Plant Microtechnique – BIO 4920

David Bogler and Richard Keating

Missouri Botanical Garden

Introduction to Laboratory
Collecting material, fixation, basic sectioning and staining techniques
Leaf characters – Morphology, anatomy
Stem characters - Tissue embedding and sectioning
Microtome sectioning and staining
Wood characters – Anatomy, properties, evolution, identification
Flower, fruit, and seed characters
Scanning Electron Microscopy – Theory
Scanning Electron Microscopy - Practice
Pollen Analysis – morphology, terminology
Pollen Analysis - Applications
Cytology - Chromosome numbers and taxonomy
Cytology – Karyotypes, polyploidy, meiosis
Preparing posters and presentations
Final Class Presentations

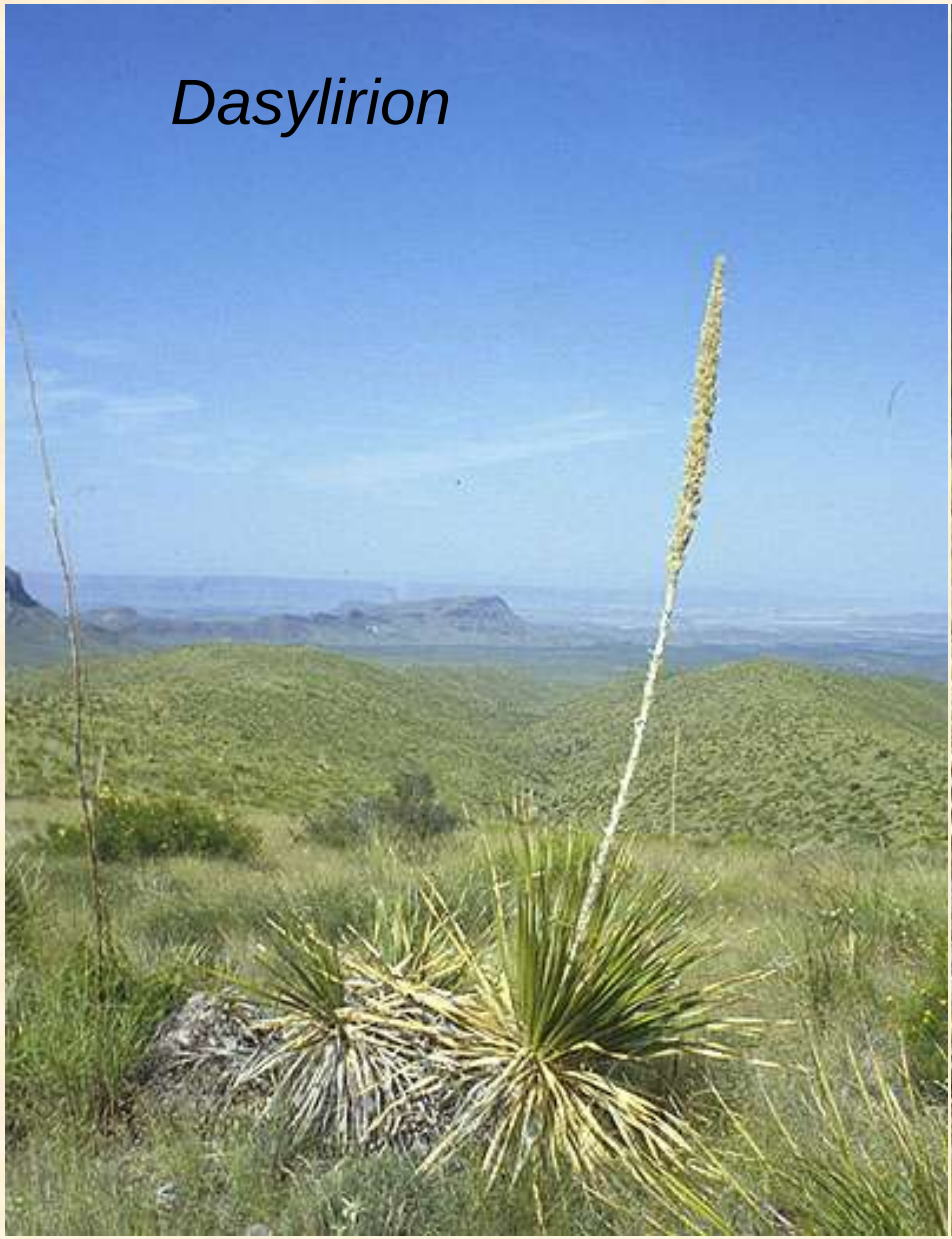
Agavaceae

Yucca faxoniana

Yucca
Hesperaloe
Beschorneria
Furcraea
Agave
Manfreda
Polianthes
Prochnyanthes

Agave salmiana

Dasylirion



Dasylirion leiophyllum, Big Bend N.P.

Dasylirion berlandieri, Nuevo Leon

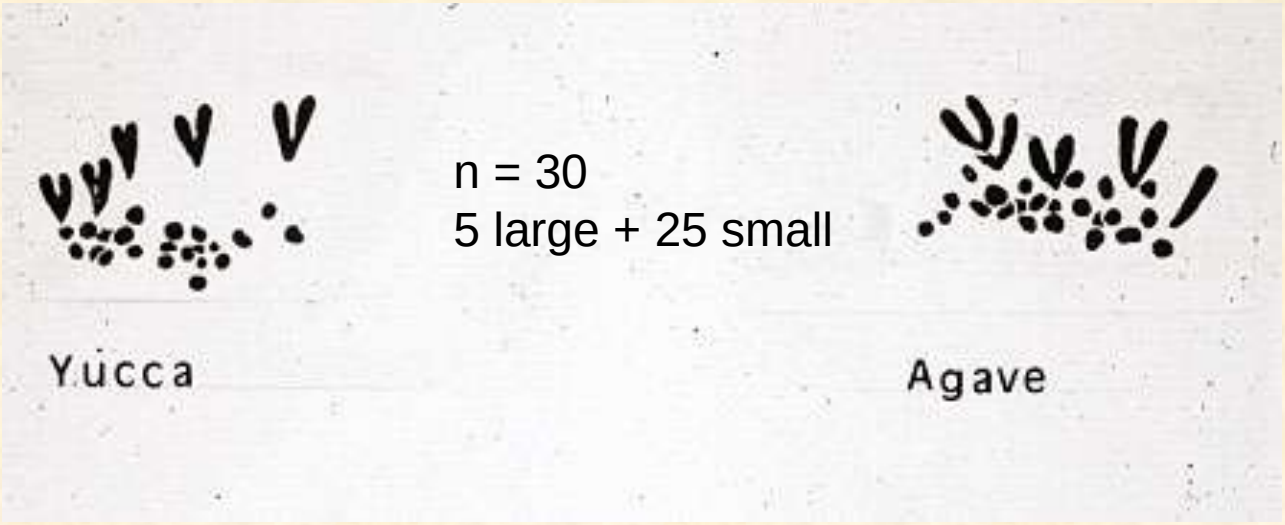
Nolinaceae (APG3 = Asparagaceae, Nolinoideae

