Basic Plant Biology:

Plant Diversity

Modular plant structure

Plant Growth

Asexual and Sexual Reproduction

Plant responses

Bryophytes:

~ 16,000 species of liverworts, hornworts, and mosses

Reproduce by spores

Non-vascular

(no xylem or phloem)

Pteridophytes:

Ferns and ‘allies’ ~ 11,000 species
Reproduce by spores
Vascular tissue
(xylem and phloem)

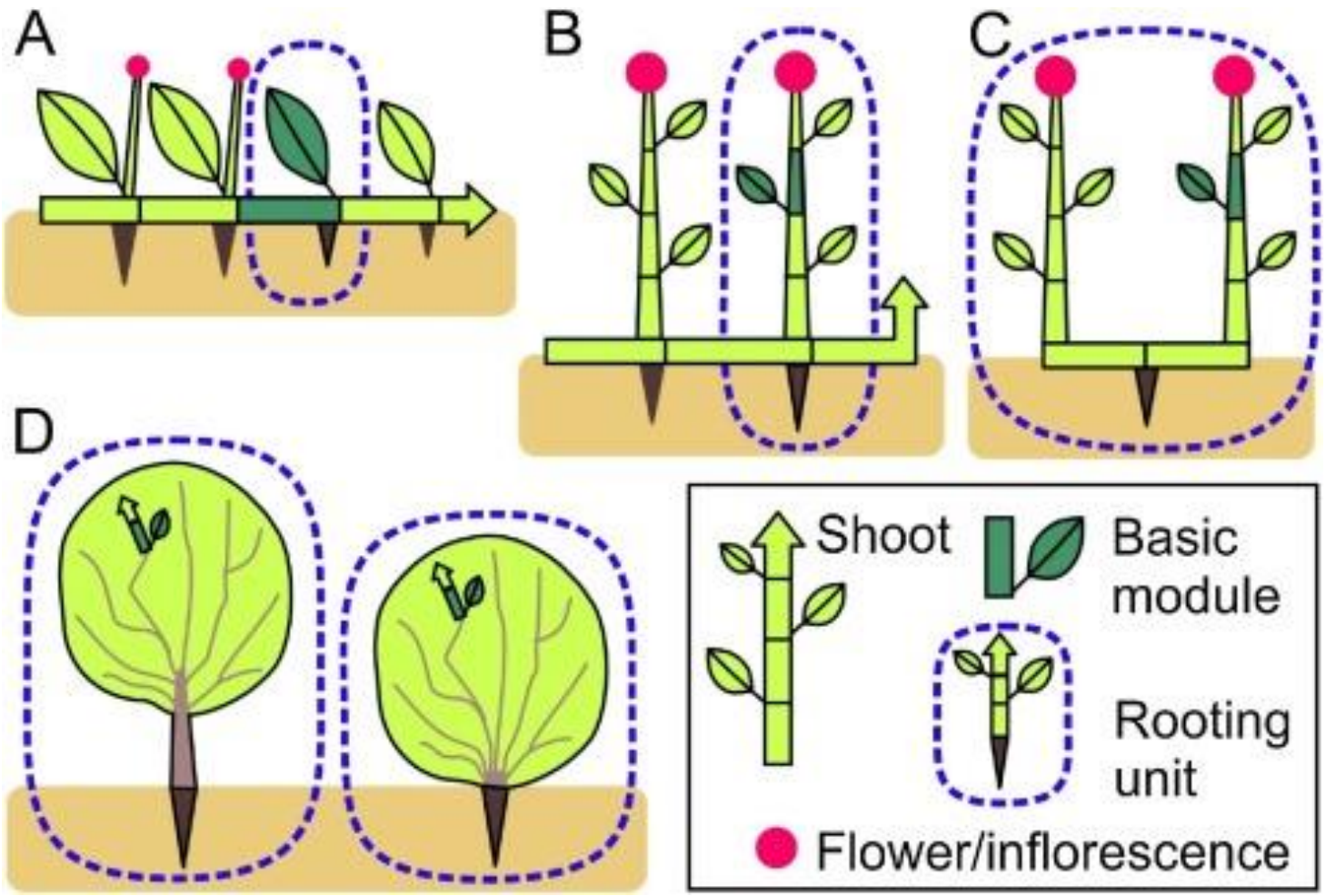
Gymnosperms: ~ 1,000 species, produce seeds, (but not flowers or fruit), wind pollinated

Angiosperms: flowering plants
~300,000 species
Produce seeds within fruit
Animal, wind, and water pollination

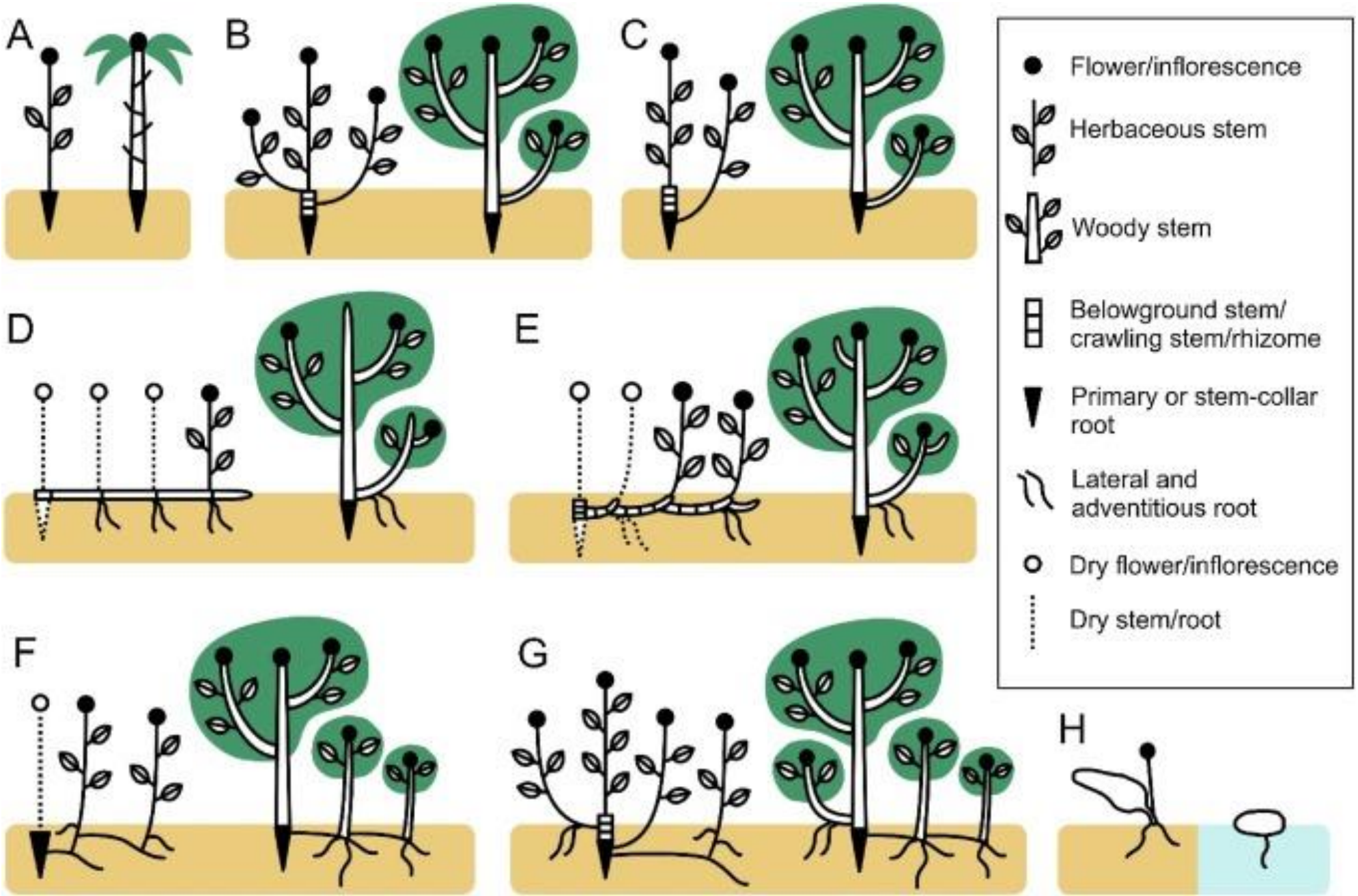
Monocots (one seed leaf)
Eudicots (two seed leaves)

There are no ‘typical’ plants, but there are some important patterns:

Plants are <u>modular</u> in both sexual and asexual growth:



From Klimesova et al. 2019. *Perspectives in Plant Ecology, Evolution, & Systematics*



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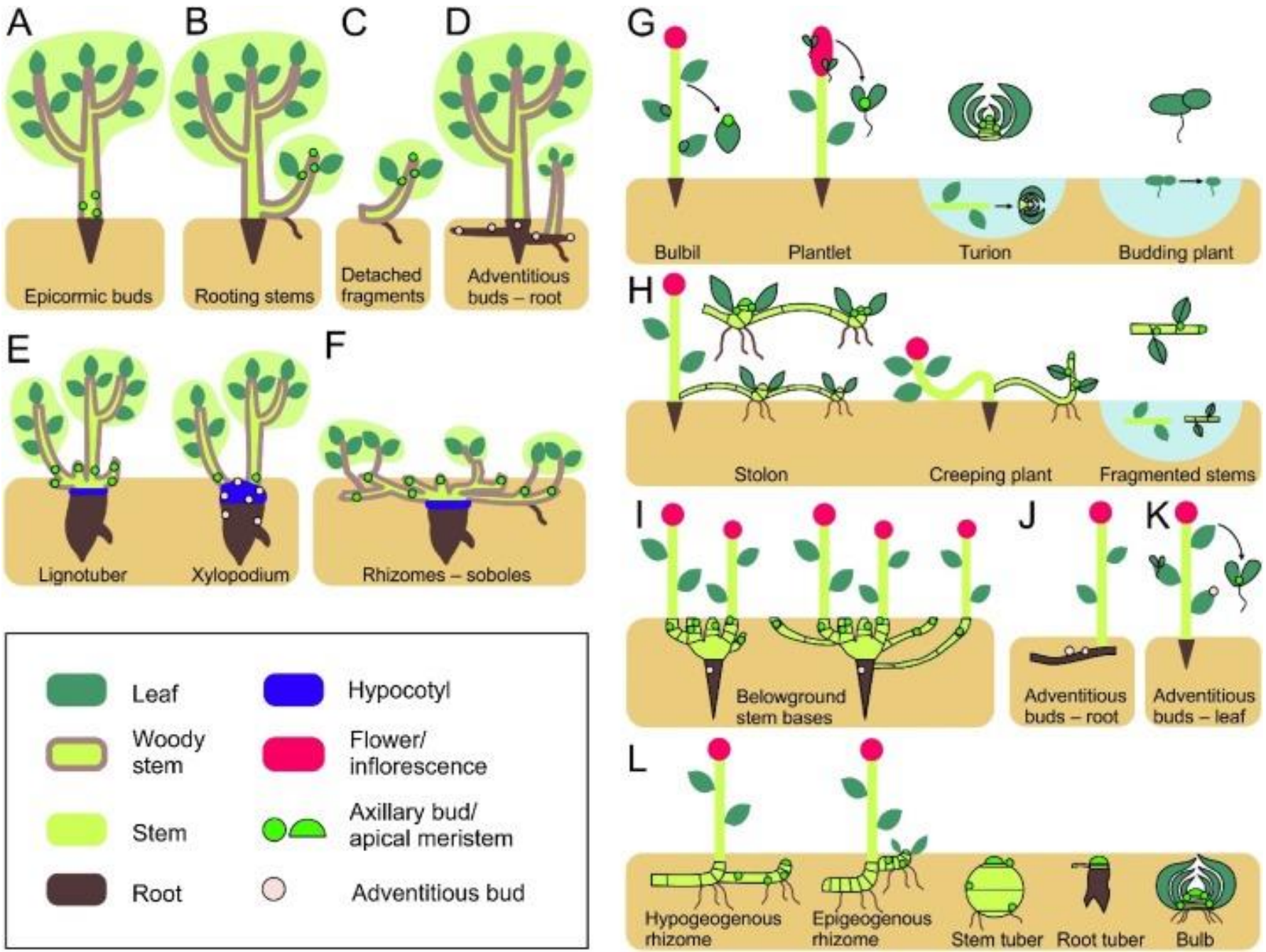
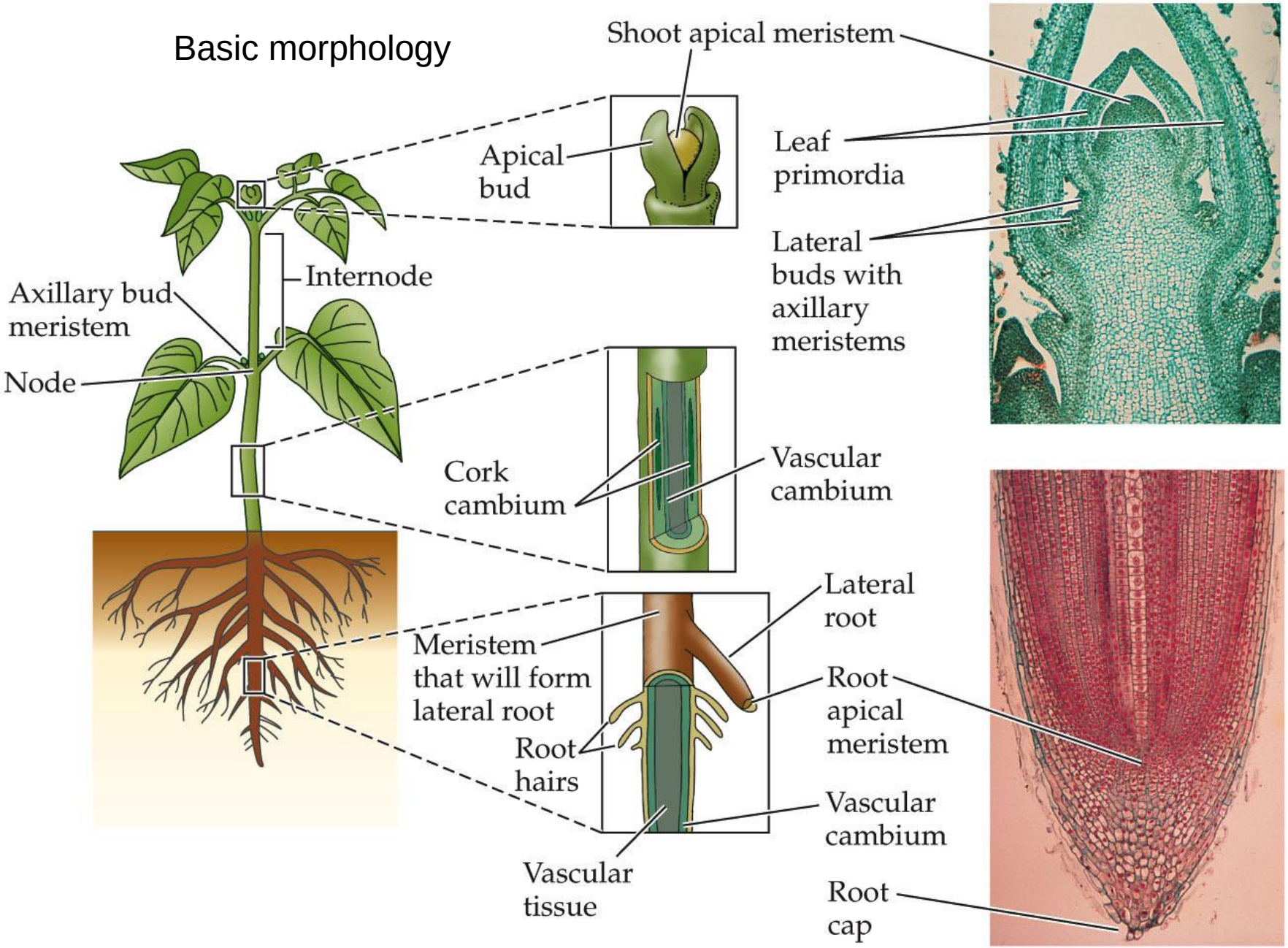


