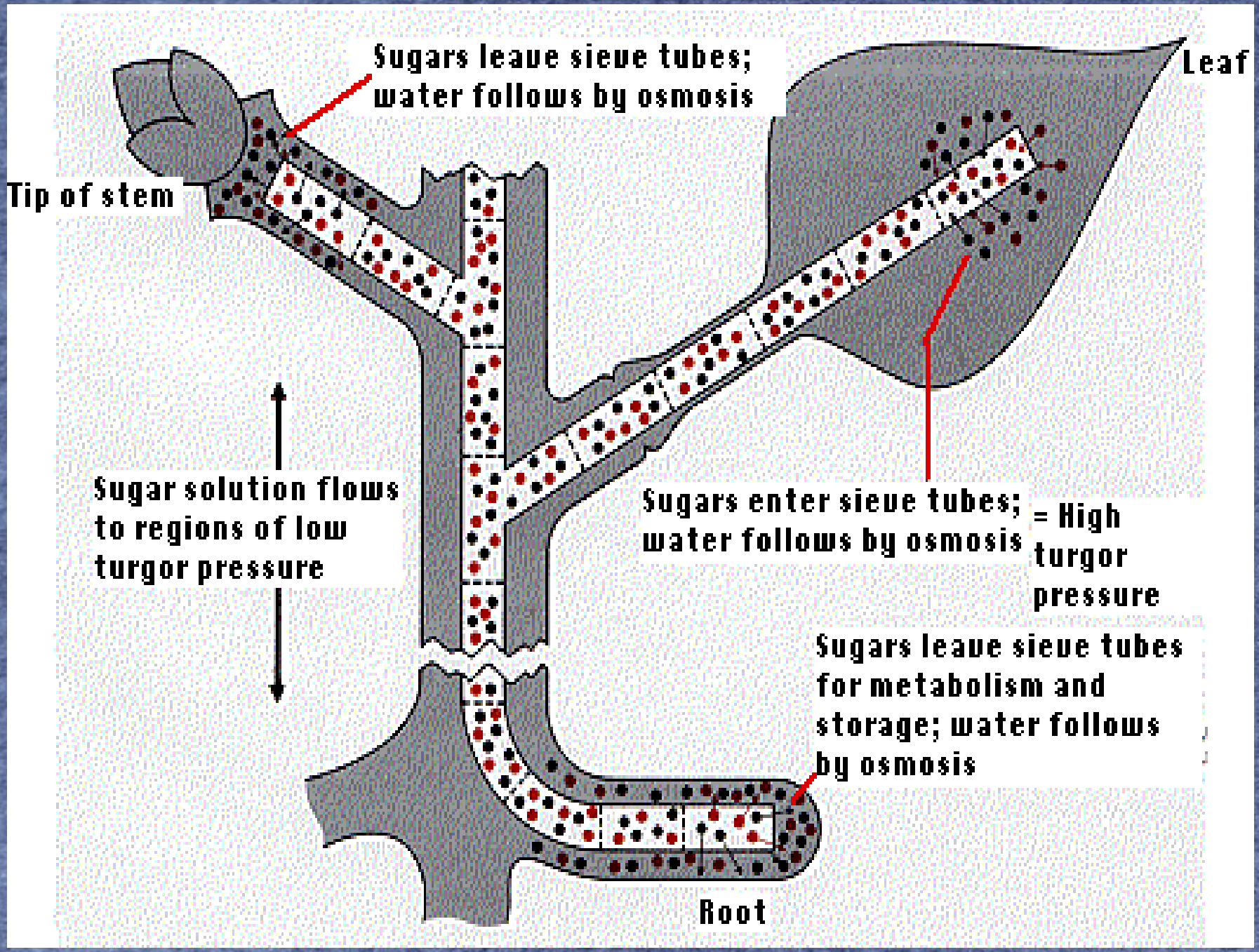
Fig. 4.1. (*a*) Xylem ((*i*) Tracheid and (*ii*) Vessel) (*b*) Phloem.