Nolina

Dasylirion

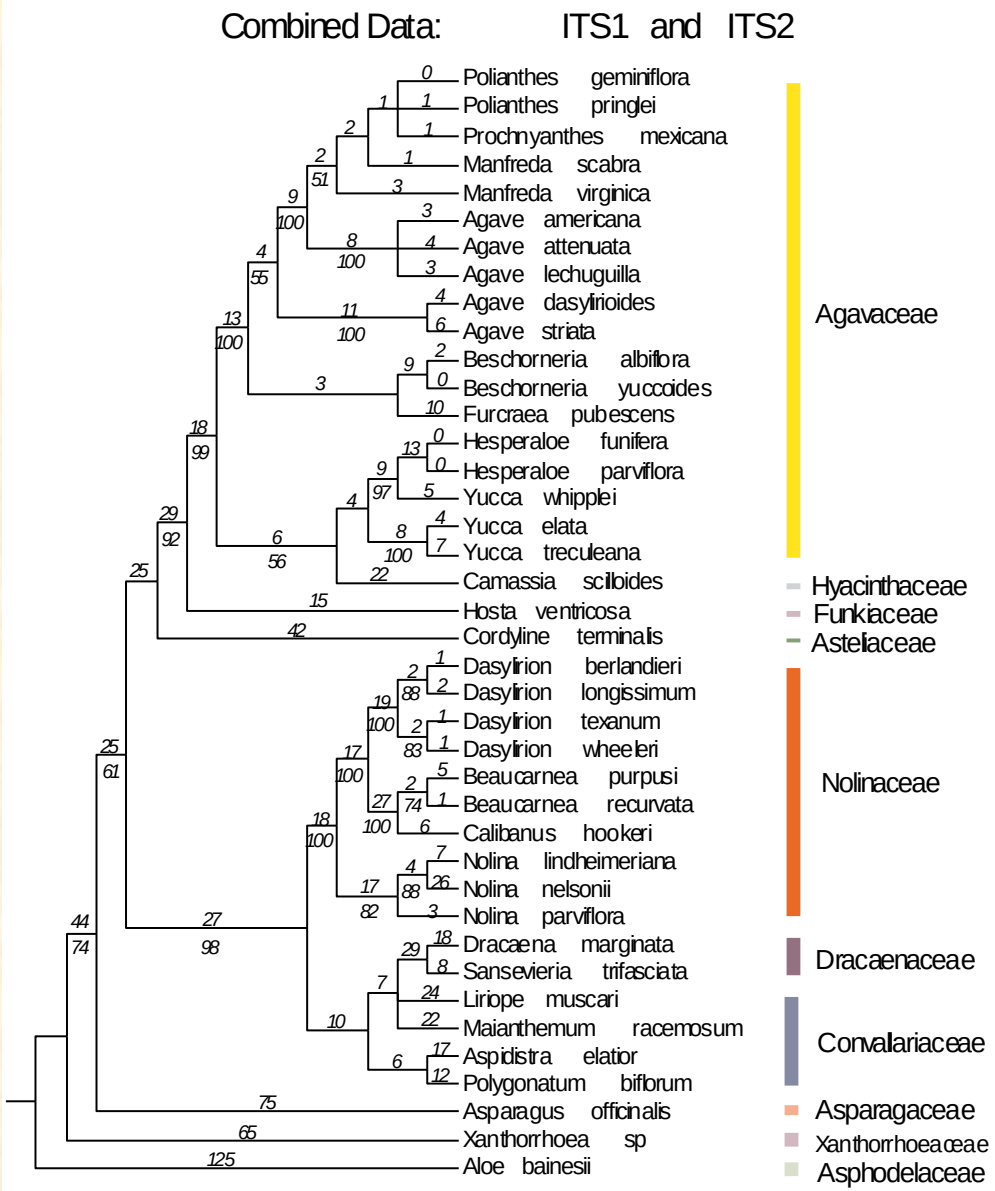
Calibanus

Beaucarnea

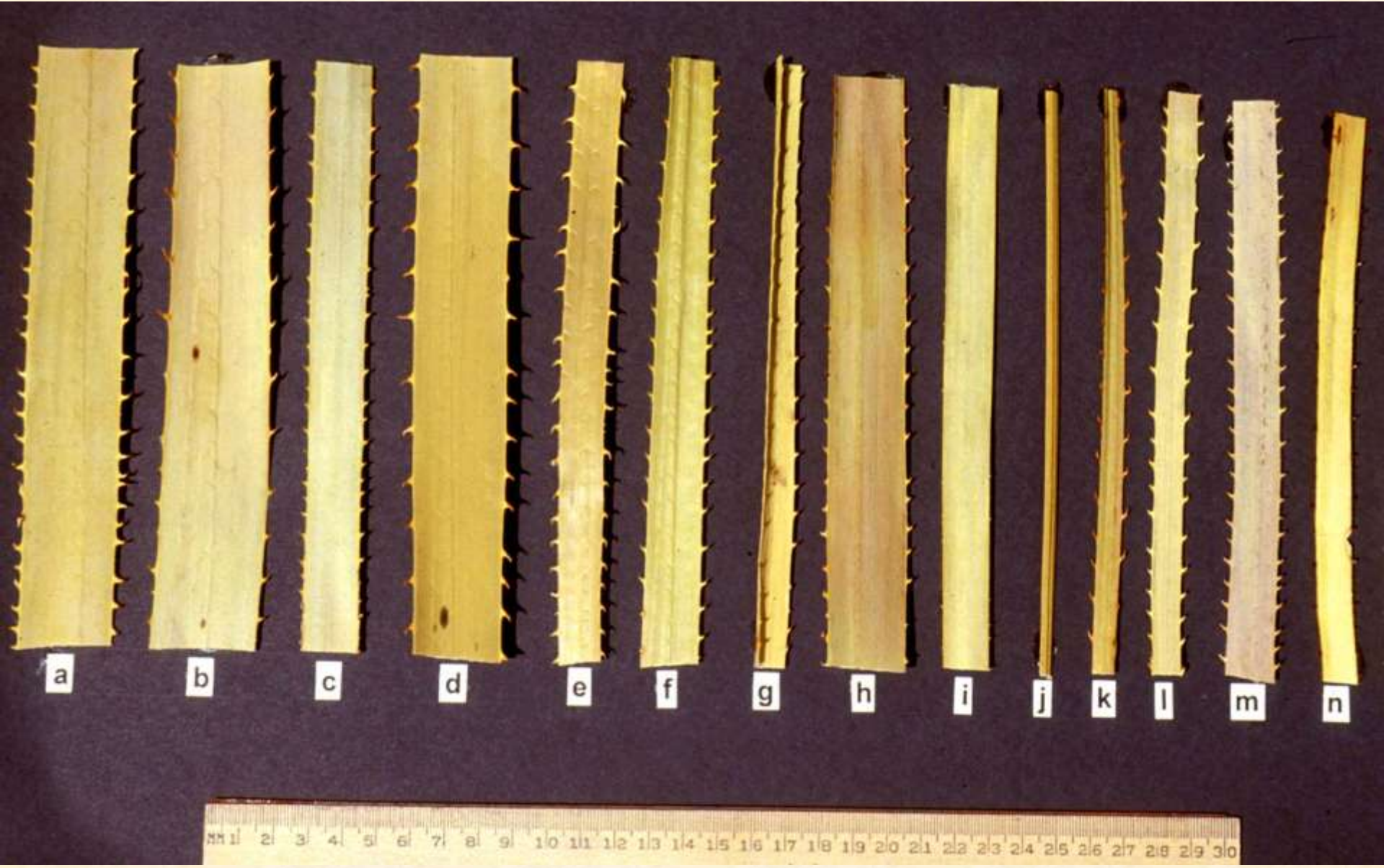


Dasylirion n = 19

ITS1 and ITS2
Strict Consensus
4 Trees
979 Steps
CI = 0.659
RI = 0.815

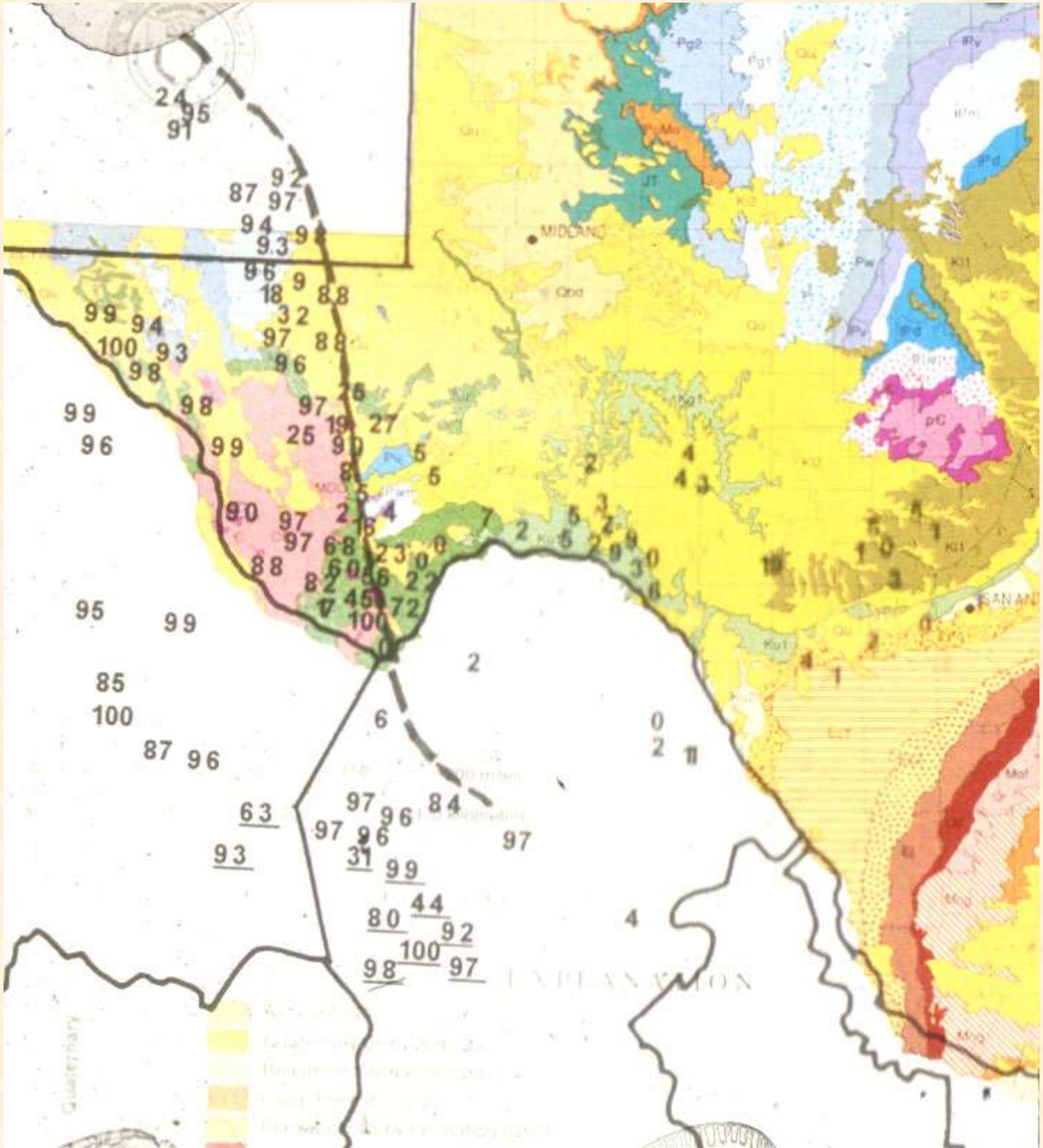


Bogler and Simpson. 1996. Amer. J. Bot. 83: 1225-1235.



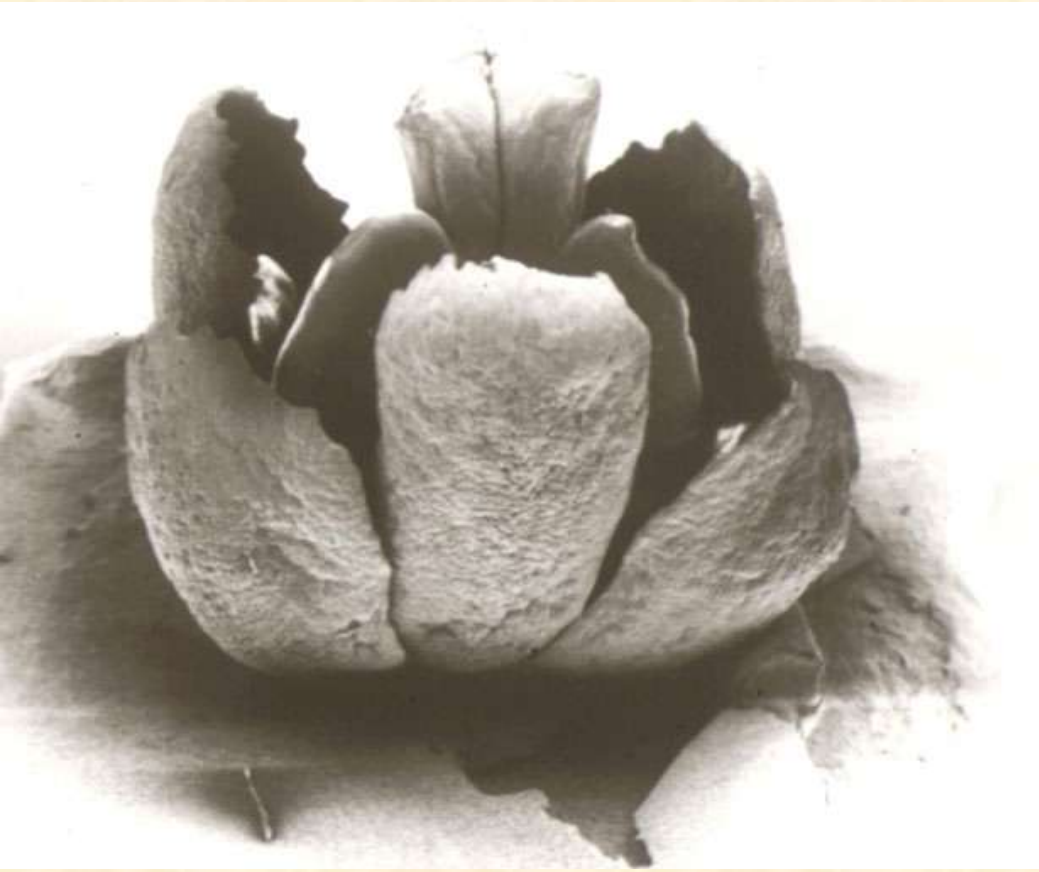
Leaf variation in *Dasylirion*

Dasylirion - Percent Recurved Prickles




01 m 101kV 106E2 0296/51 &ATMN H
01 m 100kV 115E2 0300/51 &ATMN H

Dasylirion - Pistillate and Staminate Flowers