From Klimesova et al. 2019. *Perspectives in Plant Ecology, Evolution, & Systematics*

Plant growth occurs by both cell *division* and by cell *expansion*, in response to different cues, and varies among growth forms.

Plants can direct resources to different functions or storage depending on the stimulus.

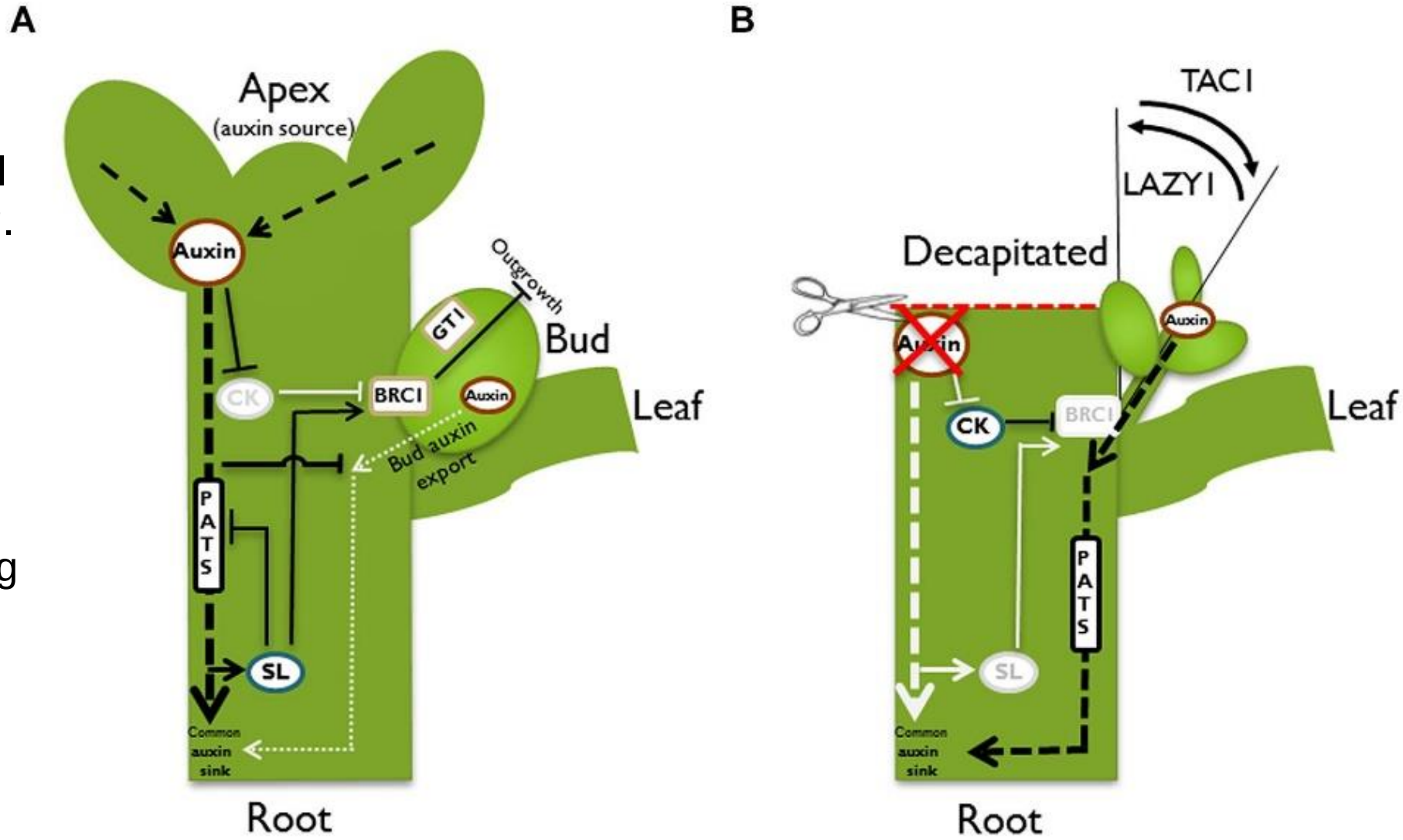
Basic morphology



Hormonal control of apical dominance and branching.

Branching patterns vary among species producing distinctive architecture.

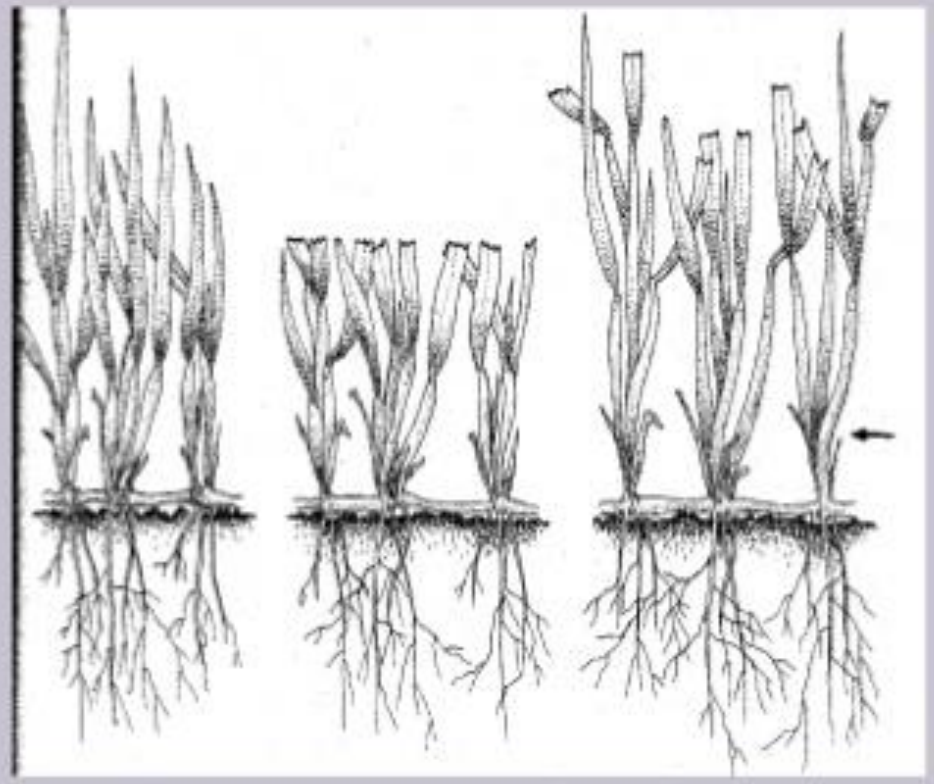
We use this response in pruning trees and trimming hedges.