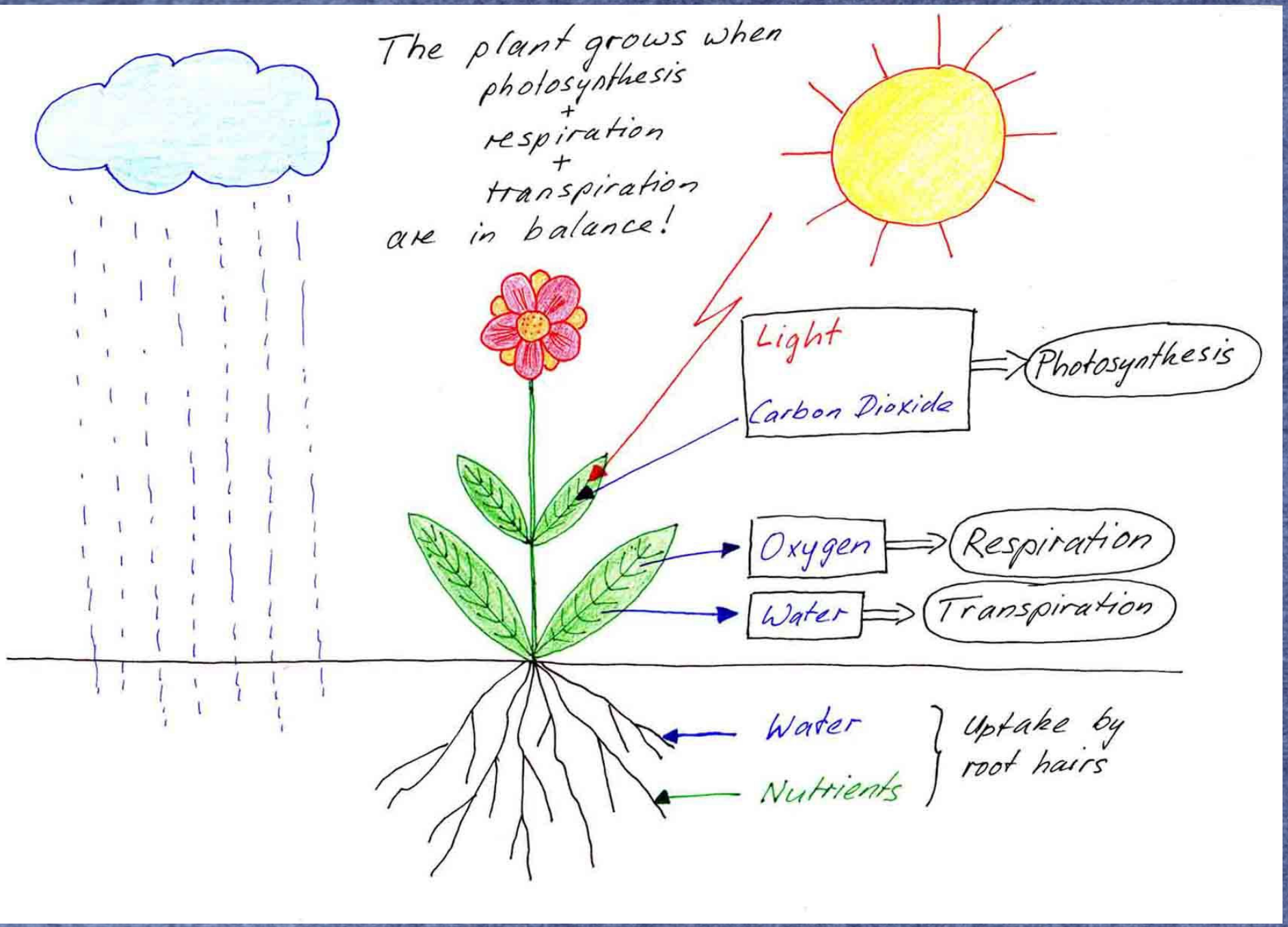
Phloem and translocation

- Living tissue that transports organic nutrients, mainly sucrose from photosynthesis, plus mRNAs
- Formed from sieve tubes with enlarged pores and specialized anatomy (no nucleus) in close arrangement with companion cells
- Innermost layer of bark, vulnerable to ring barking / girdling
- Bidirectional flow
- Pressure flow Hypothesis – from sources to sinks
- Aphids used as early evidence of pressure in phloem, metabolic activity required (the cooling jacket)

Aphids in the flow




Sugars leave sieve tubes; water follows by osmosis
Leaf
Tip of stem
Sugar solution flows to regions of low turgor pressure
Sugars enter sieve tubes; water follows by osmosis
= High turgor pressure
Sugars leave sieve tubes for metabolism and storage; water follows by osmosis
Root


The plant grows when
photosynthesis
+
respiration
+
transpiration
are in balance!
Light
Carbon Dioxide
Photosynthesis
Oxygen
Respiration
Water
Transpiration
Water
Nutrients
Uptake by
root hairs