Rolf Dahlgren
(1932-1987)

The Families of the Monocotyledons,
Dahlgren, Clifford, and Yeo, 1985

System based on work of Huber, 1969

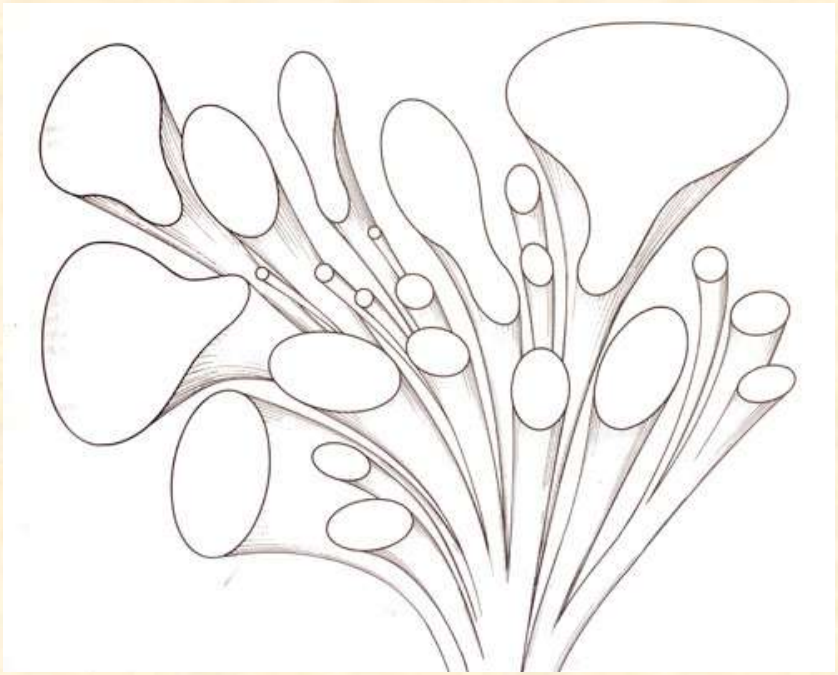
Examined micro-characters of seed coat, cuticle, endosperm, embryo etc

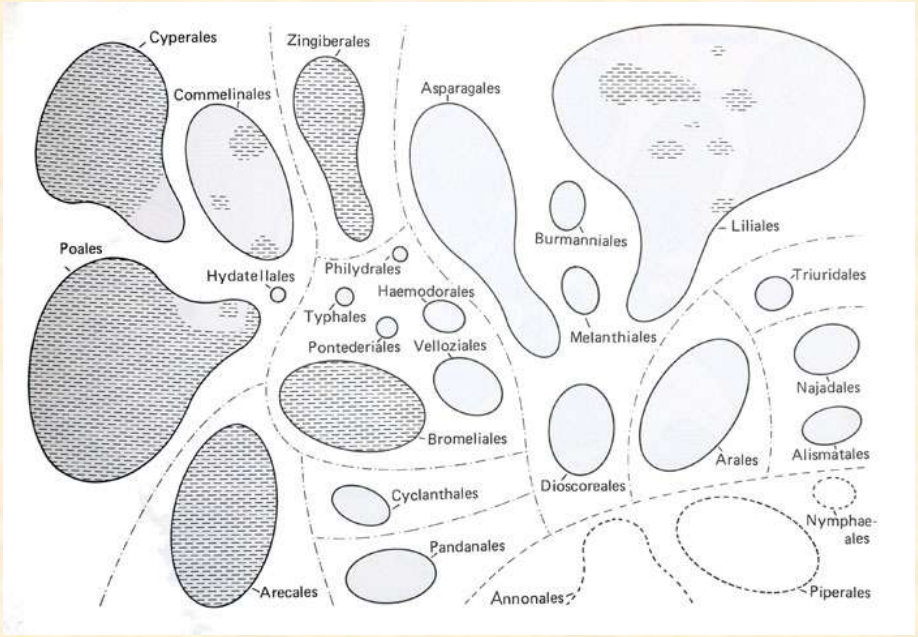
Monocots derived from Dioscoreales-like dicot ancestor

Liliiflorae divided into major groups

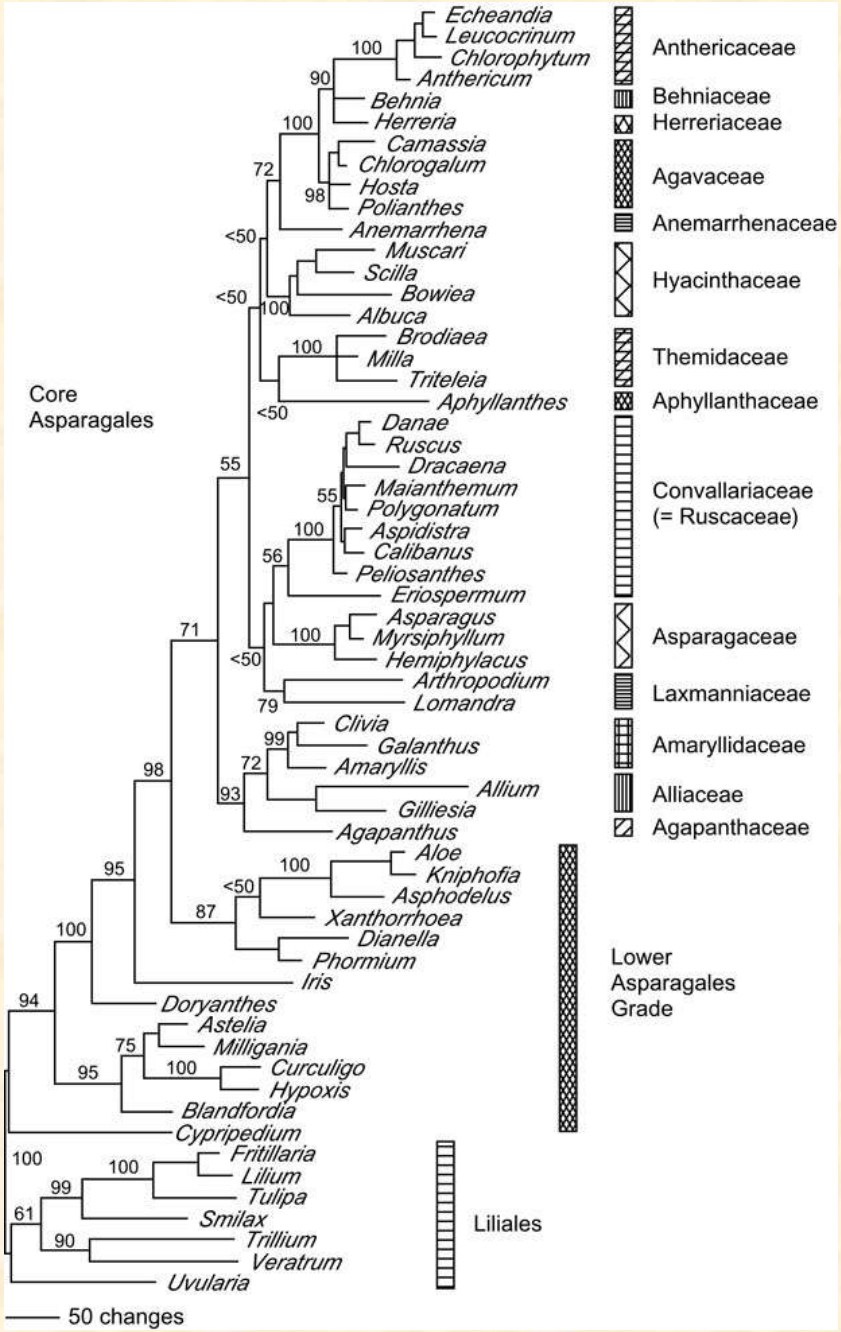
Dioscoreales - 7 families
Asparagales - 31 families
Liliales - 10 families
Melanthiales - 2 families