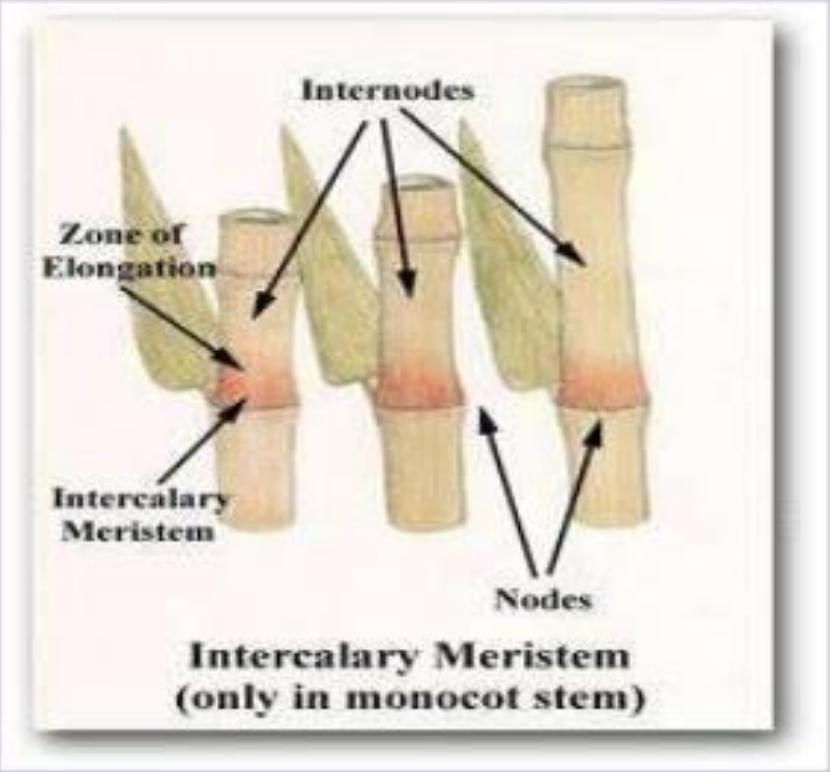


dormant axillary bud

outgrowing axillary bud

INTERCALARY MERISTEMS

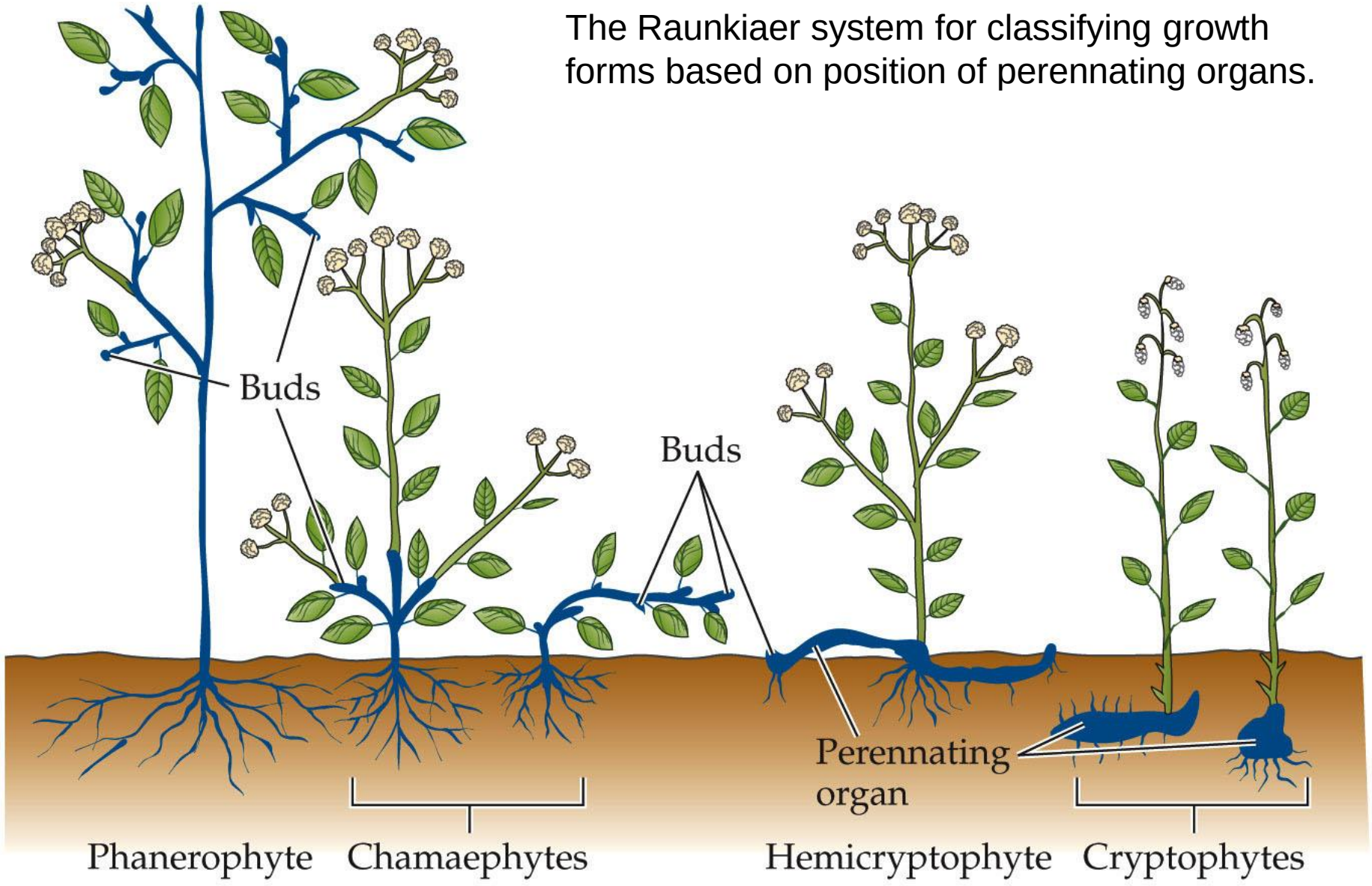




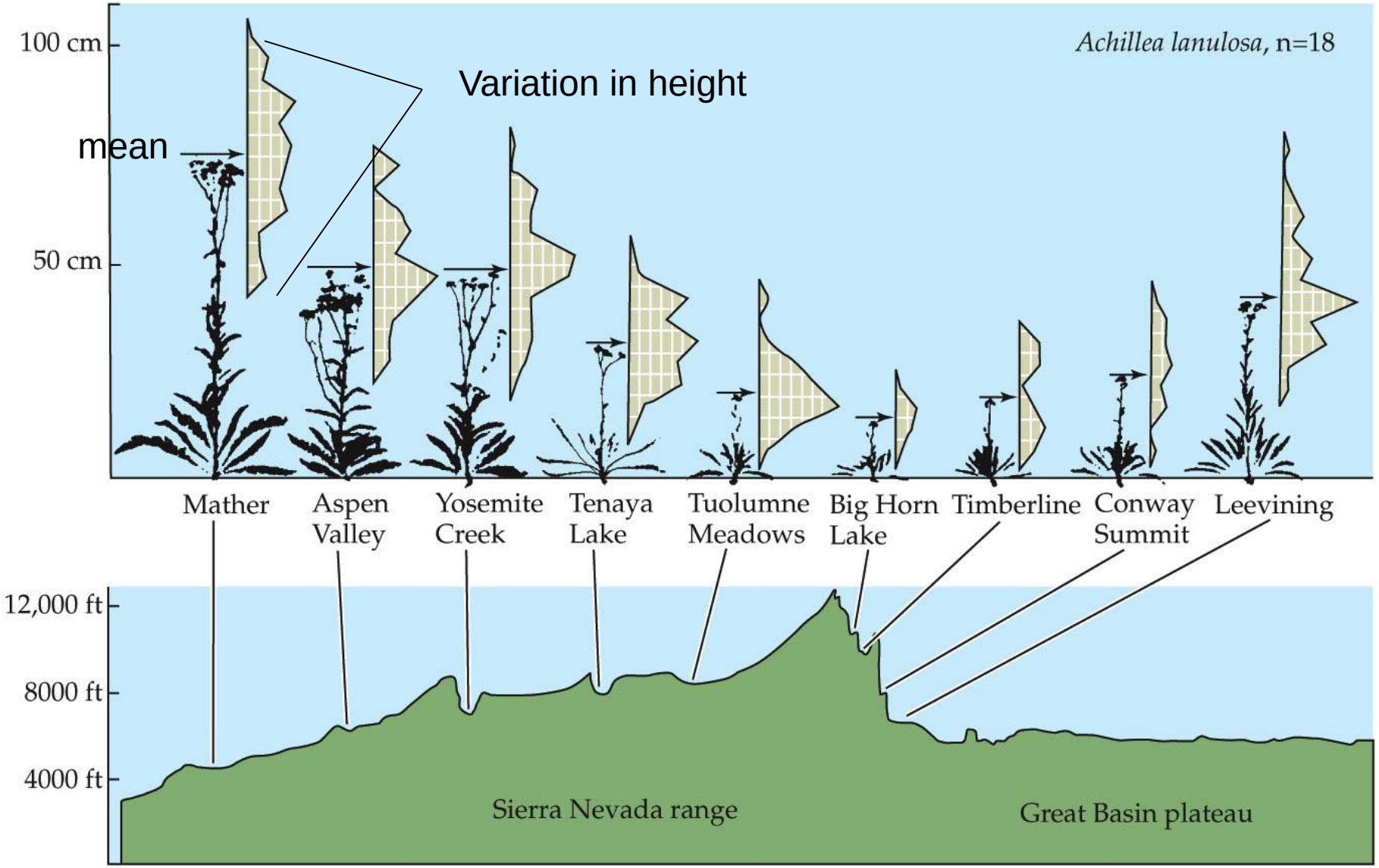
Monocots, like grasses, have intercalary meristems which allow the leaves to grow back after mowing.

Plants have adaptations for responding to stress (temperature, water, herbivory) through avoidance and tolerance.

The Raunkiaer system for classifying growth forms based on position of perennating organs.



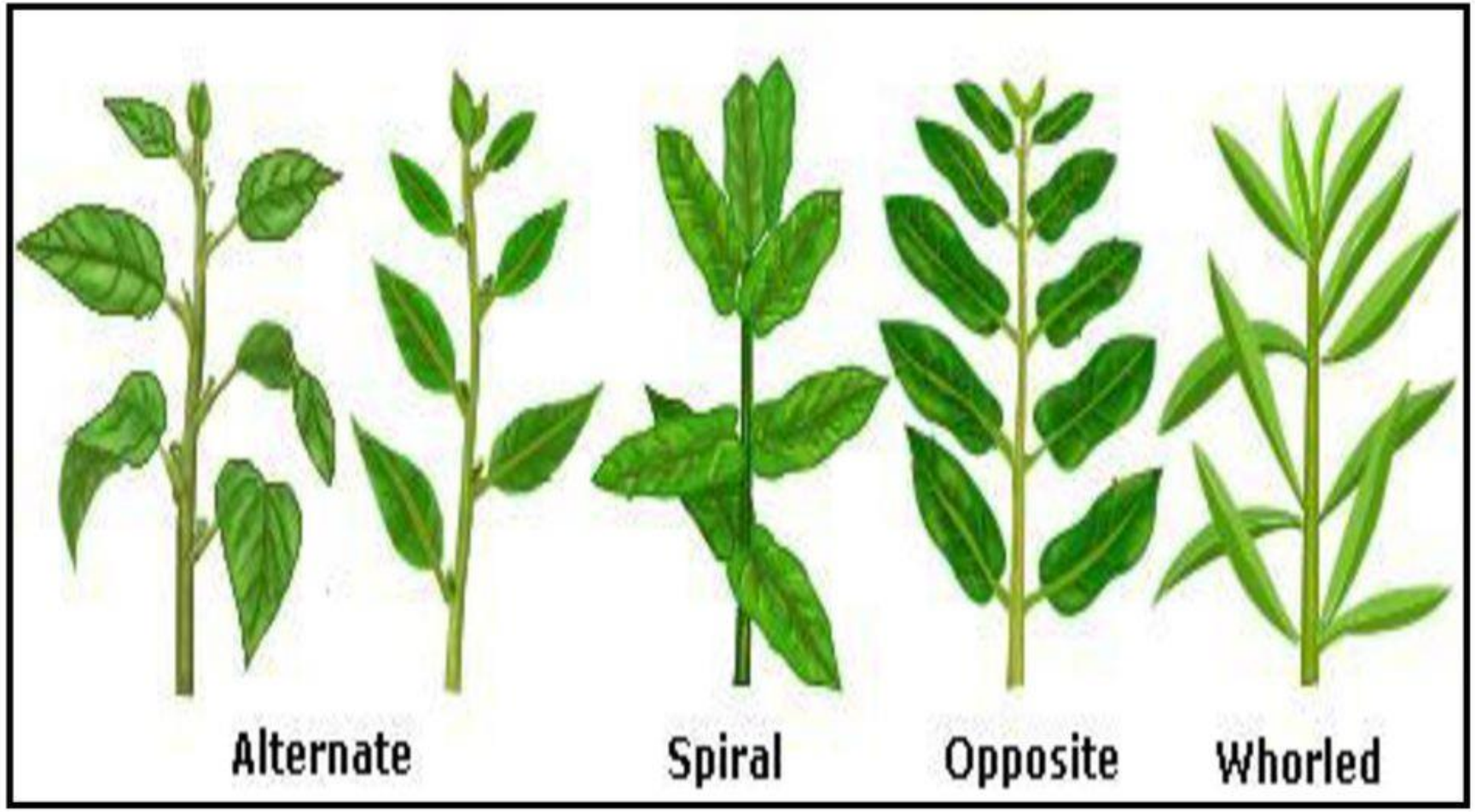
Clinal variation: an elevation cline



Other clines: pH, salinity, latitude, moisture

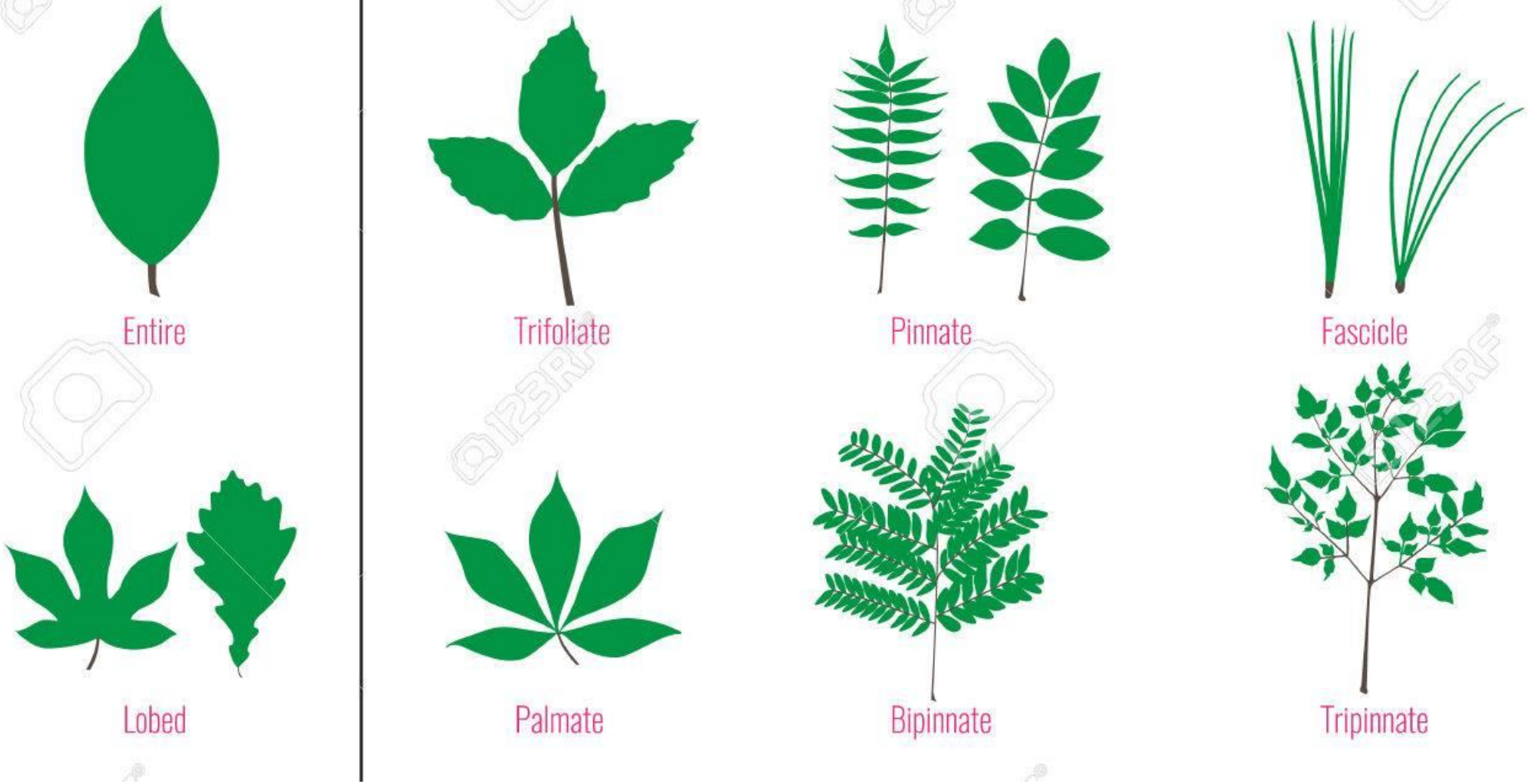
Growth forms

Phyllotaxy – arrangement of the leaves



TYPES OF LEAF

SIMPLE | COMPOUND




LEAF MARGINS
www.infovisual.info
undulate
sinuate
serrate
dentale
lobate
scalloped
palmate
digitate
bipinnatisect
tripinnatisect
pinnatisect
palmatisect
pedate
palmatilobate
bipartite
tripartite
palmatipartite
pinnatipartite
pinnatifid

Herman Boerhaave – founder of scientific medicine – made clear that, like animals, plants have sexual reproduction (in the first half of the 18th century)

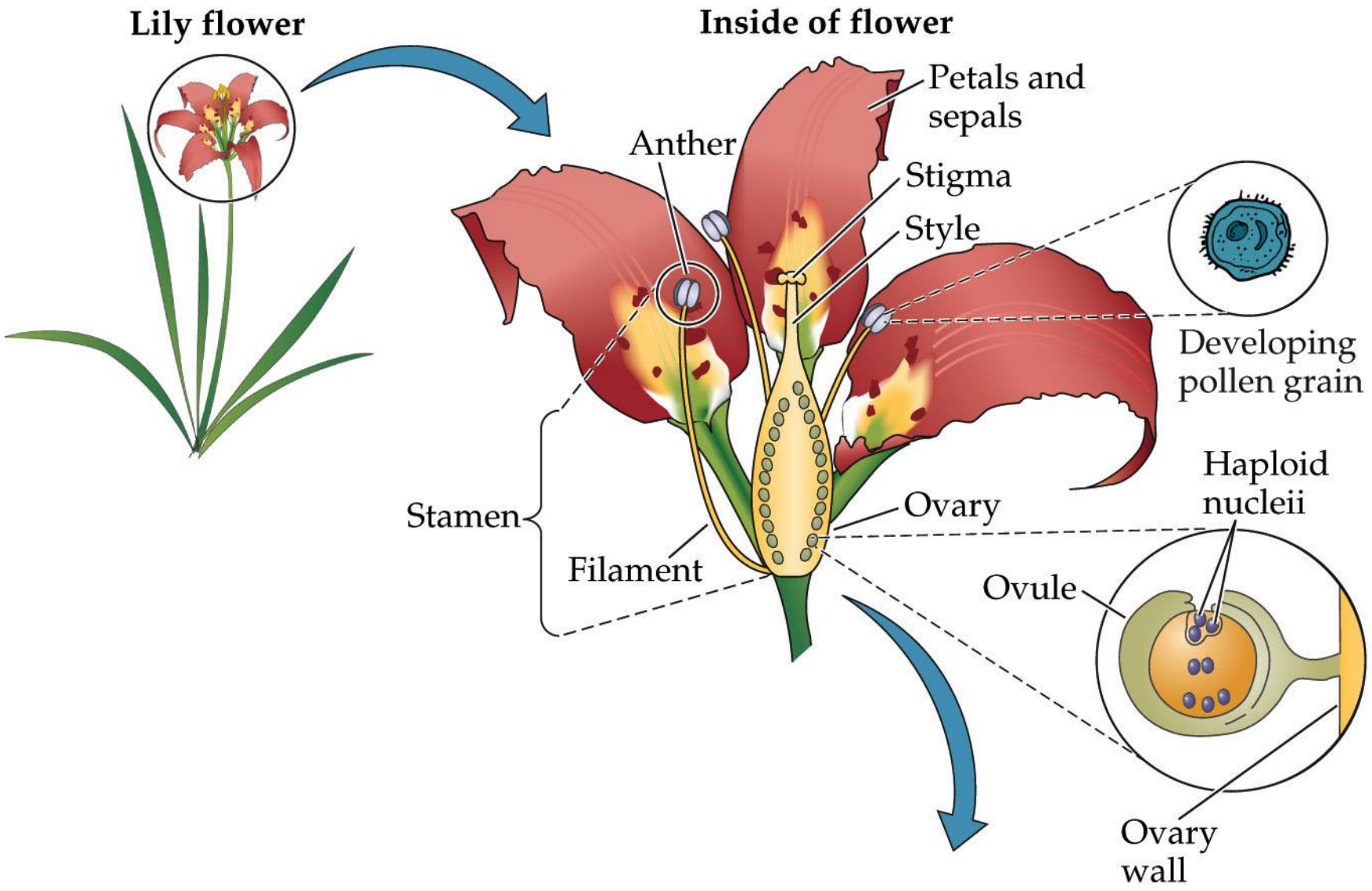
Linnaeus used sexual organs as the basis for organizing plants and animals: his motto: *“God created, Linnaeus organizes.”*

If Linnaeus's critics chafed at his naming system, they were truly disgusted by something else he publicized: *Plants reproduce sexually*. Up to that time, the gentle study of botany had been sufficiently delicate to serve as a pastime for well-bred ladies. Then Linnaeus ruined everything. The Reverend Richard Polwhele observed *"boys and girls botanizing together*" with horror; the Bishop of Carlisle doubted that *"virtuous students"* would be able to follow the indecent analogies; English naturalist William Goodenough scowled at Linnaeus's *"disgusting names, his nomenclatural wantonness, vulgar lasciviousness, and the gross prurience of his mind."*

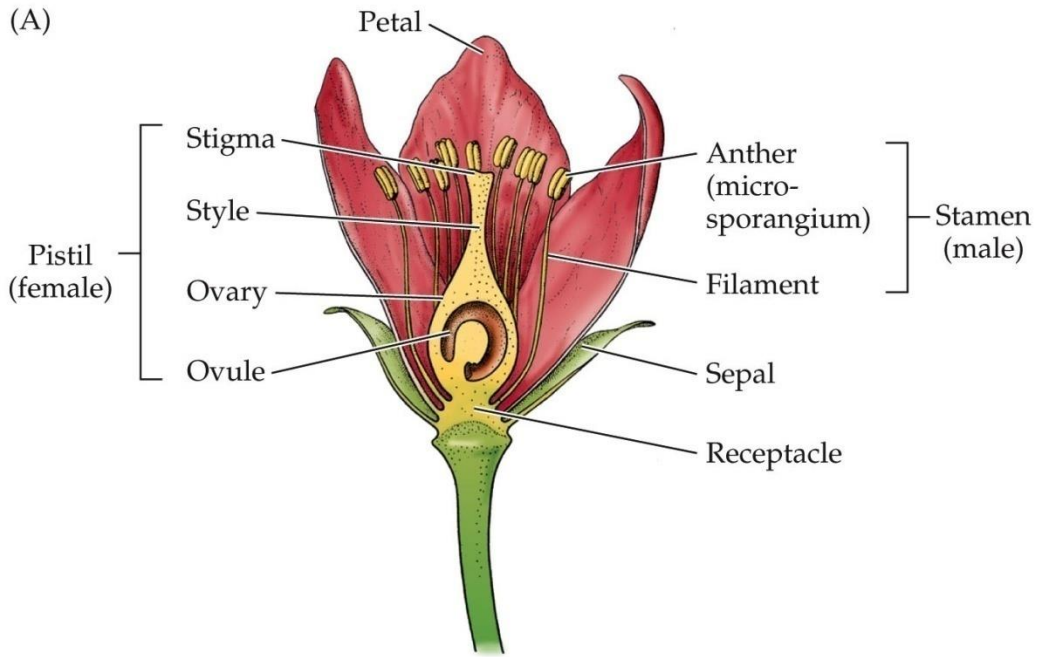
"Who would have thought that bluebells, lilies, and onions could be up to such immorality?" "What man will ever believe that God Almighty should have introduced such confusion, or rather such shameful whoredom, for the propagation of the reign of plants? Who will instruct the young students in such a voluptuous system without scandal?"

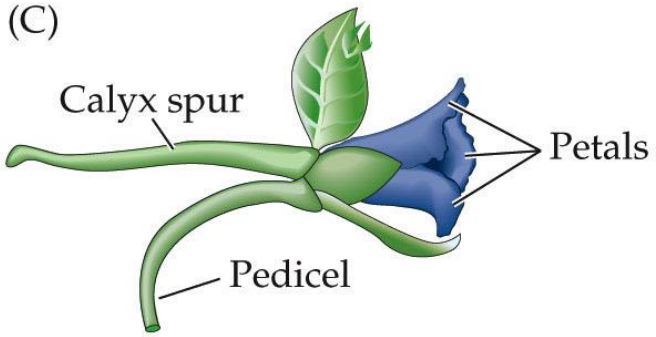
- Johann Georg Siegesbeck, in his criticism of Linnaeus for using sexual organs in plant classification, and of the very notion that plants have sex organs.

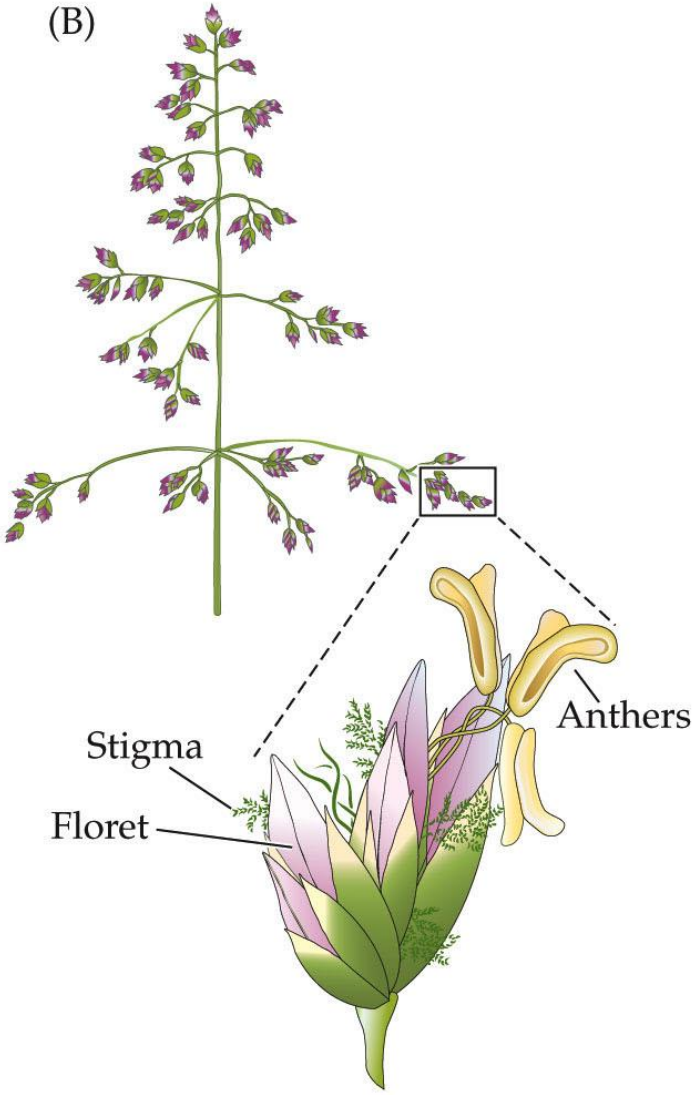
Linnaeus named a genus of foul-smelling plants *Siegesbeckia*