Rolf Dahlgren
1980s
Microcharacters
“Lacrymograms”



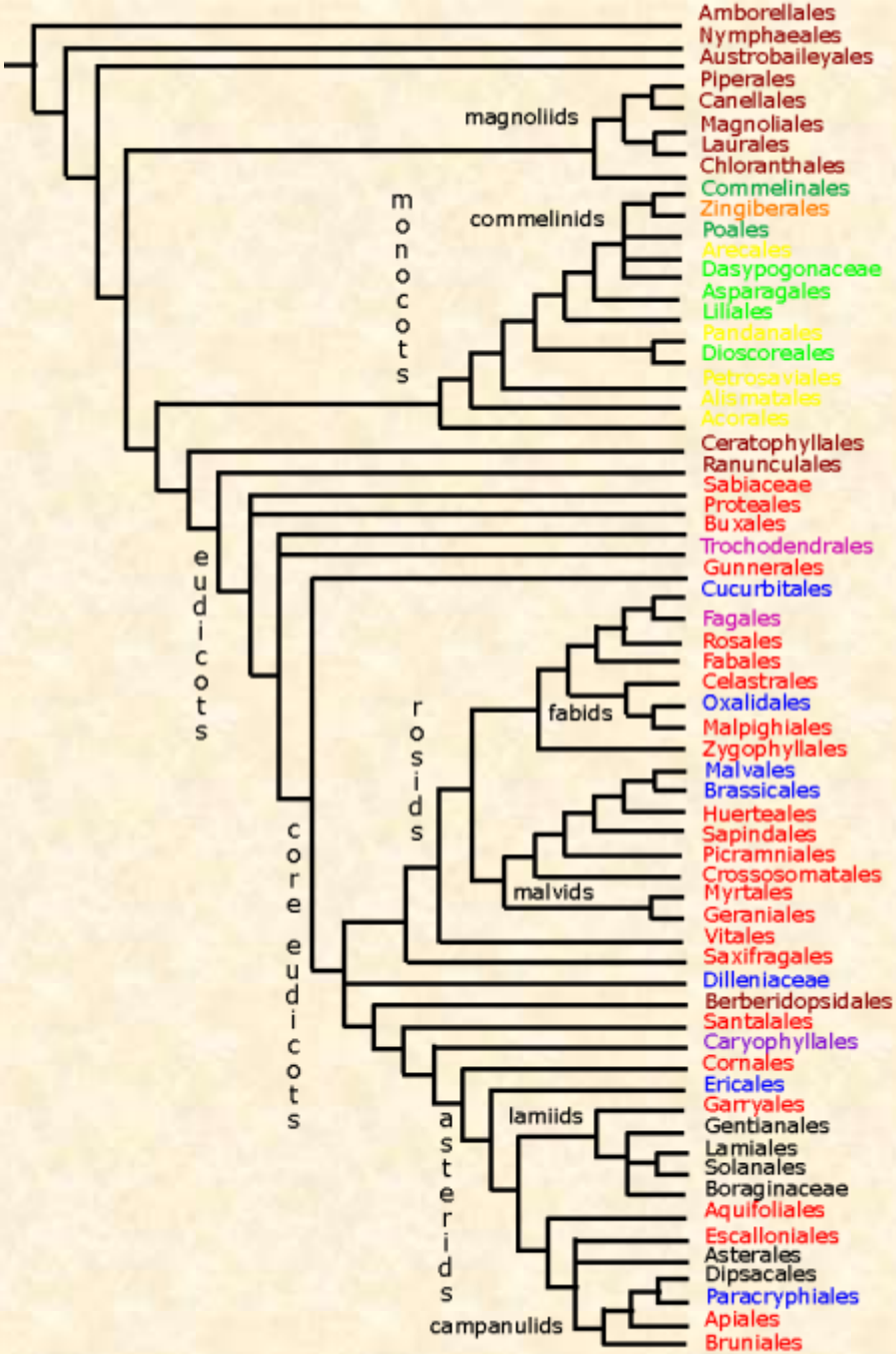


Combined
rbcL and ndhF
Sequence data



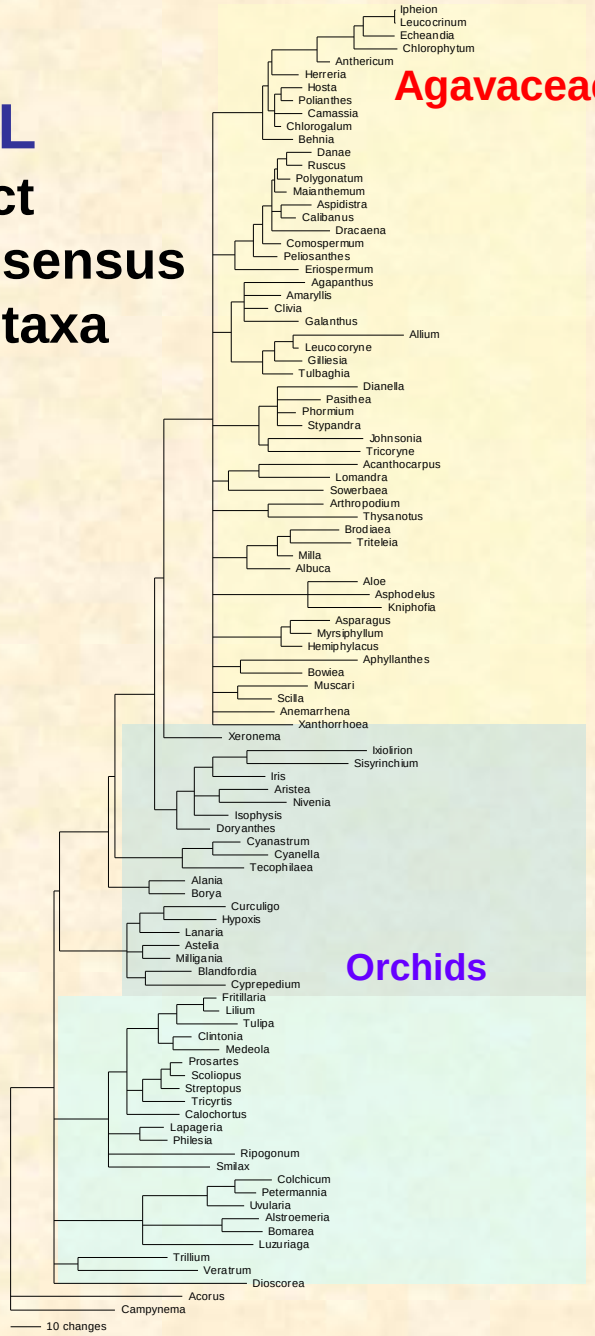
Agave

Dasylirion



APG III Phylogeny of Flowering Plants

rbcL
Strict Consensus
100 taxa



Asparagales
Seeds characters
Phytomelan Pigment

Higher Asparagales

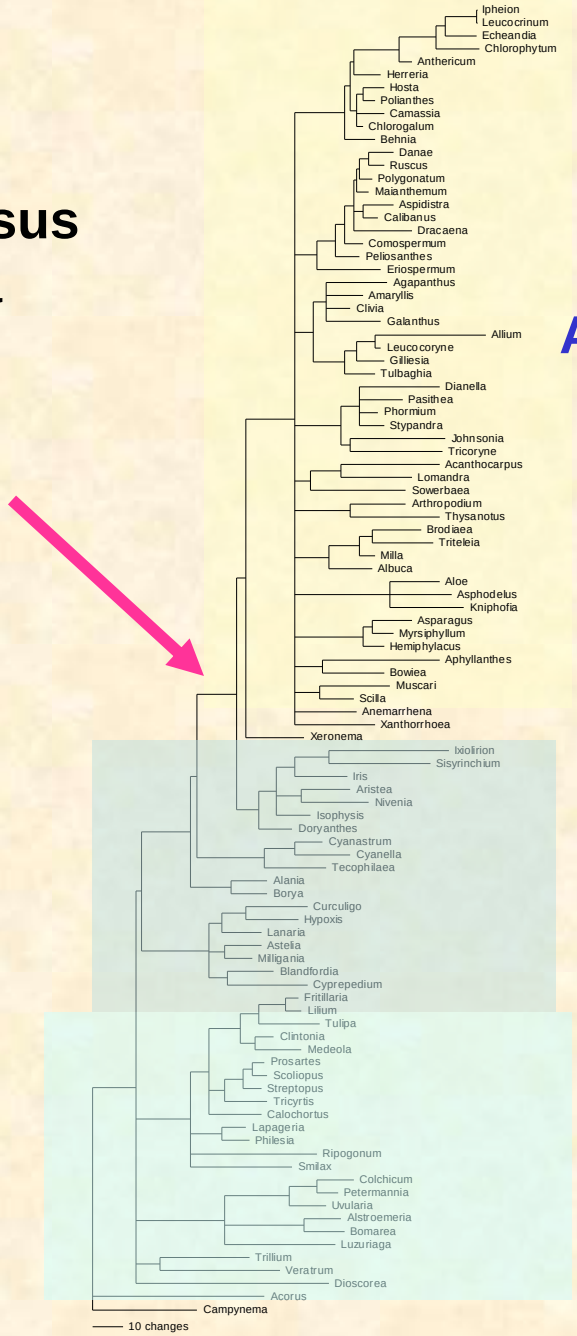
Lower Asparagales

Liliales

Successive Microsporogenesis

Simultaneous Microsporogenesis

rbcL
Strict Consensus
100 taxa



Agavaceae

Higher Asparagales

Lower Asparagales

Liliales

http://davidbogler.com/MonocotsUS/MonocotFamilies.html
laticifers
Edit View Favorites Tools Help
Favorites Player Nehemiah G... Missouri Bot... Missouri Bot... Interact... Page Safety Tools
Matching Taxa | Best | Describe Remaining Taxa | Restart | Filter by Genus | Lookup | Help | About SLIKS

Interactive Key to Monocot Families of the U.S.

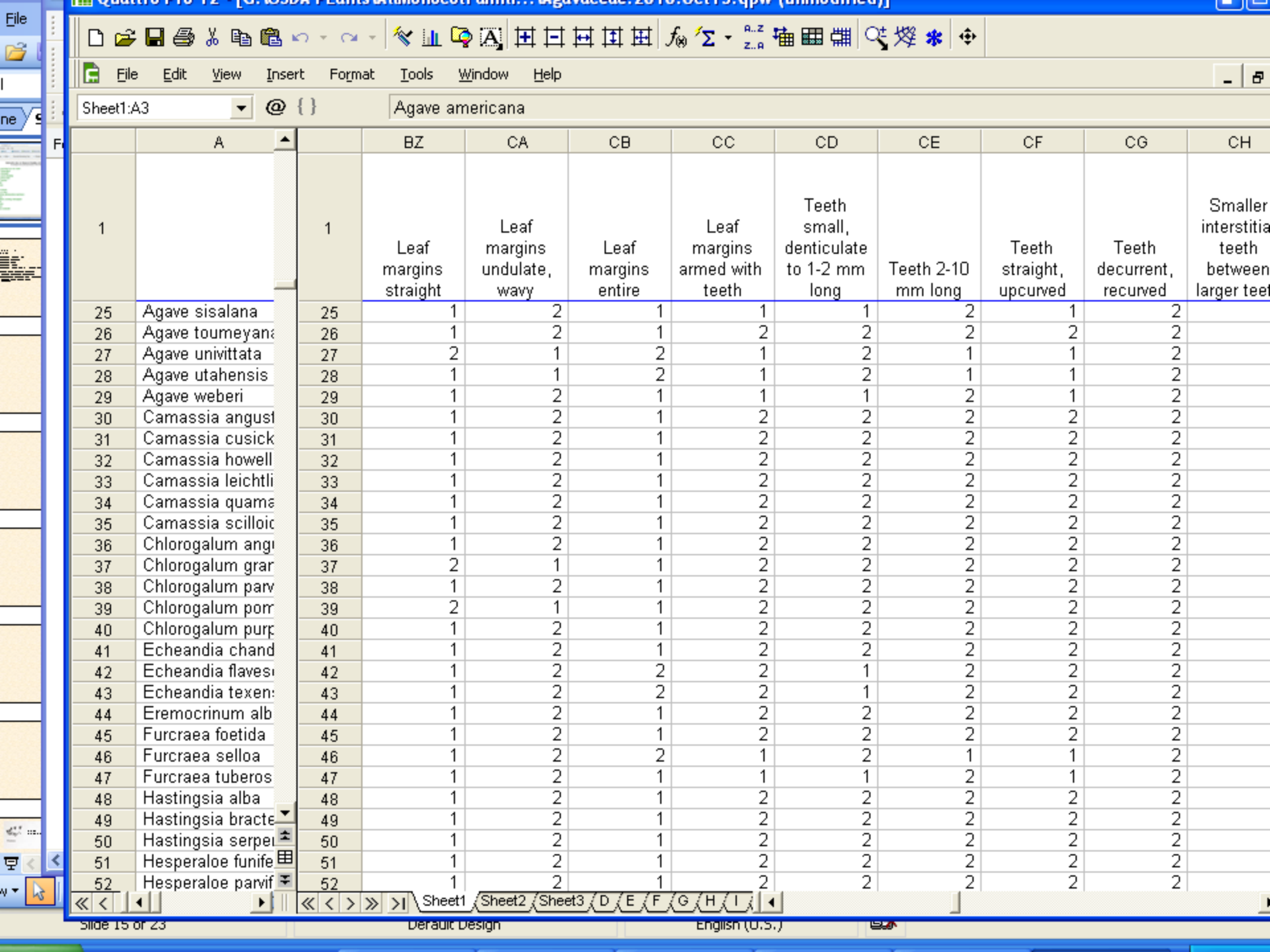
David Bogler, Missouri Botanical Garden, USDA-NRCS