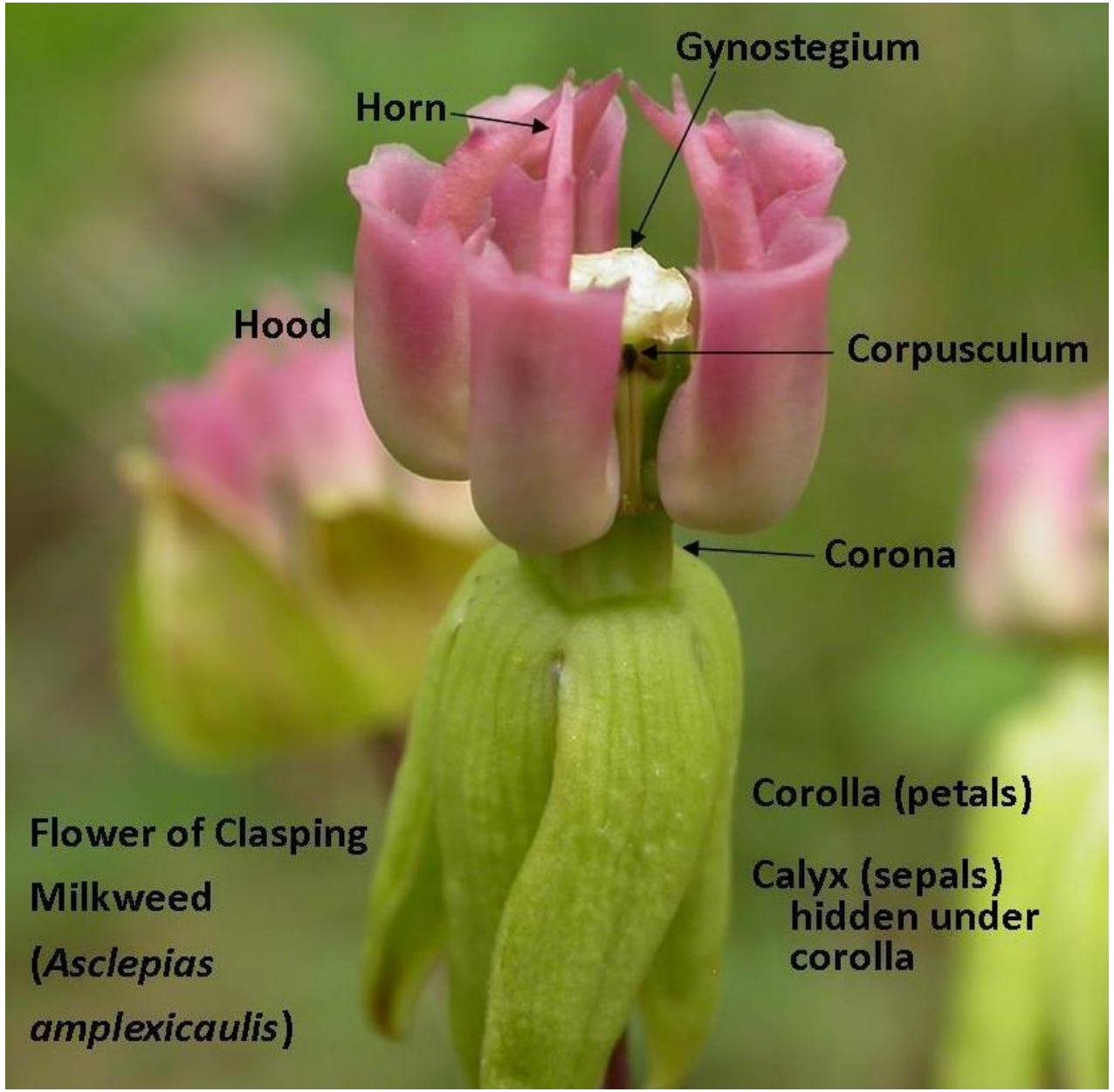


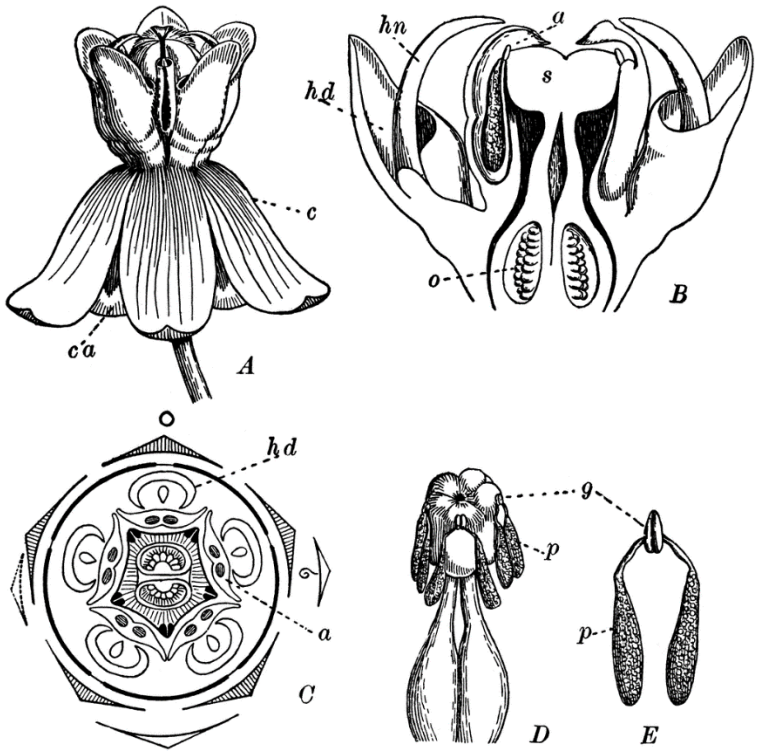
ECOLOGY OF PLANTS, Second Edition, Figure 7.5 (Part 1)








Gynostegium
Horn
Hood
Corpusculum
Corona
Corolla (petals)
Calyx (sepals) hidden under corolla
Flower of Clasping Milkweed (*Asclepias amplexicaulis*)


hn
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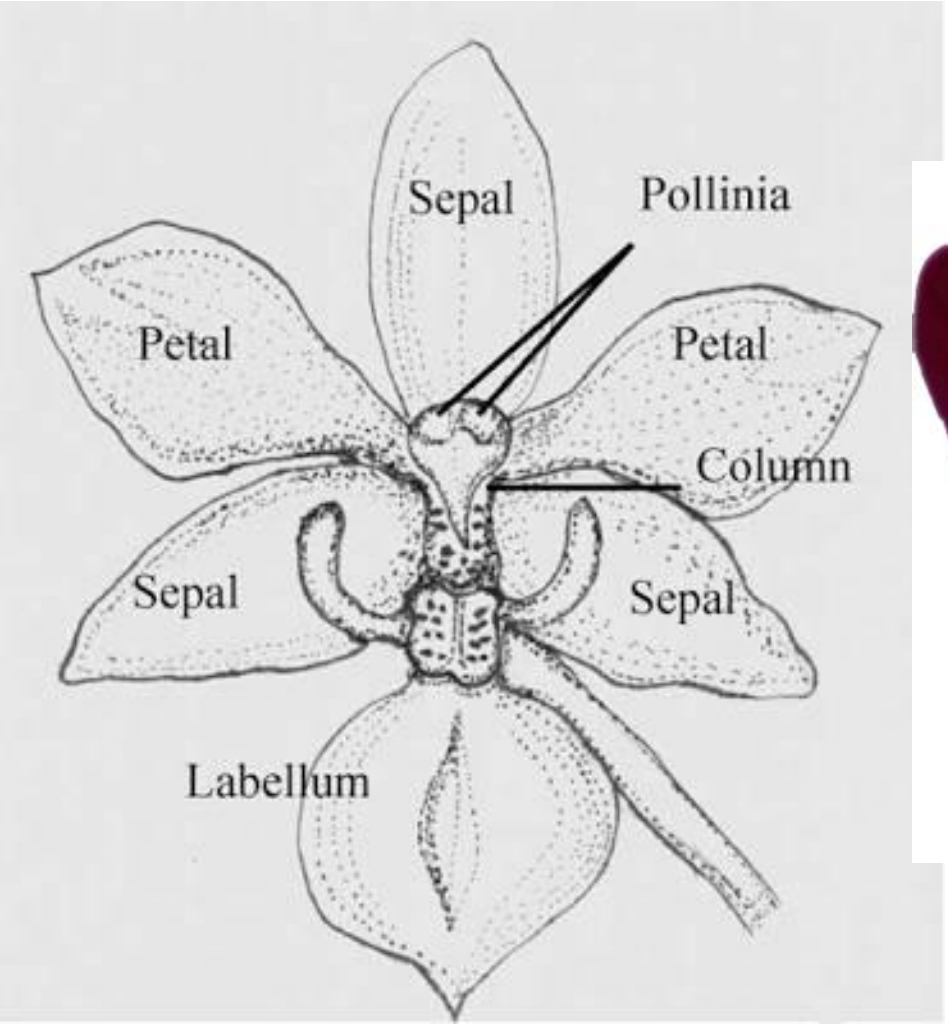
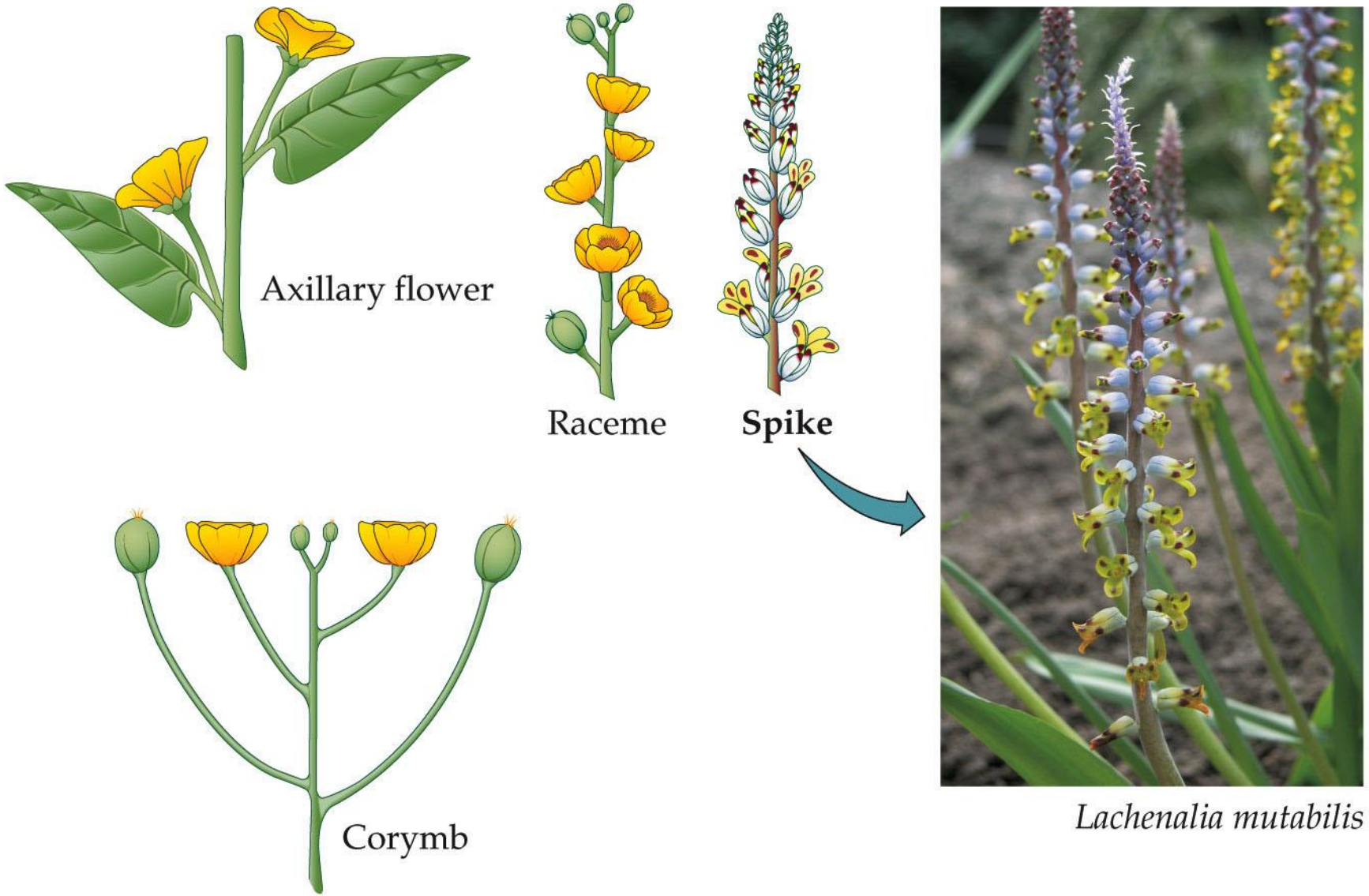
Tom Potterfield / Flickr