1. *Aquatic, growing in or on water*
2. *Aquatic, submerged*
3. *Aquatic, emergent*
4. *Aquatic, leaves floating*
5. *Aquatic, fresh water*
6. *Aquatic, marine*
7. *Terrestrial*
8. *Herbaceous*
9. *Woody*
10. *Trees or shrubs*
11. *Lianas or vines*
12. *Pseudostem, formed from leaf bases*
13. *Epiphytes*
14. *Saprophytes, lacking chlorophyll*
15. *Annuals*
16. *Perennials*
17. *Rhizomes*
18. *Rhizomes aromatic*
19. *Bulbs*
20. *Corms*

All Taxa:

- D *Acoraceae*
- D *Agavaceae*
- D *Alismataceae*
- D *Alliaceae*
- D *Alstroemeriaceae*
- D *Amaryllidaceae*
- D *Aponogetonaceae*
- D *Araceae*
- D *Arecaceae*
- D *Asparagaceae*
- D *Asteliaceae*
- D *Bromeliaceae*
- D *Burmanniaceae*
- D *Butomaceae*
- D *Cannaceae*
- D *Colchicaceae*
- D *Commelinaceae*
- D *Costaceae*

Internet 100%



File Edit View Insert Format Tools Window Help

Sheet1:A3 Agave americana

	A	BZ	CA	CB	CC	CD	CE	CF	CG	CH
1		Leaf margins straight	Leaf margins undulate, wavy	Leaf margins entire	Leaf margins armed with teeth	Teeth small, denticulate to 1-2 mm long	Teeth 2-10 mm long	Teeth straight, upcurved	Teeth decurrent, recurved	Smaller interstitia teeth between larger teet
25	Agave sisalana	1	2	1	1	1	2	1	2	
26	Agave toumeyana	1	2	1	2	2	2	2	2	
27	Agave univittata	2	1	2	1	2	1	1	2	
28	Agave utahensis	1	1	2	1	2	1	1	2	
29	Agave weberi	1	2	1	1	1	2	1	2	
30	Camassia angust	1	2	1	2	2	2	2	2	
31	Camassia cusick	1	2	1	2	2	2	2	2	
32	Camassia howell	1	2	1	2	2	2	2	2	
33	Camassia leichtli	1	2	1	2	2	2	2	2	
34	Camassia quama	1	2	1	2	2	2	2	2	
35	Camassia scilloic	1	2	1	2	2	2	2	2	
36	Chlorogalum angu	1	2	1	2	2	2	2	2	
37	Chlorogalum grar	2	1	1	2	2	2	2	2	
38	Chlorogalum parv	1	2	1	2	2	2	2	2	
39	Chlorogalum pom	2	1	1	2	2	2	2	2	
40	Chlorogalum purp	1	2	1	2	2	2	2	2	
41	Echeandia chand	1	2	1	2	2	2	2	2	
42	Echeandia flaves	1	2	2	2	1	2	2	2	
43	Echeandia texen	1	2	2	2	1	2	2	2	
44	Eremocrinum alb	1	2	1	2	2	2	2	2	
45	Furcraea foetida	1	2	1	2	2	2	2	2	
46	Furcraea selloa	1	2	2	1	2	1	1	2	
47	Furcraea tuberos	1	2	1	1	1	2	1	2	
48	Hastingsia alba	1	2	1	2	2	2	2	2	
49	Hastingsia bracte	1	2	1	2	2	2	2	2	
50	Hastingsia serpei	1	2	1	2	2	2	2	2	
51	Hesperaloe funife	1	2	1	2	2	2	2	2	
52	Hesperaloe parvif	1	2	1	2	2	2	2	2	

Sheet1 Sheet2 Sheet3 D E F G H I

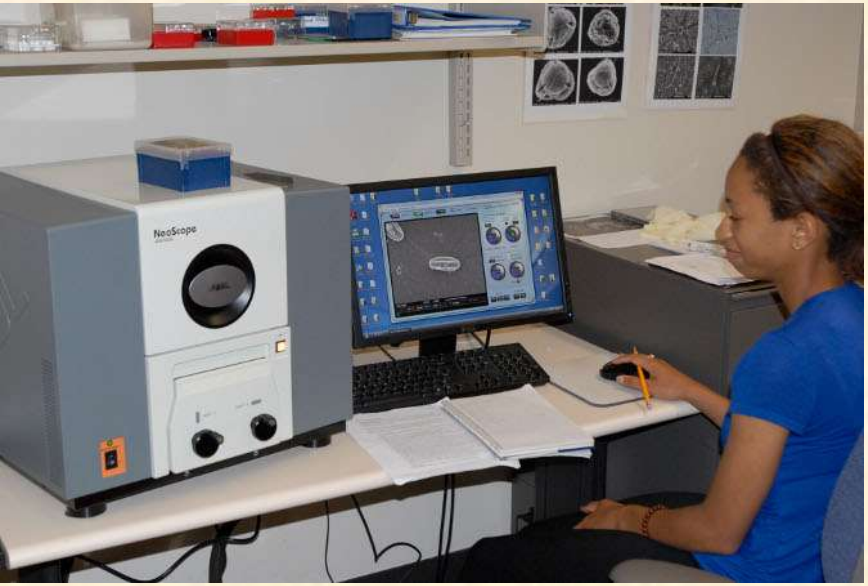
Slide 15 of 23 Default Design English (U.S.)

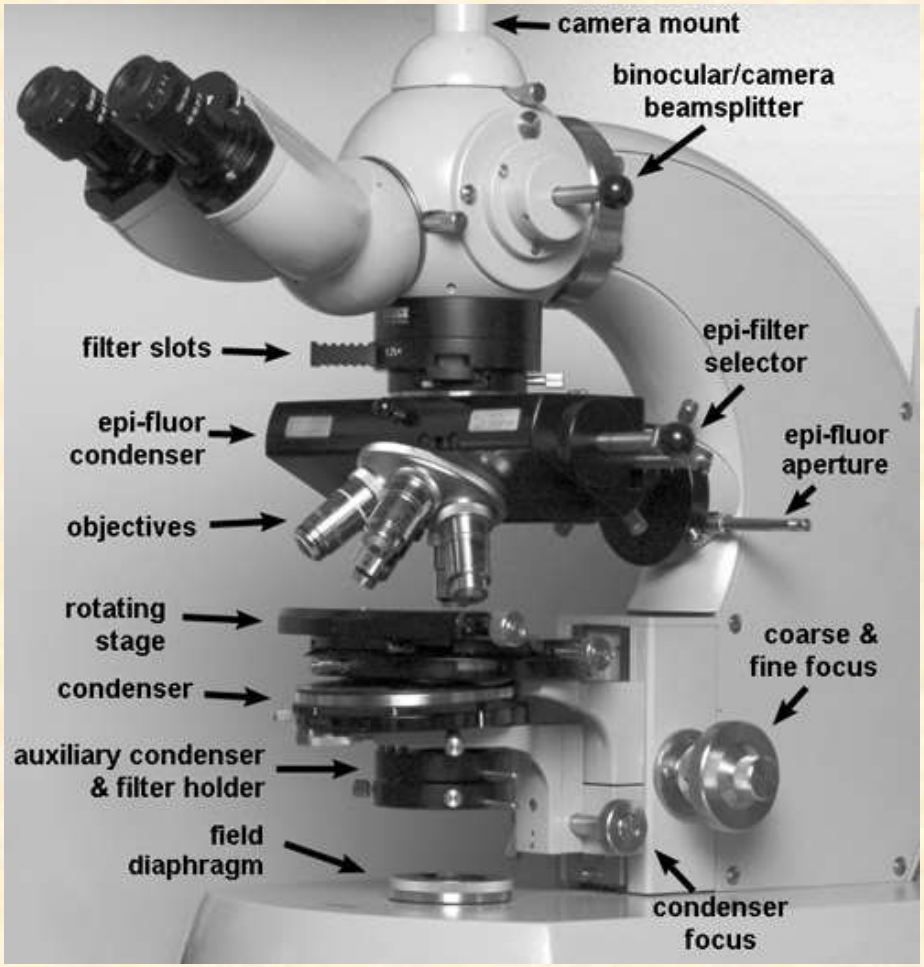
Nehemiah Grew
1641-1712

Anatomy of Plants - 1682
- Anatomy of Vegetables
- Anatomy of Roots
- Anatomy of Trunks
- Anatomy of Leaves, Flowers, Fruits and Seeds

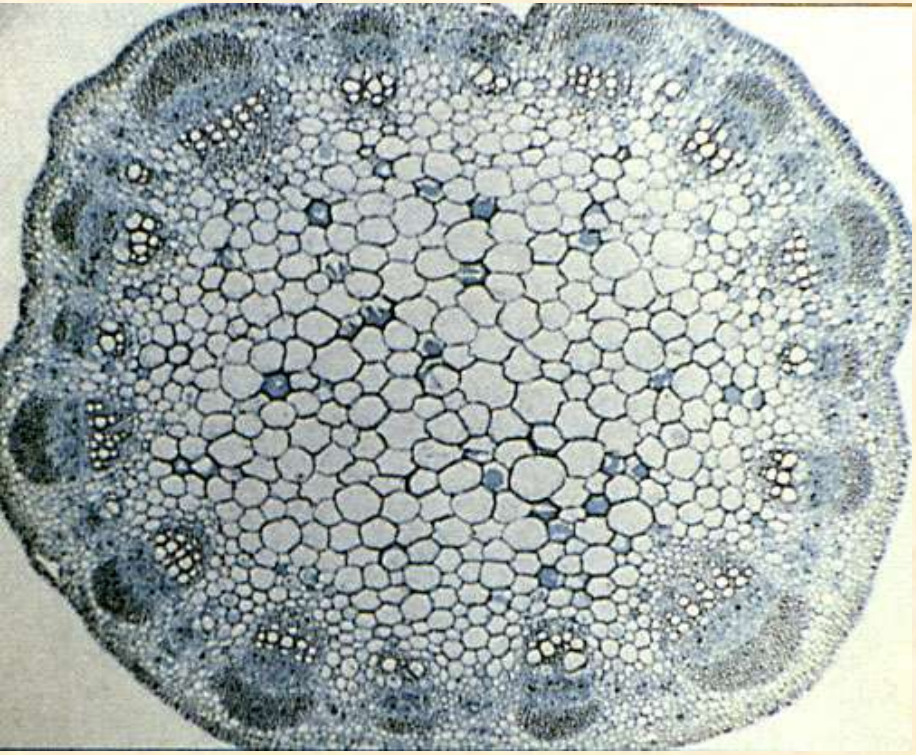
Described nearly all the morphological differences in stems and roots, identified stamens as male, described pollen, recognized differences in wood, parts of a seed, parenchyma,

Marcello Malpighi
Anatome Plantarum (1675-1679)

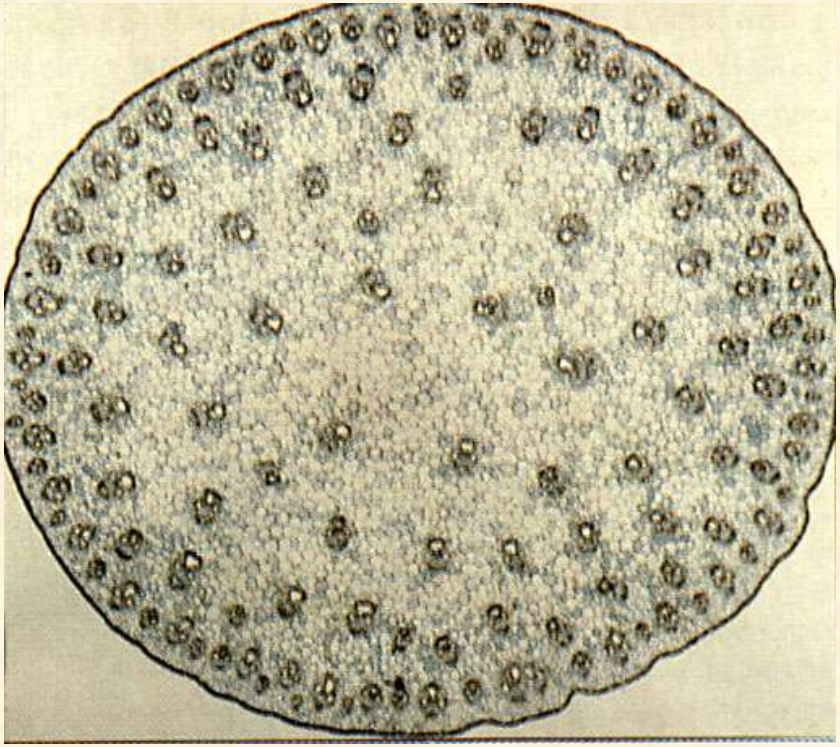



camera mount
binocular/camera beamsplitter
filter slots
epi-filter selector
epi-fluor condenser
epi-fluor aperture
objectives
rotating stage
coarse & fine focus
condenser
auxiliary condenser & filter holder
field diaphragm
condenser focus

Stem Anatomy

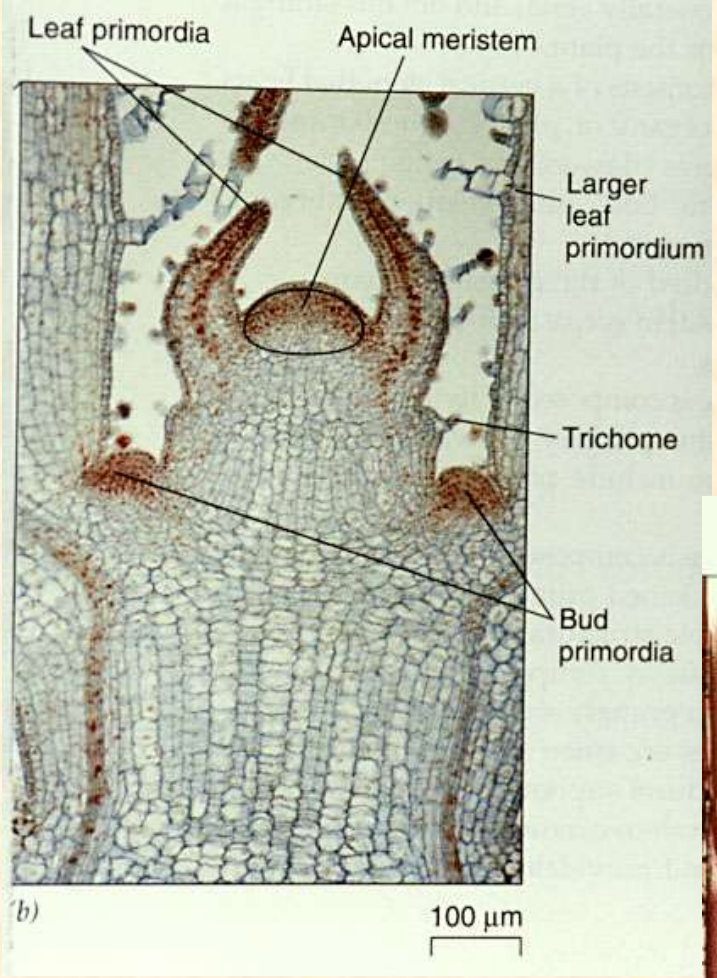


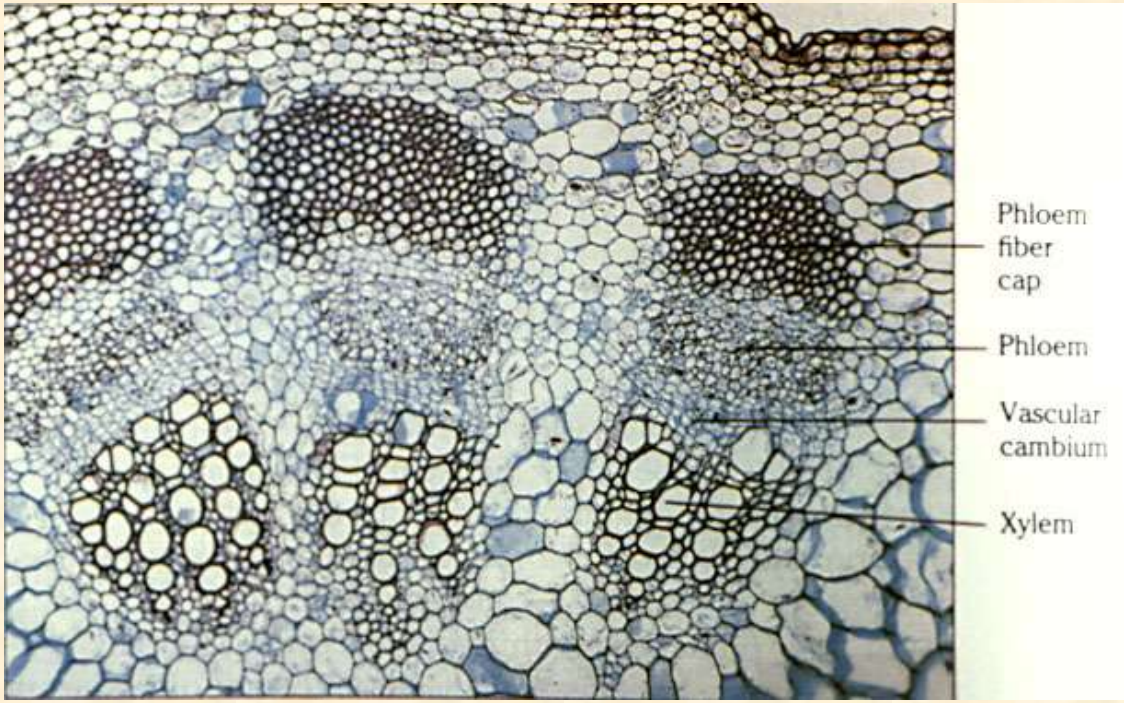
Dicot

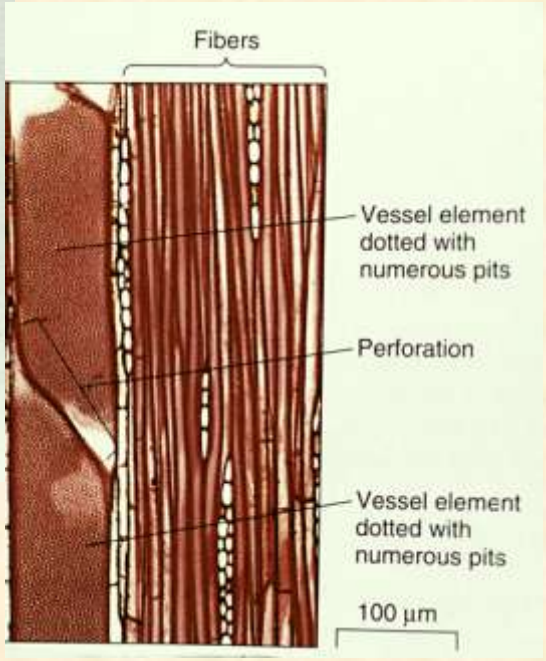


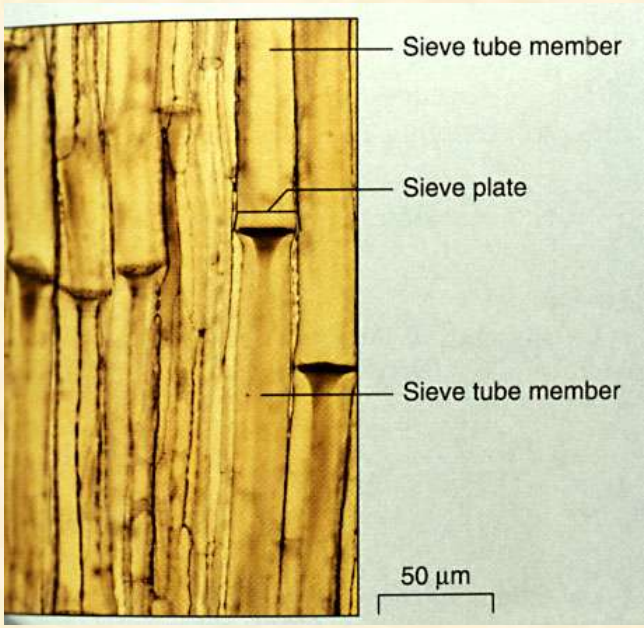
Monocot

Stem Anatomy

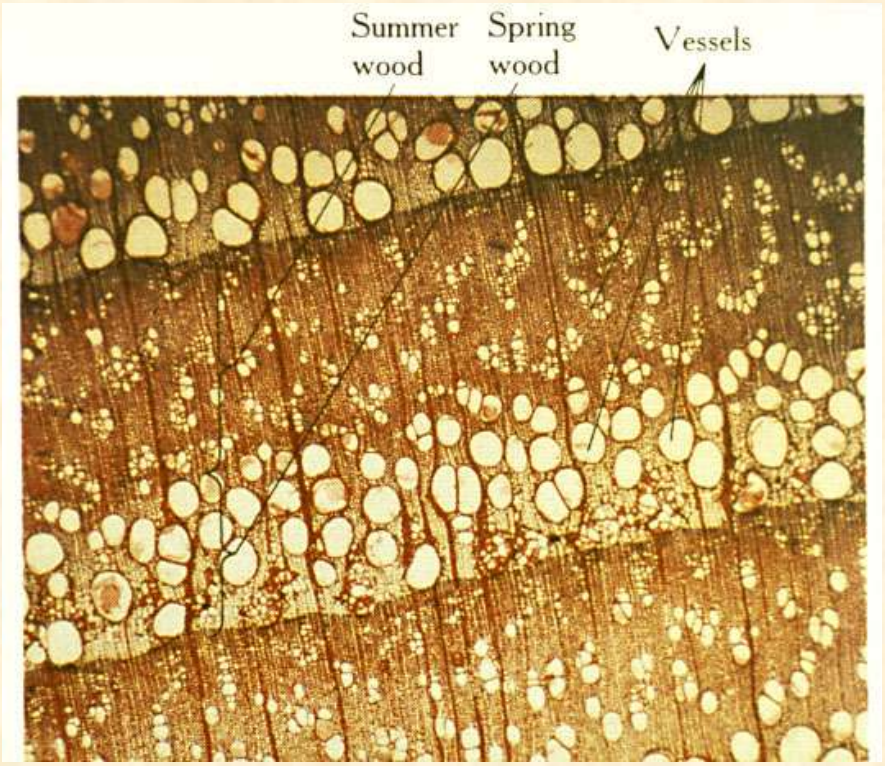


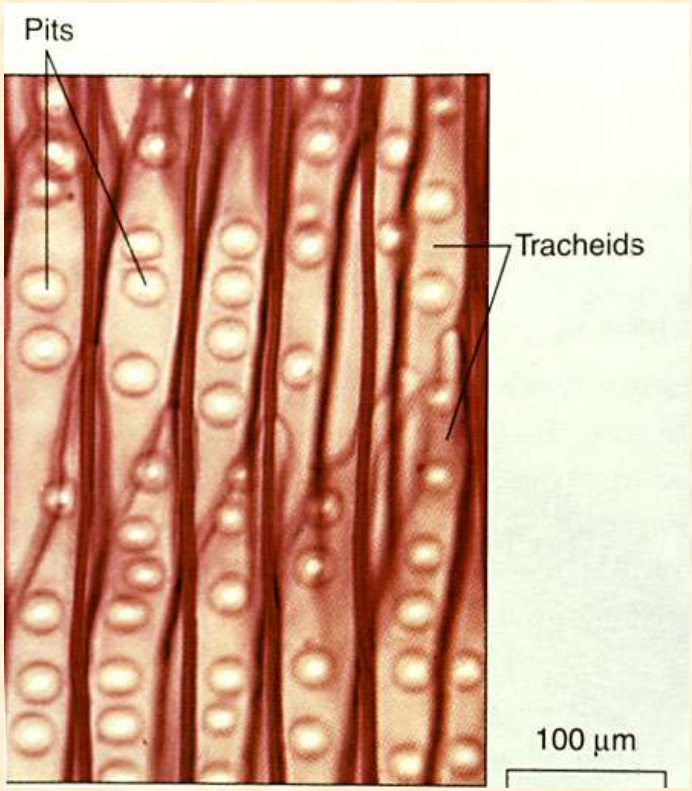


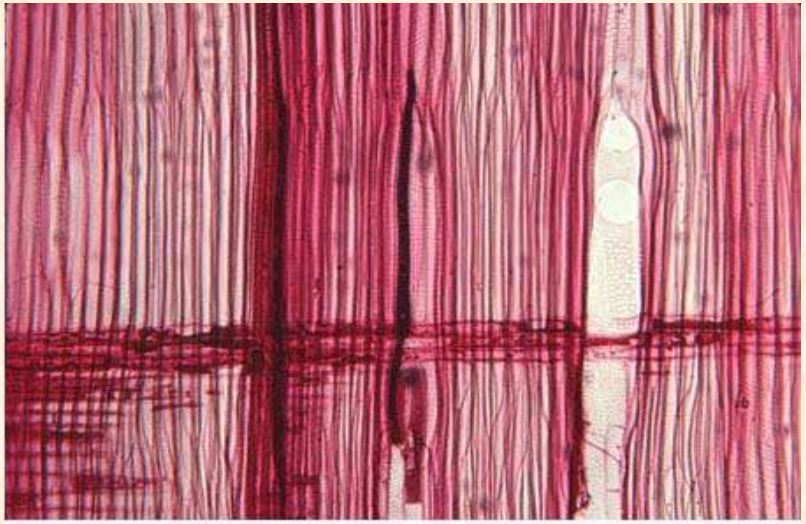




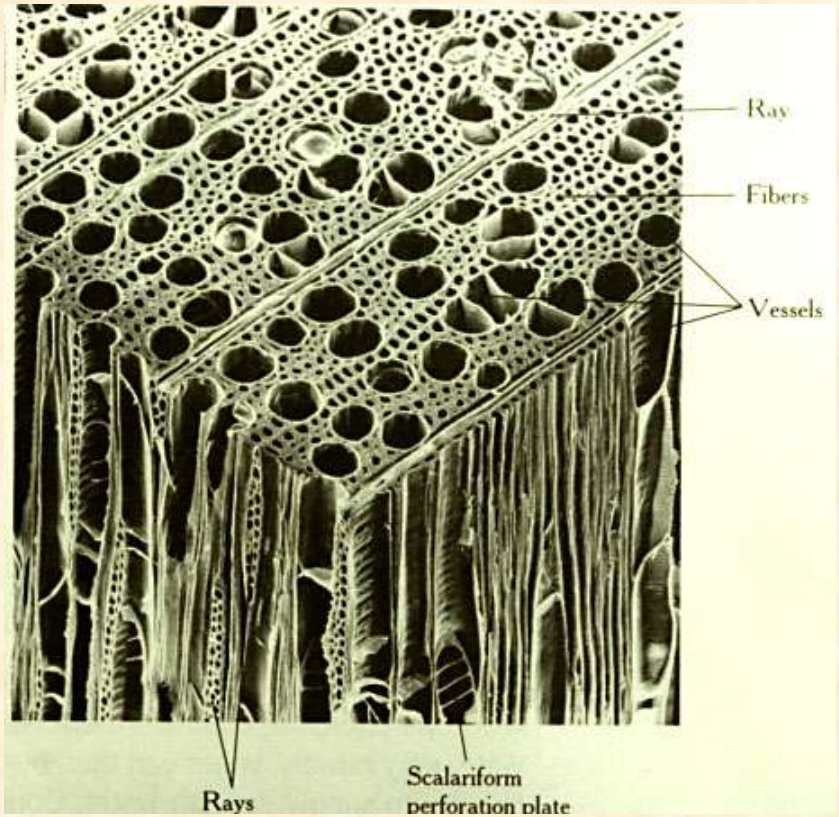
Wood Anatomy

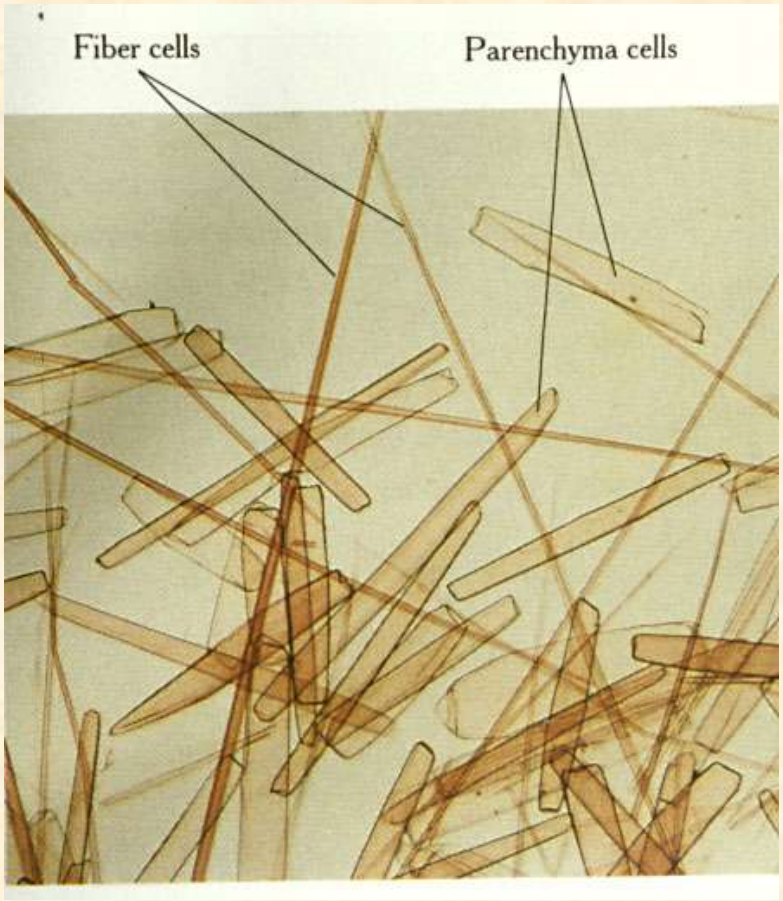


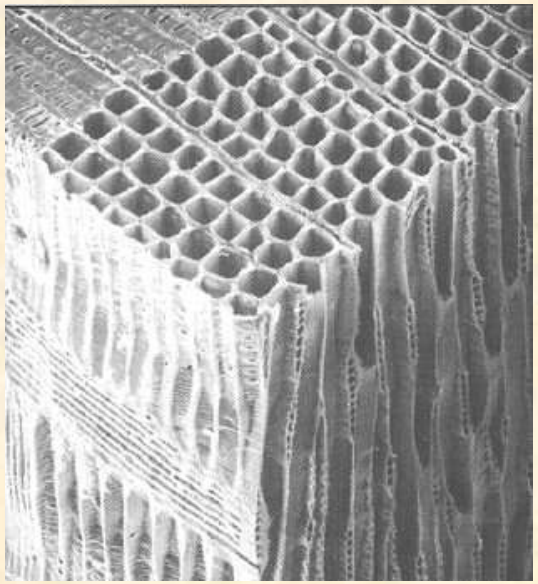


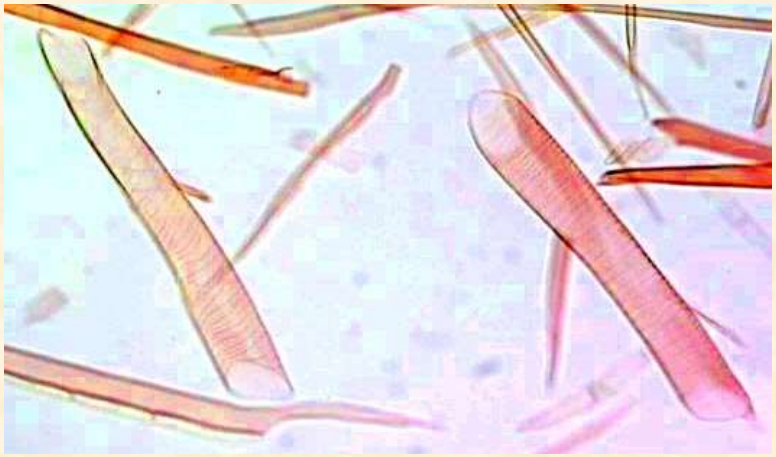


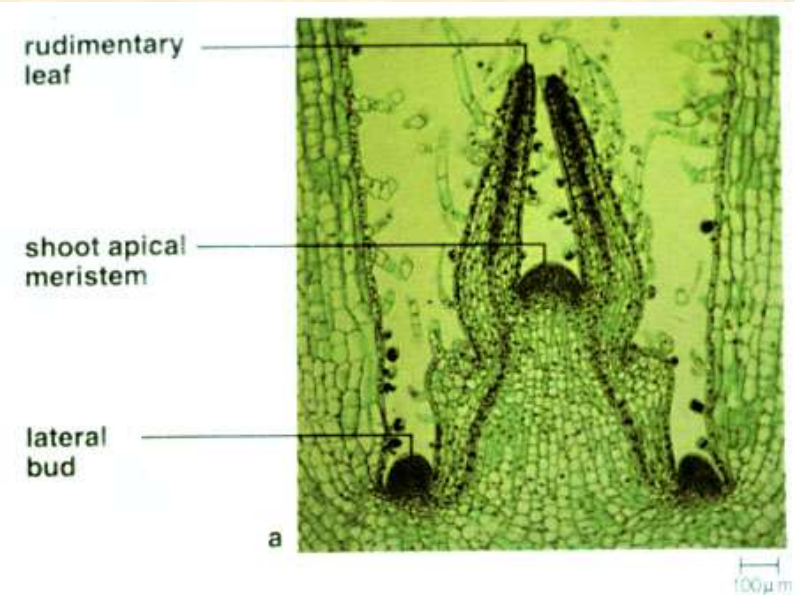
Acer wood radial section.