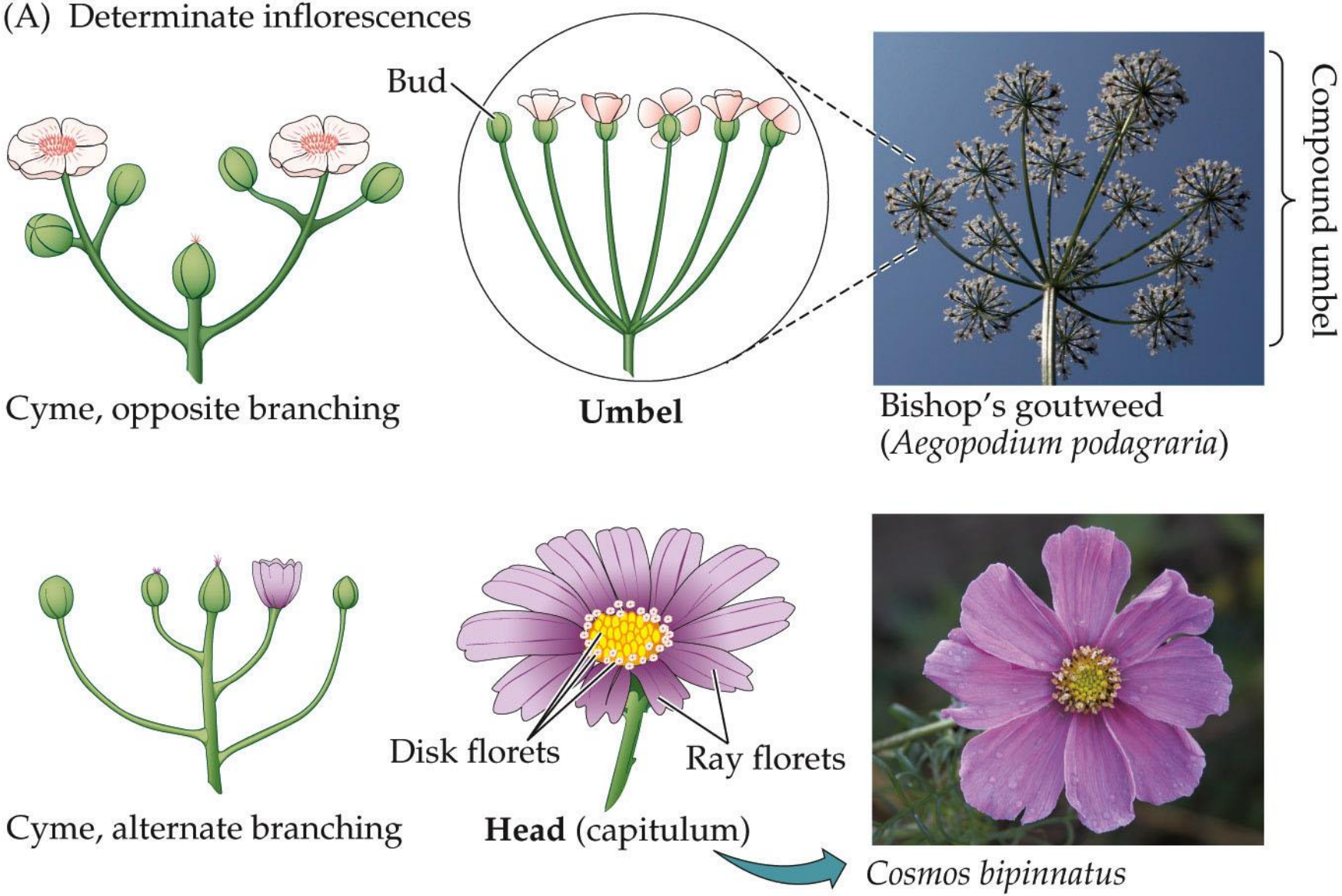

CARNIVOROUS
PLANT NURSERY

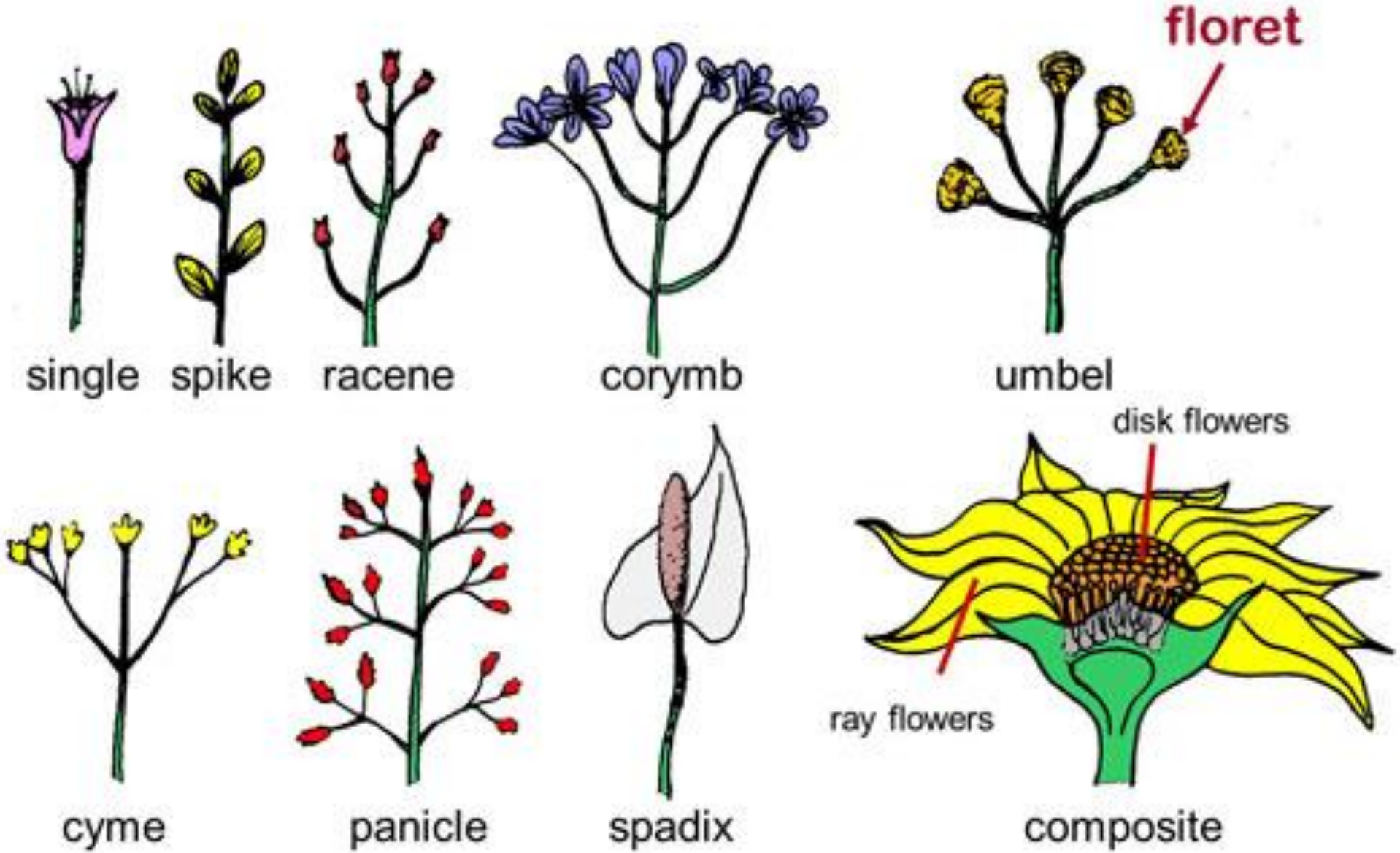

Sepal
Pollinia
Petal
Petal
Column
Sepal
Sepal
Labellum

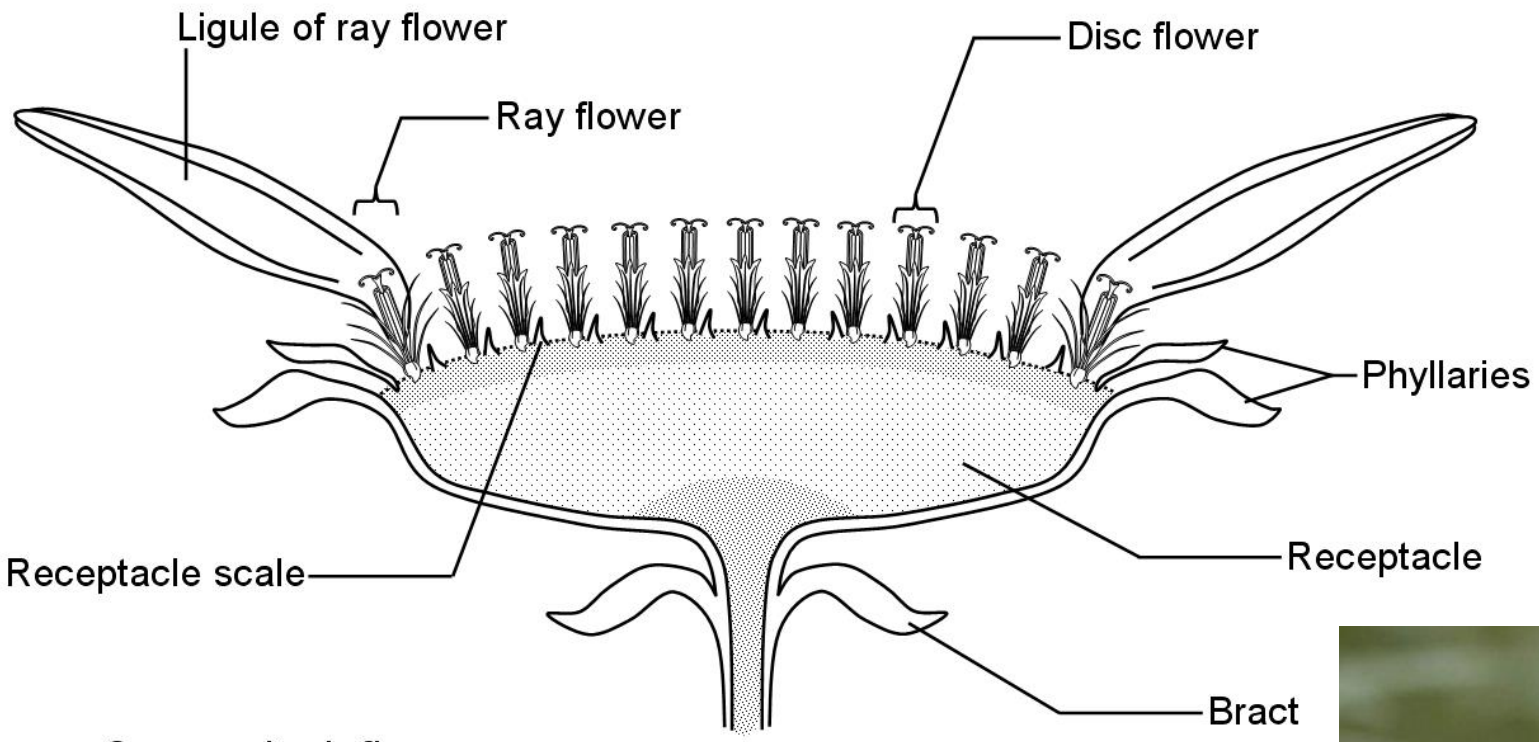
(B) Indeterminate inflorescences



(A) Determinate inflorescences

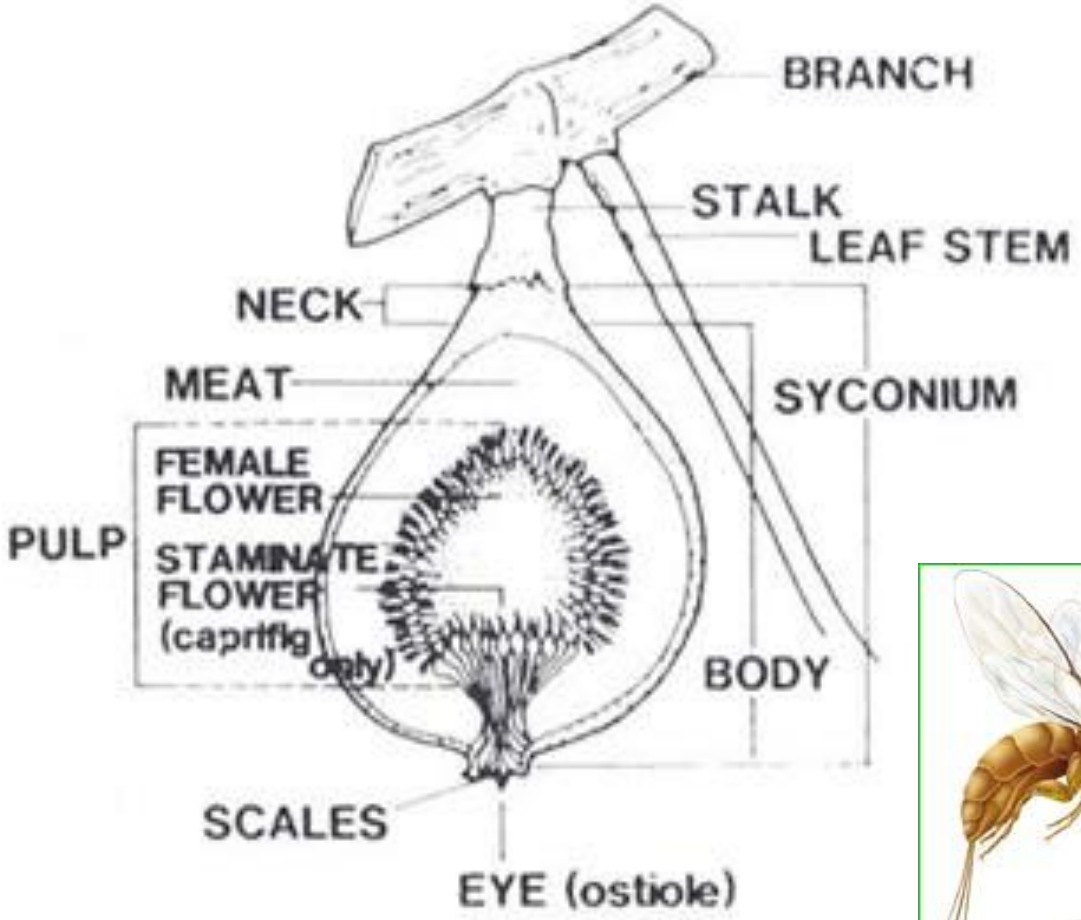


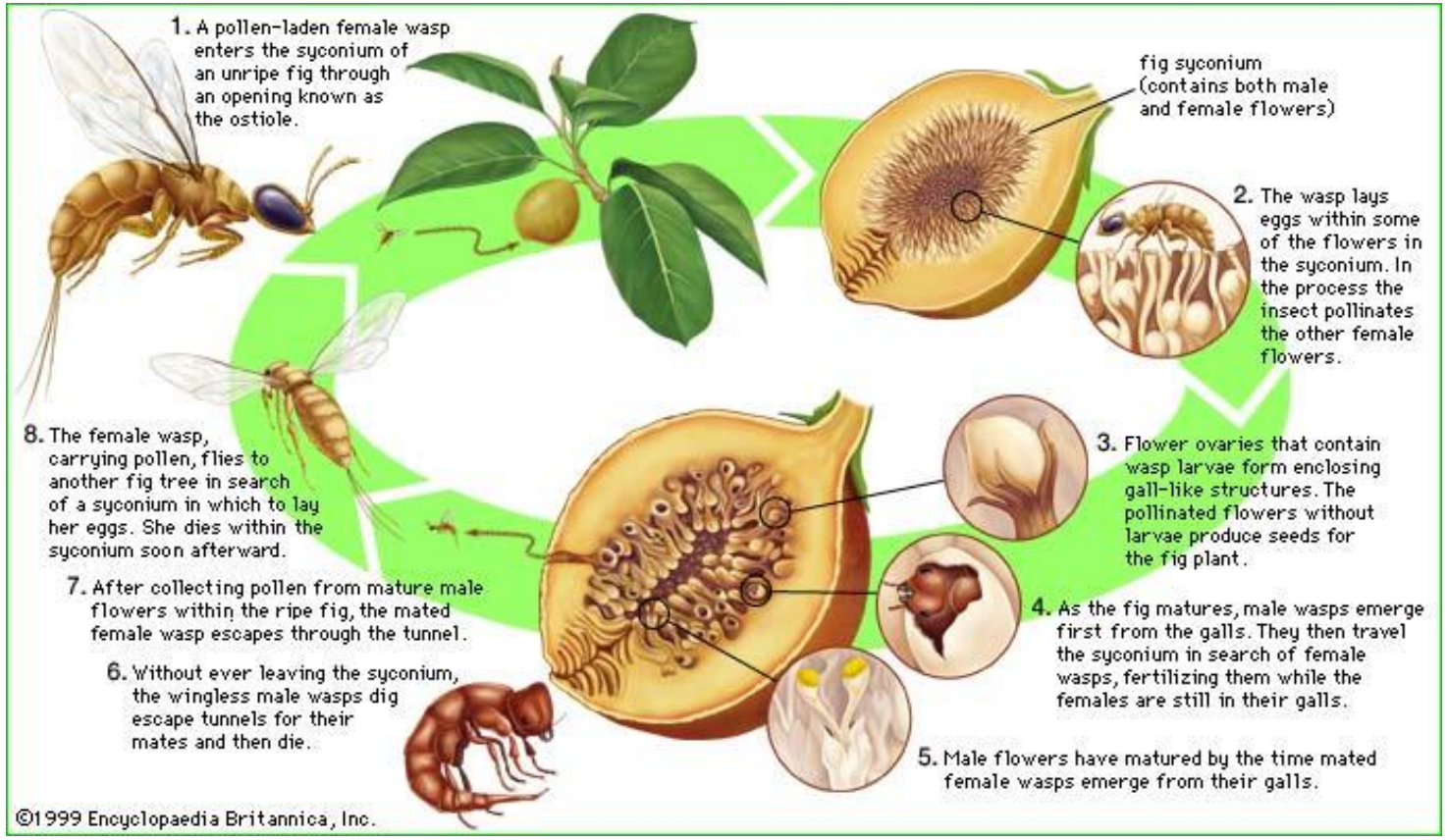

floret
single
spike
racene
corymb
umbel
disk flowers
ray flowers
cyme
panicle
spadix
composite



Composite Inflorescence

e.g. *Chrysanthemum*


BRANCH
STALK
LEAF STEM
NECK
MEAT
SYCONIUM
PULP
FEMALE FLOWER
STAMINATE FLOWER (caprifig only)
BODY
SCALES
EYE (ostiole)


1. A pollen-laden female wasp enters the syconium of an unripe fig through an opening known as the ostiole.
fig syconium (contains both male and female flowers)
2. The wasp lays eggs within some of the flowers in the syconium. In the process the insect pollinates the other female flowers.
3. Flower ovaries that contain wasp larvae form enclosing gall-like structures. The pollinated flowers without larvae produce seeds for the fig plant.