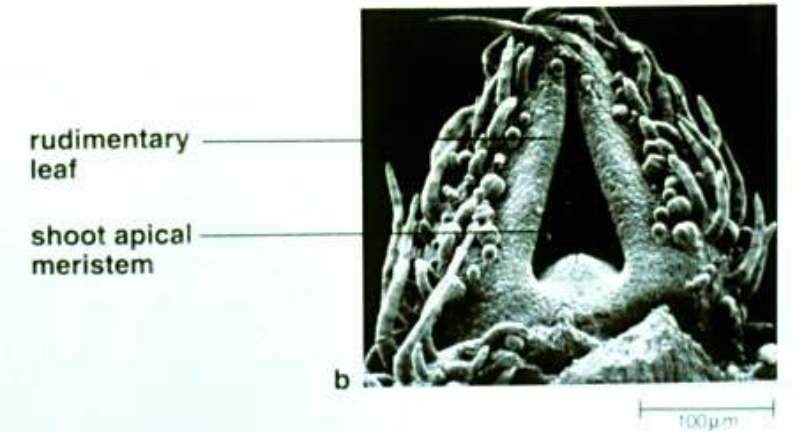

Ray
Fibers
Vessels
Rays
Scalariform
perforation plate

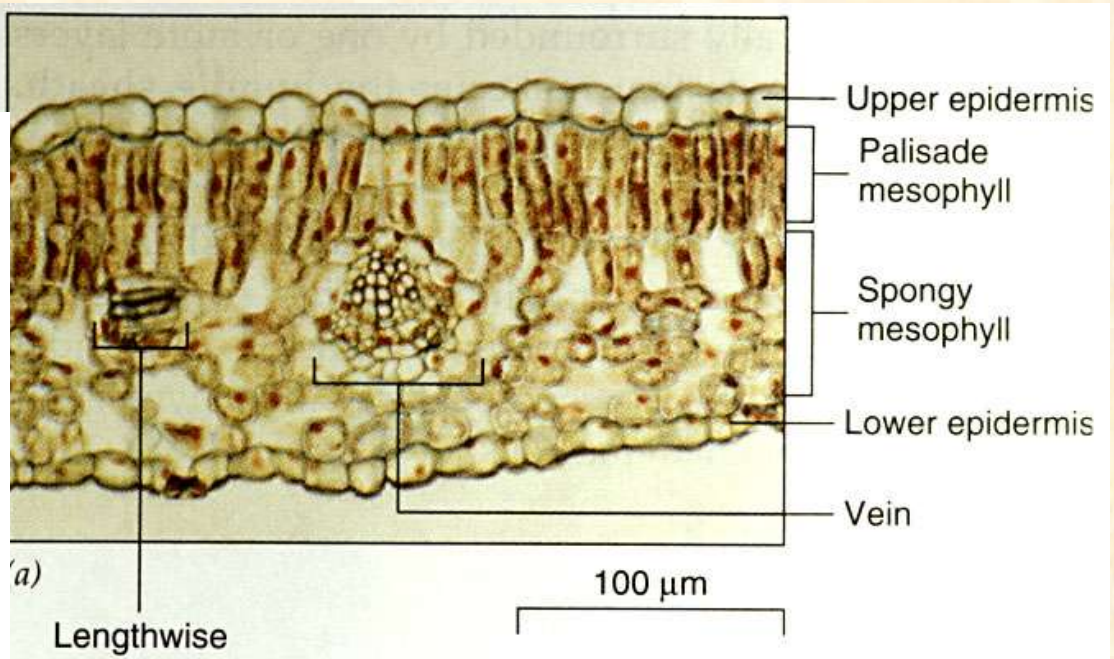

Fiber cells
Parenchyma cells

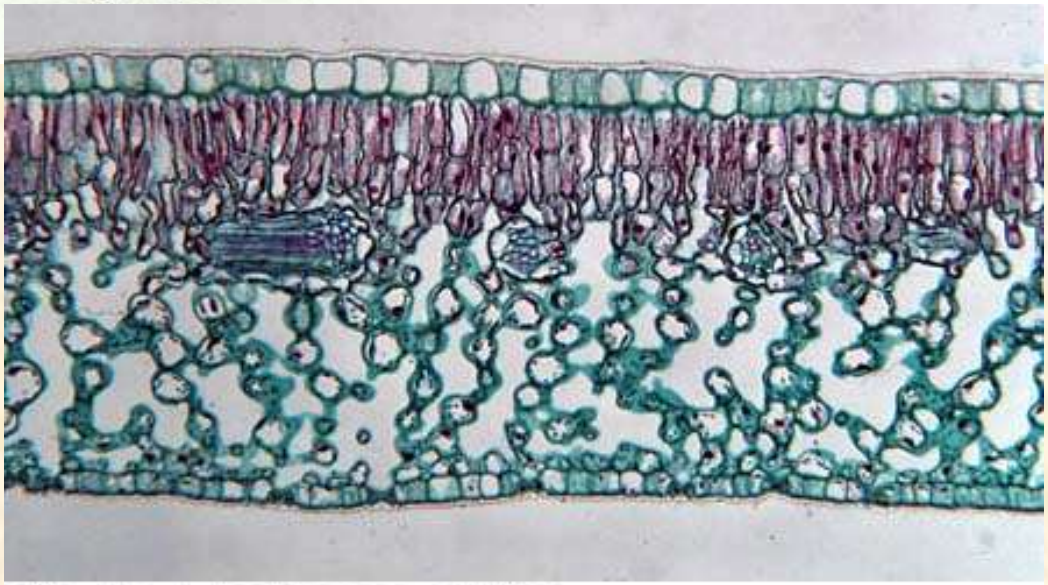






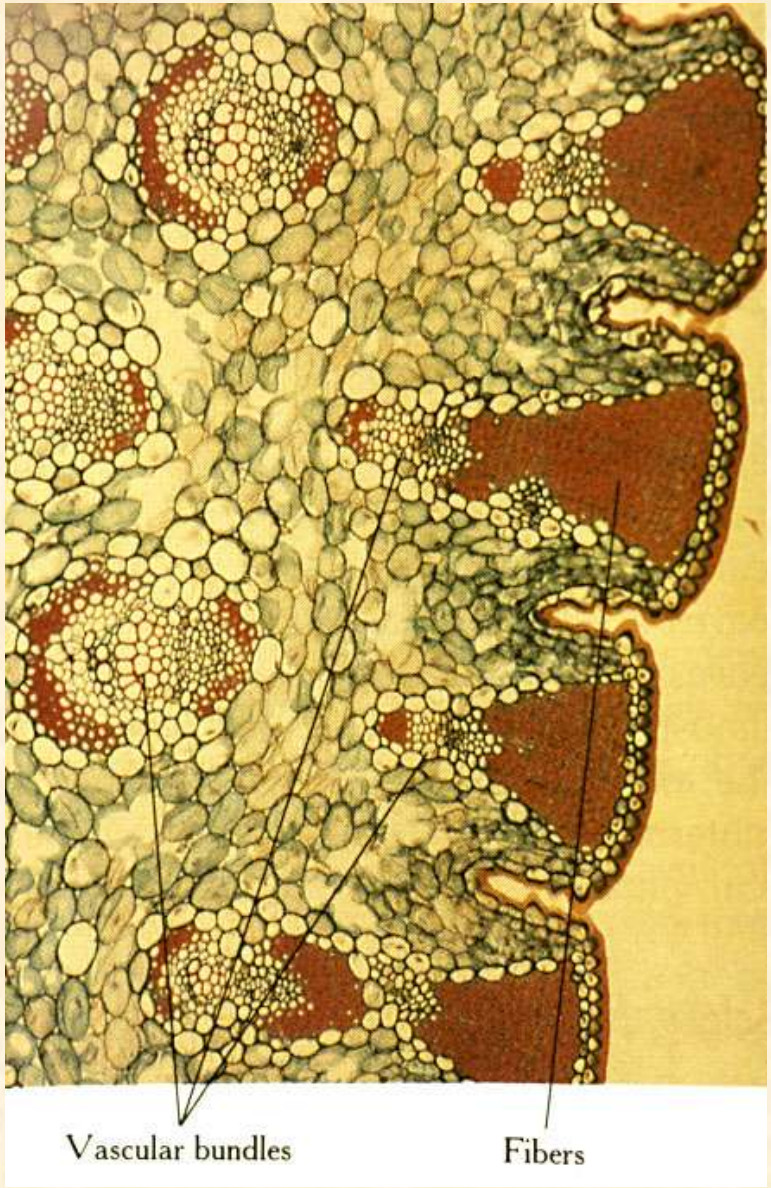


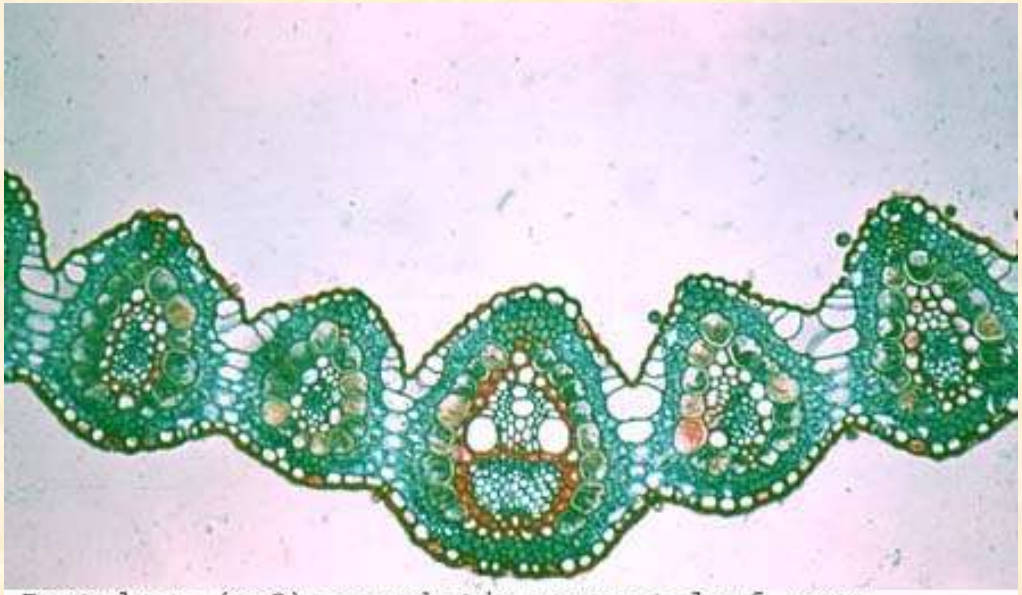




Ligustrum leaf cross section.

Monocot Leaves

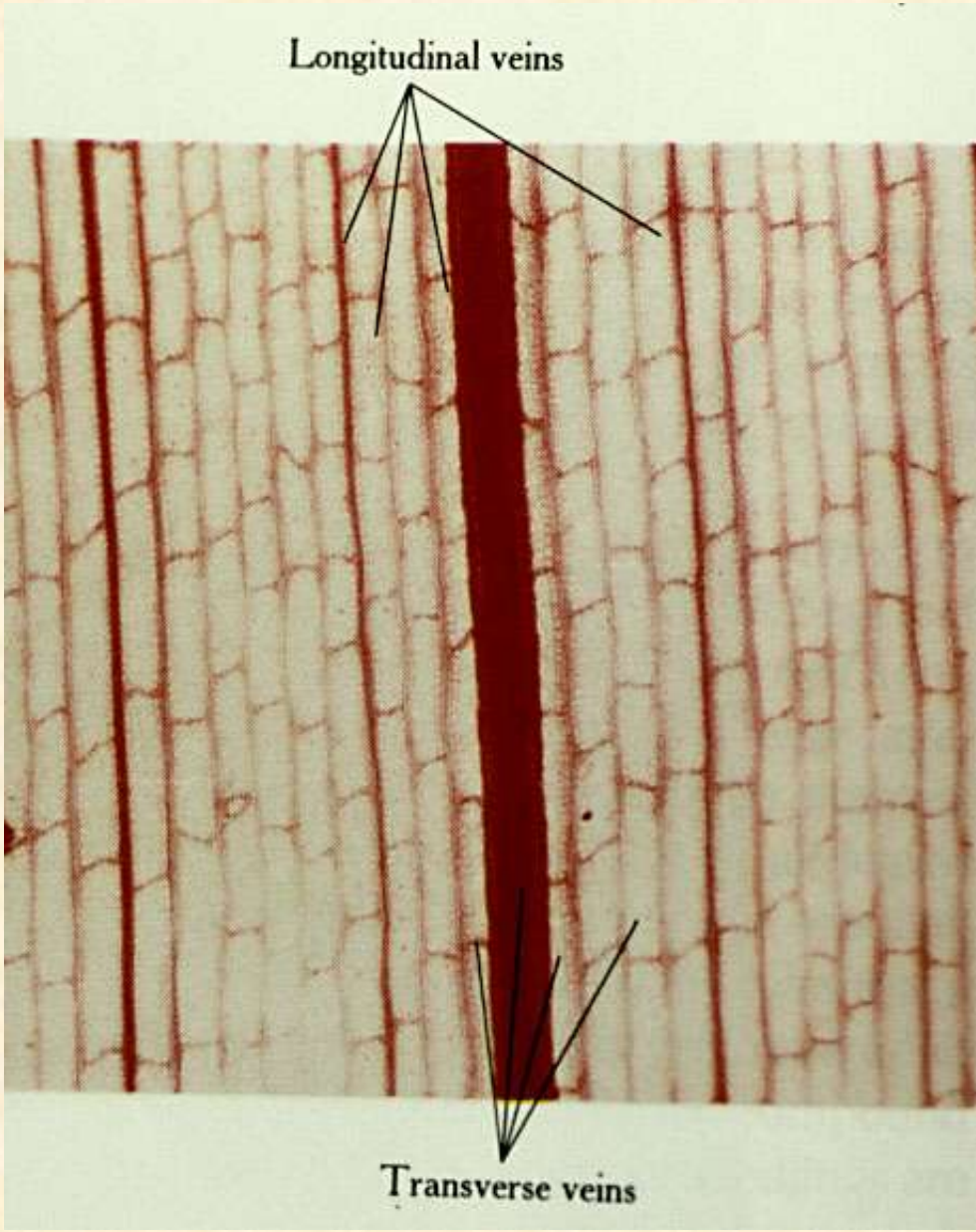




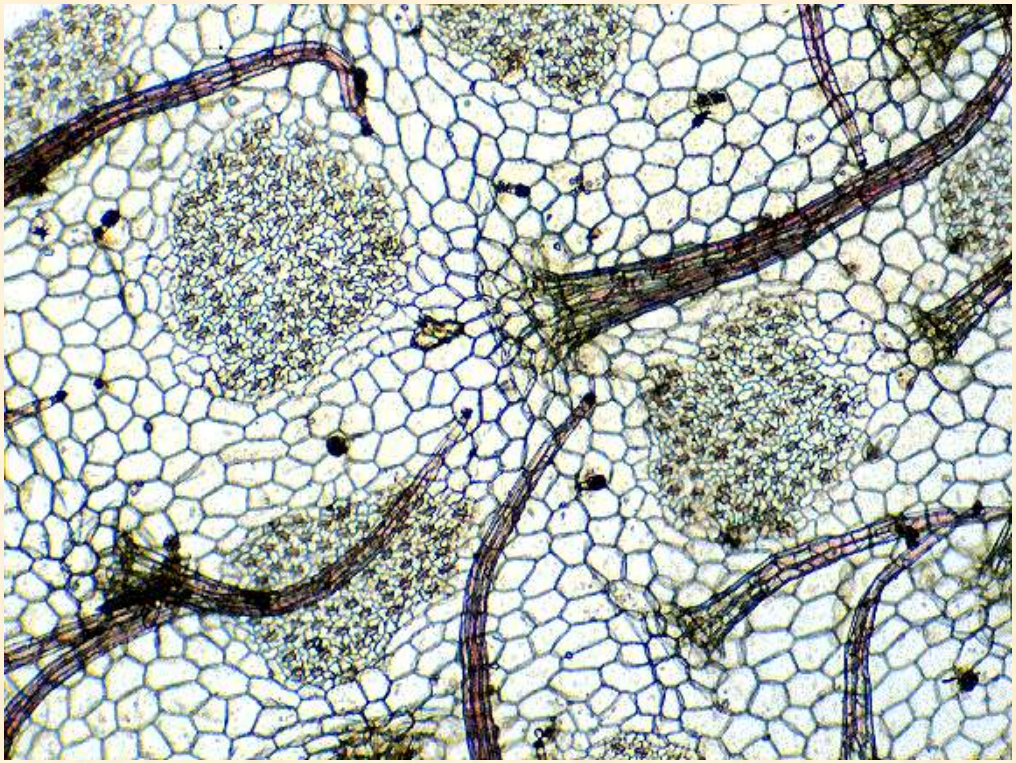
Bouteloua (sp?) xerophytic monocot leaf cross section.

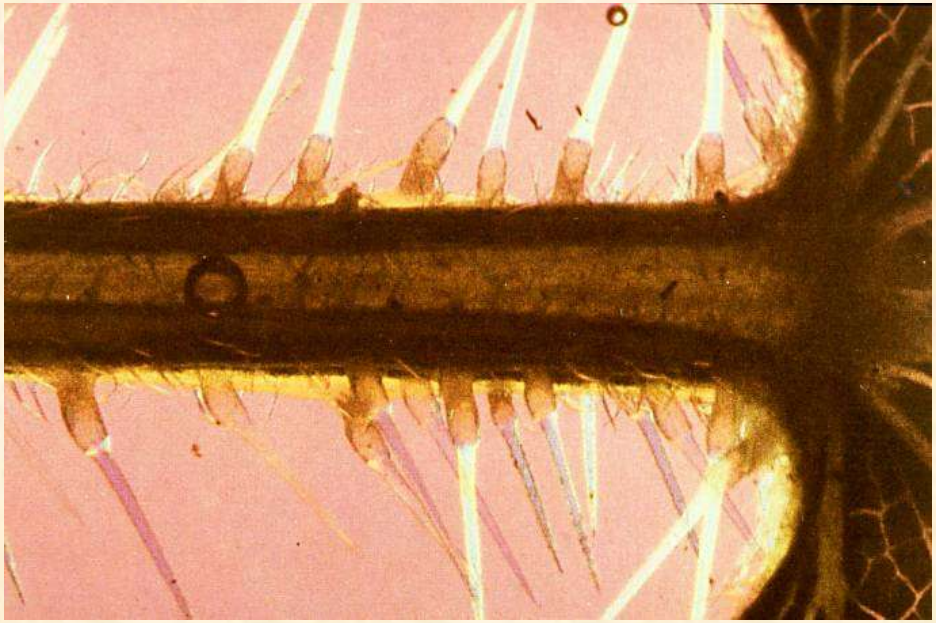
Zea leaf cross section.