4. As the fig matures, male wasps emerge first from the galls. They then travel the syconium in search of female wasps, fertilizing them while the females are still in their galls.
5. Male flowers have matured by the time mated female wasps emerge from their galls.
6. Without ever leaving the syconium, the wingless male wasps dig escape tunnels for their mates and then die.
7. After collecting pollen from mature male flowers within the ripe fig, the mated female wasp escapes through the tunnel.
8. The female wasp, carrying pollen, flies to another fig tree in search of a syconium in which to lay her eggs. She dies within the syconium soon afterward.
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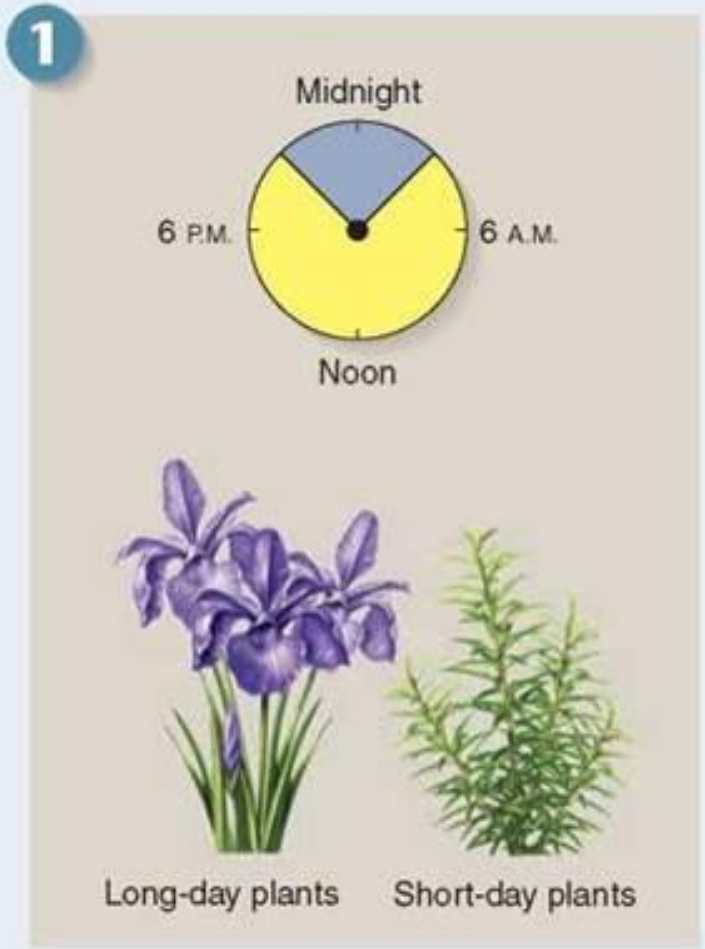
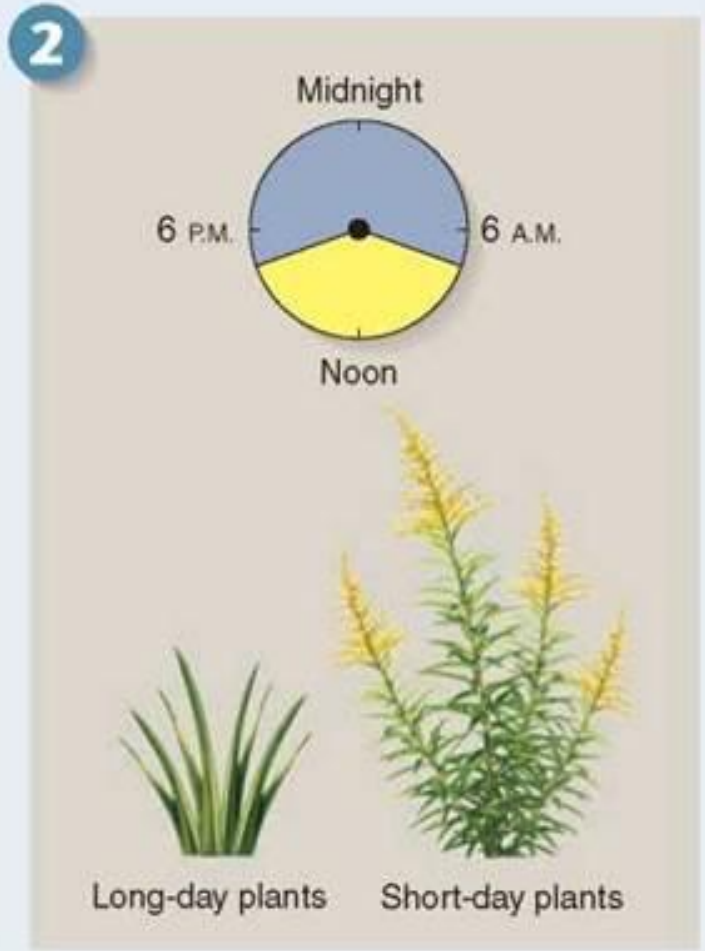
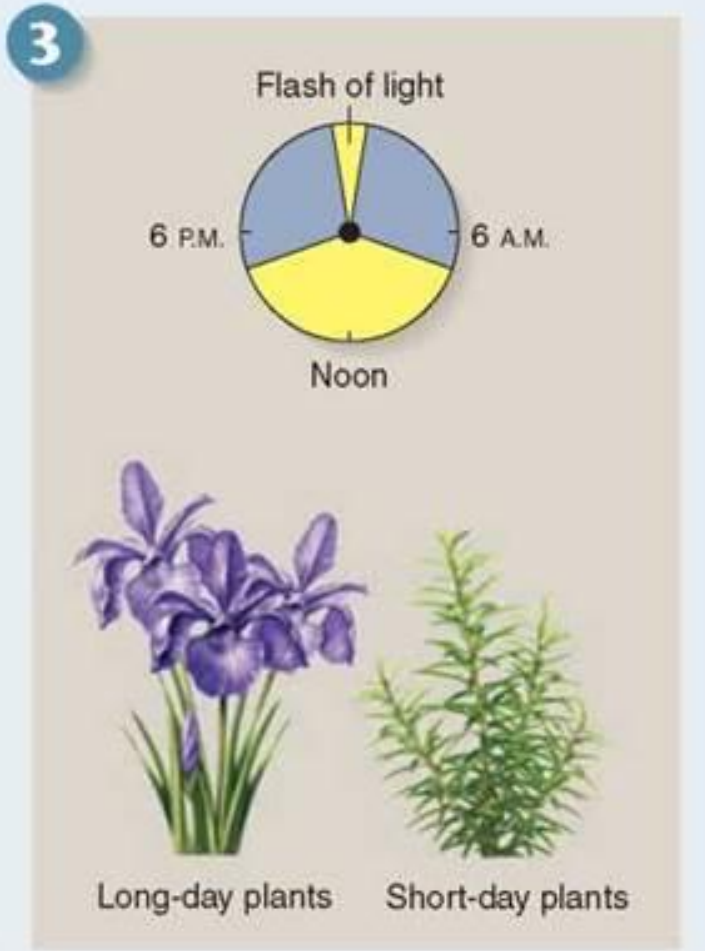
KEY BIOLOGICAL PROCESS: Photoperiodism



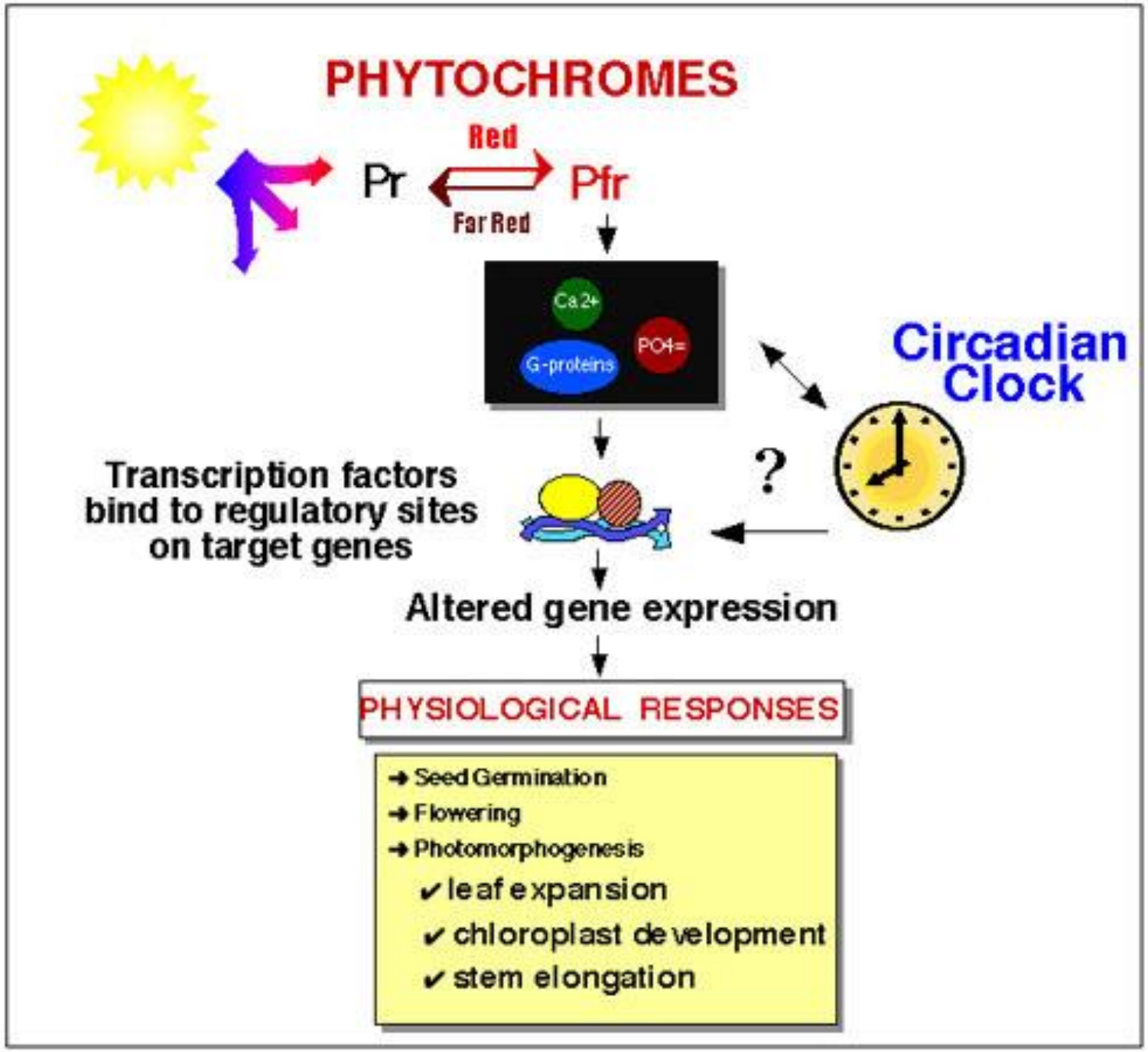
Early summer. Short periods of darkness induce flowering in long-day plants, such as iris, but not in short-day plants, such as goldenrod.

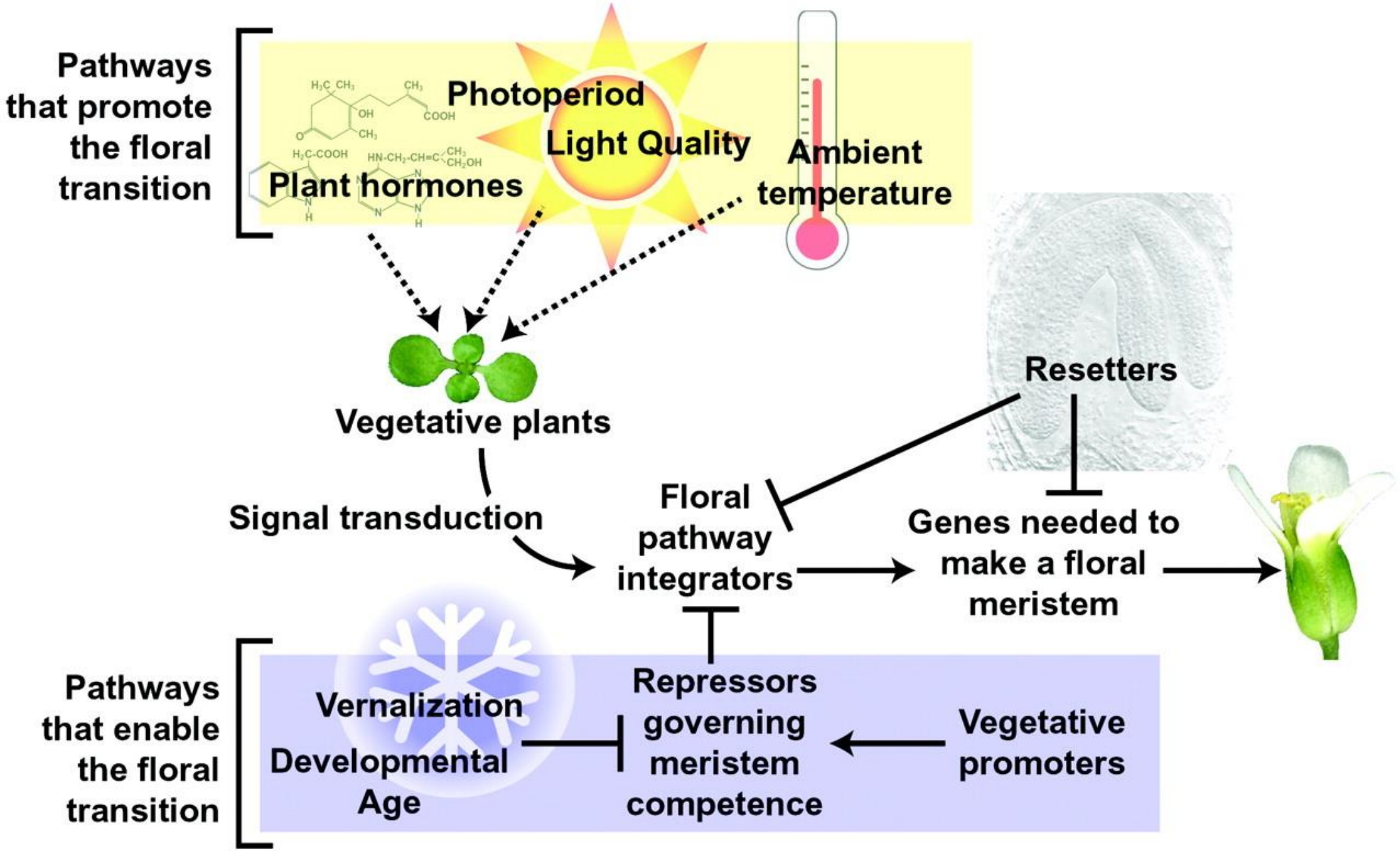


Late fall. Long periods of darkness induce flowering in short-day plants, such as goldenrod, but not in long-day plants, such as iris.

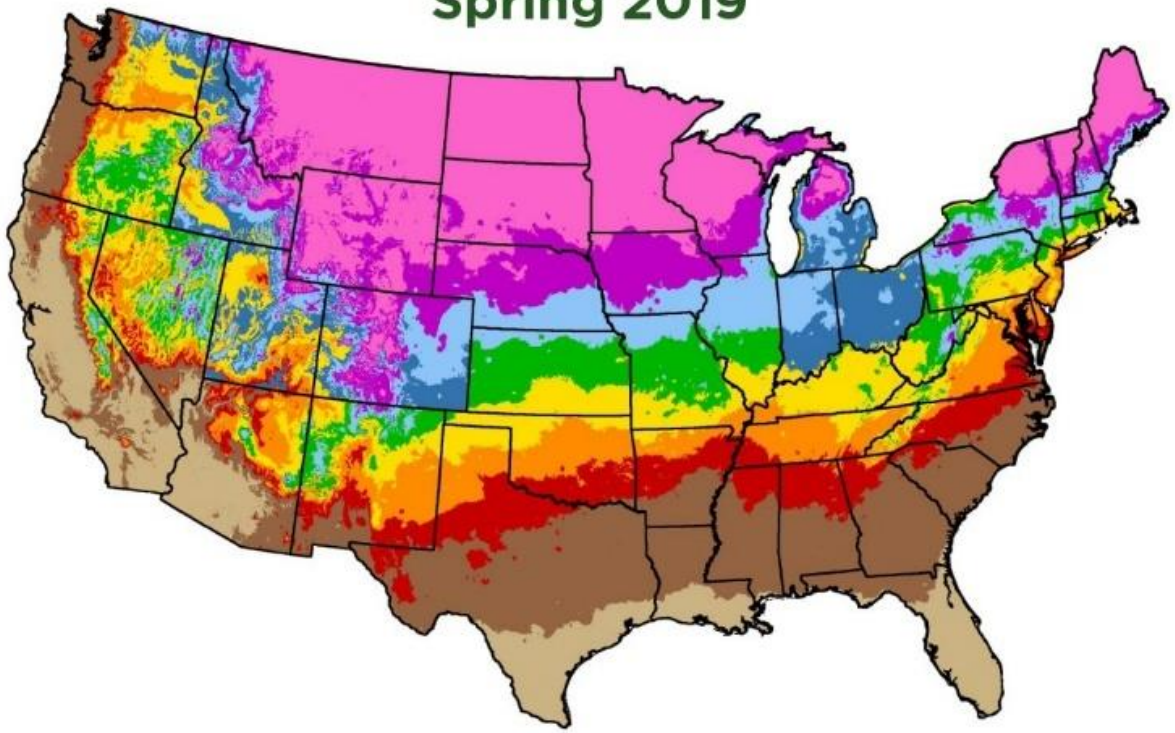


Interrupted night. If the long night of winter is artificially interrupted by a flash of light, the goldenrod will not bloom and the iris will.


PHYTOCHROMES
Red
Pr
Pfr
Far Red
Ca 2+
PO4=
G-proteins
Circadian Clock
?
Transcription factors bind to regulatory sites on target genes
Altered gene expression
PHYSIOLOGICAL RESPONSES
→ Seed Germination
→ Flowering
→ Photomorphogenesis
✔ leaf expansion
✔ chloroplast development
✔ stem elongation


Pathways that promote the floral transition
Photoperiod
Light Quality
Ambient temperature
Plant hormones
Vegetative plants
Resetters
Signal transduction
Floral pathway integrators
Genes needed to make a floral meristem
Pathways that enable the floral transition
Vernalization
Developmental Age
Repressors governing meristem competence
Vegetative promoters

USDA Hardiness Zone Map
Spring 2019

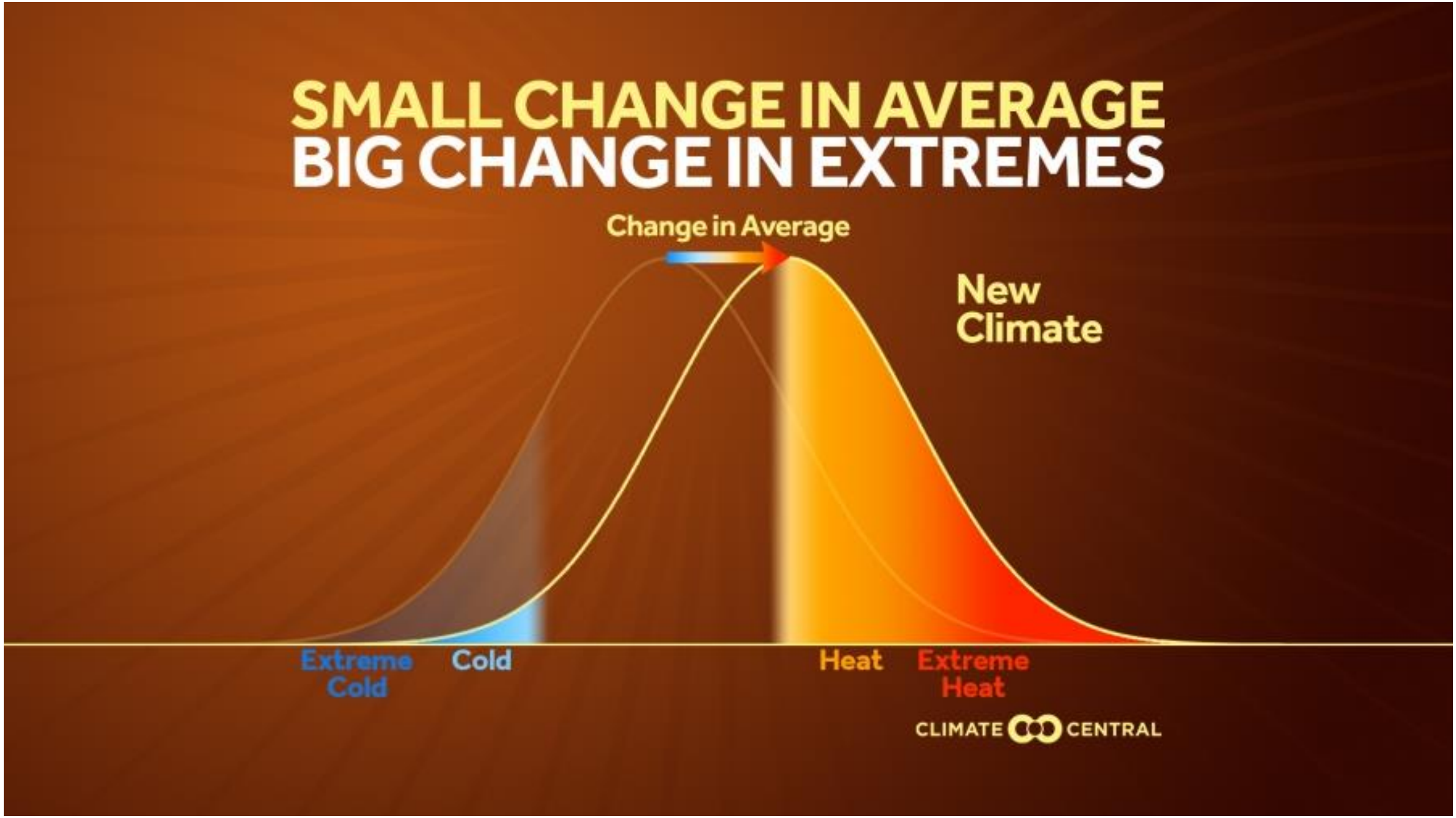


PERENNIALS			
1-4	5/6/2019*	6b	4/1/2019*
5a	4/29/2019*	7a	3/25/2019*
5bn	4/22/2019*	7b	3/18/2019*
5bs	4/15/2019*	8	3/11/2019*
6an	4/15/2019*	9-11	3/4/2019*
6as	4/8/2019*		

*earliest suggested planting date

ANNUALS			
1-4	5/20/2019*	6b	4/15/2019*
5a	5/13/2019*	7a	4/8/2019*
5bn	5/6/2019*	7b	4/1/2019*
5bs	4/29/2019*	8	3/25/2019*
6an	4/29/2019*	9-11	3/18/2019*
6as	4/22/2019*		

*earliest suggested planting date


SMALL CHANGE IN AVERAGE
BIG CHANGE IN EXTREMES
Change in Average
New Climate
Extreme Cold
Cold
Heat
Extreme Heat
CLIMATE CENTRAL

Thank you. Questions?