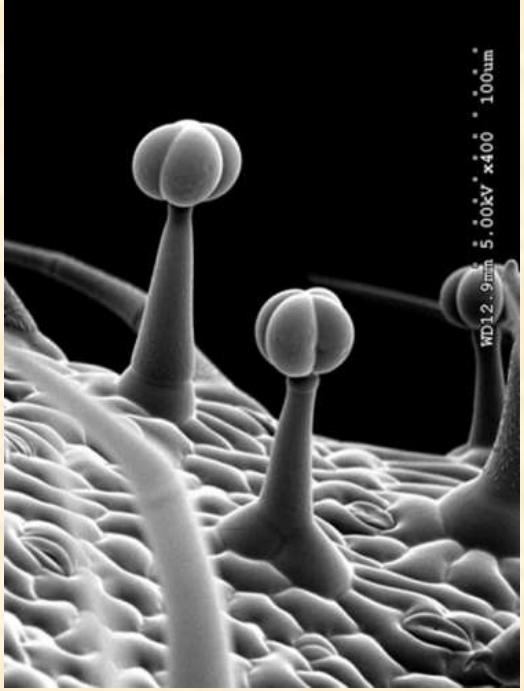
Leaf Clearings



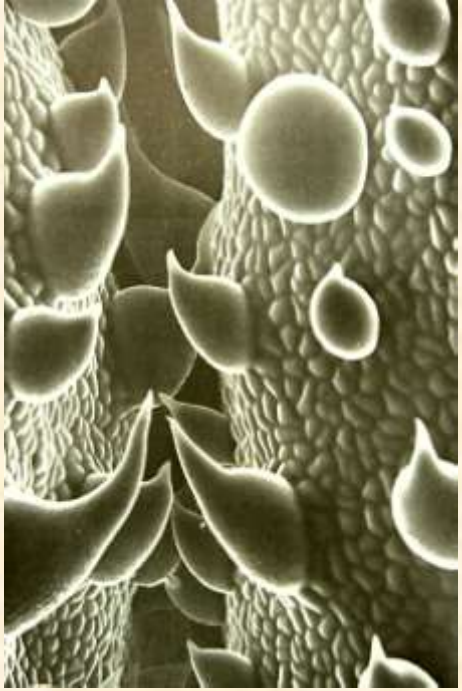
Trichomes



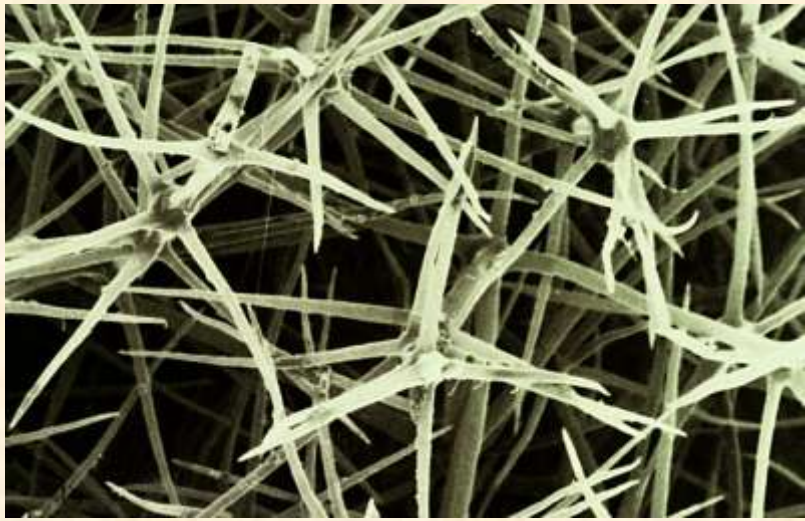




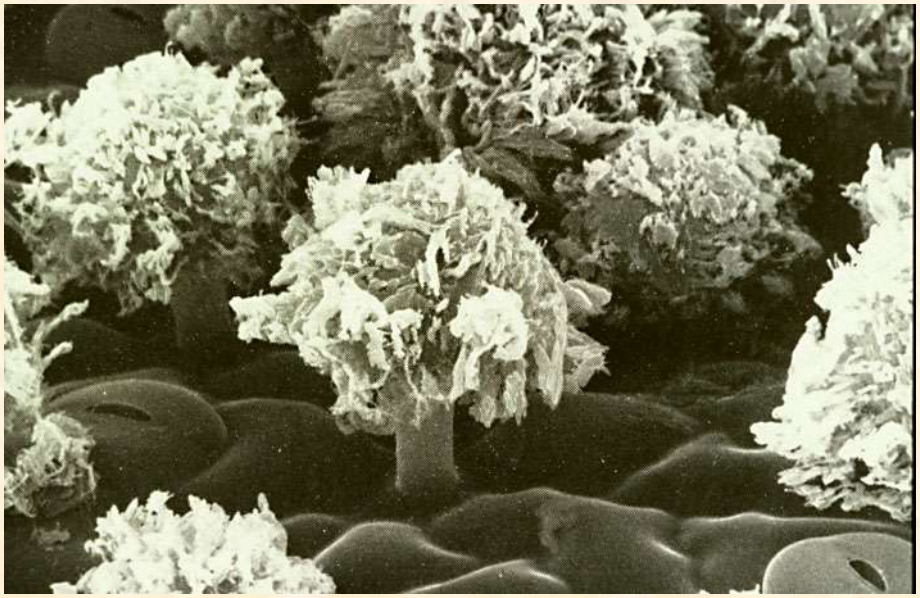
Solanum



Cannabis



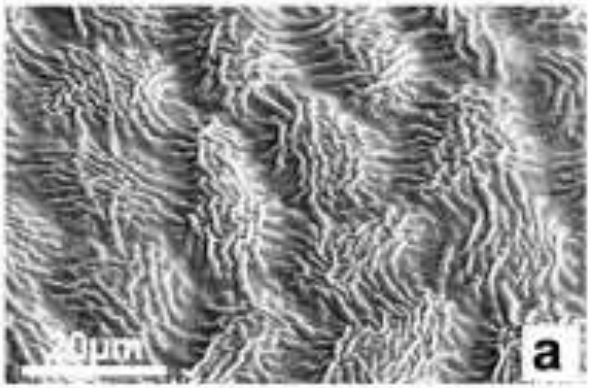
Arabidopsis

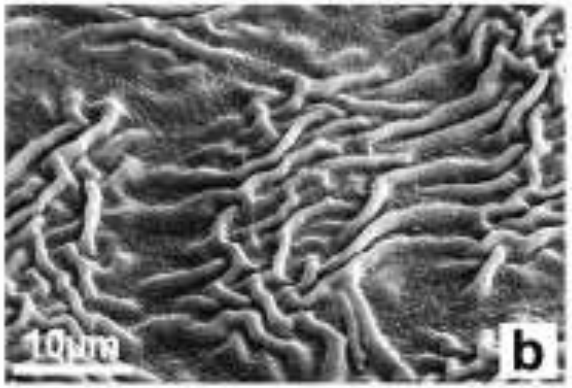


Primula

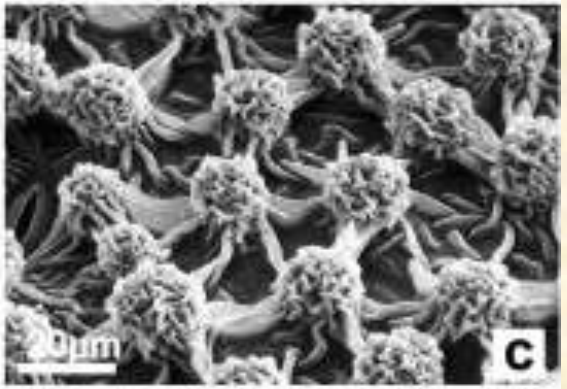
Eleagnus

Cell surface structuring by cuticular folds

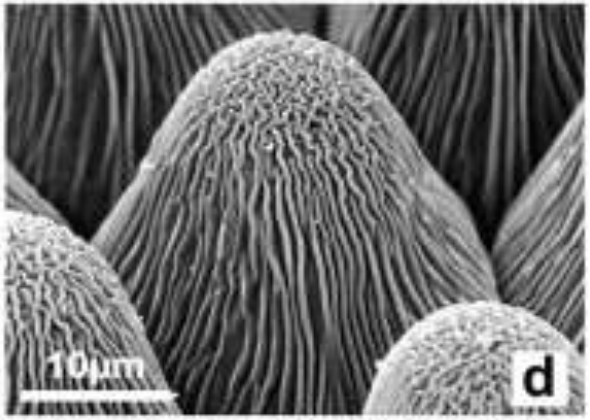




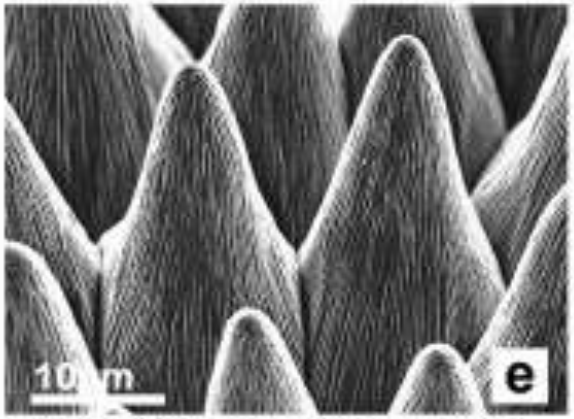
Schismantoglottis neoguinensis: upper leaf (a) side and a detail in (b)



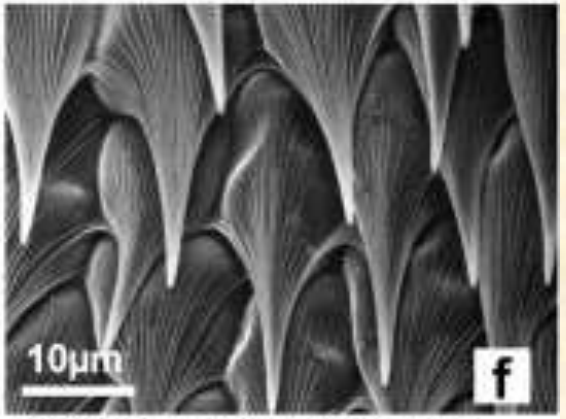
Alocasia macrorhiza: lower leaf side



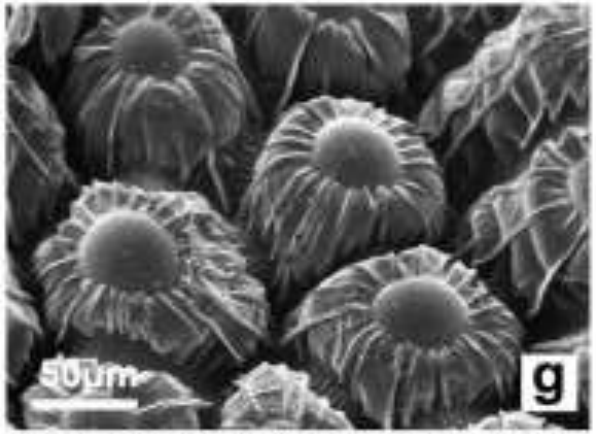
Rosa montana: upper side flower leaf



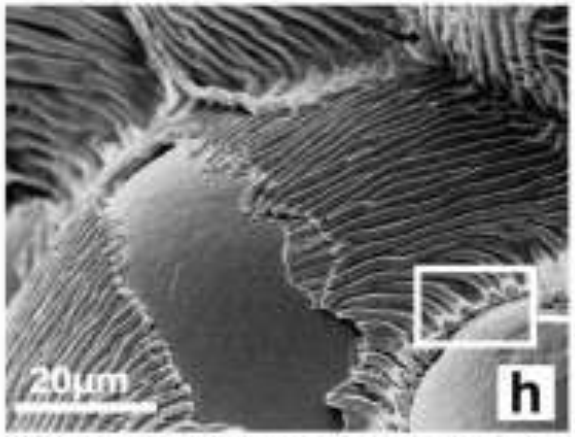
Violoa tricolor: uper side flower leaf

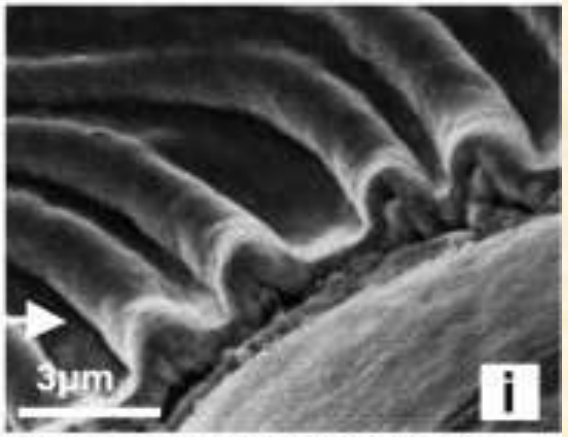


Sarracenia leucophyla: trap leaf



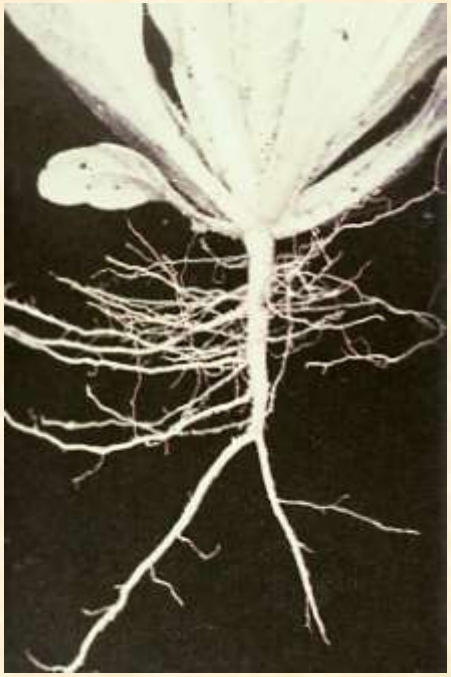
Austrocactus patagonicus: seed surface

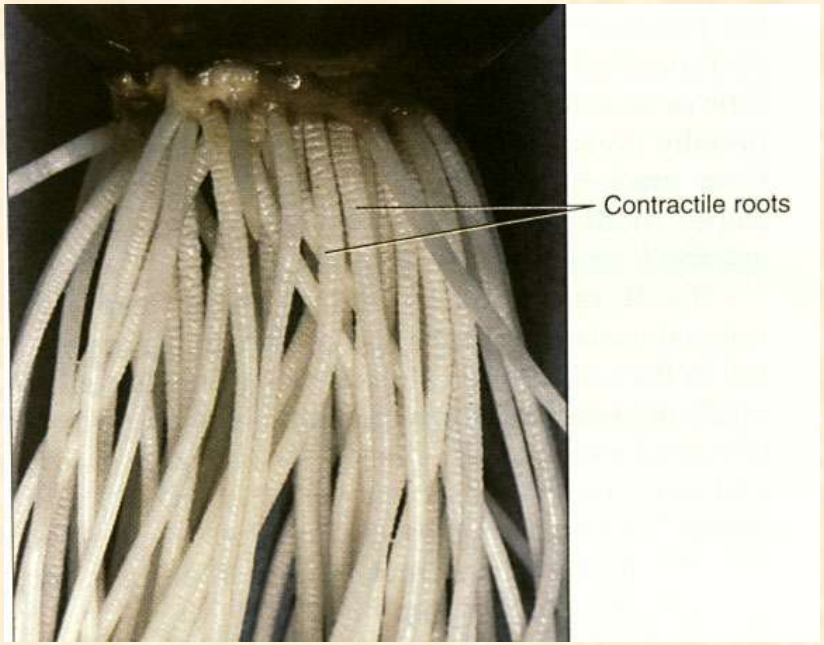




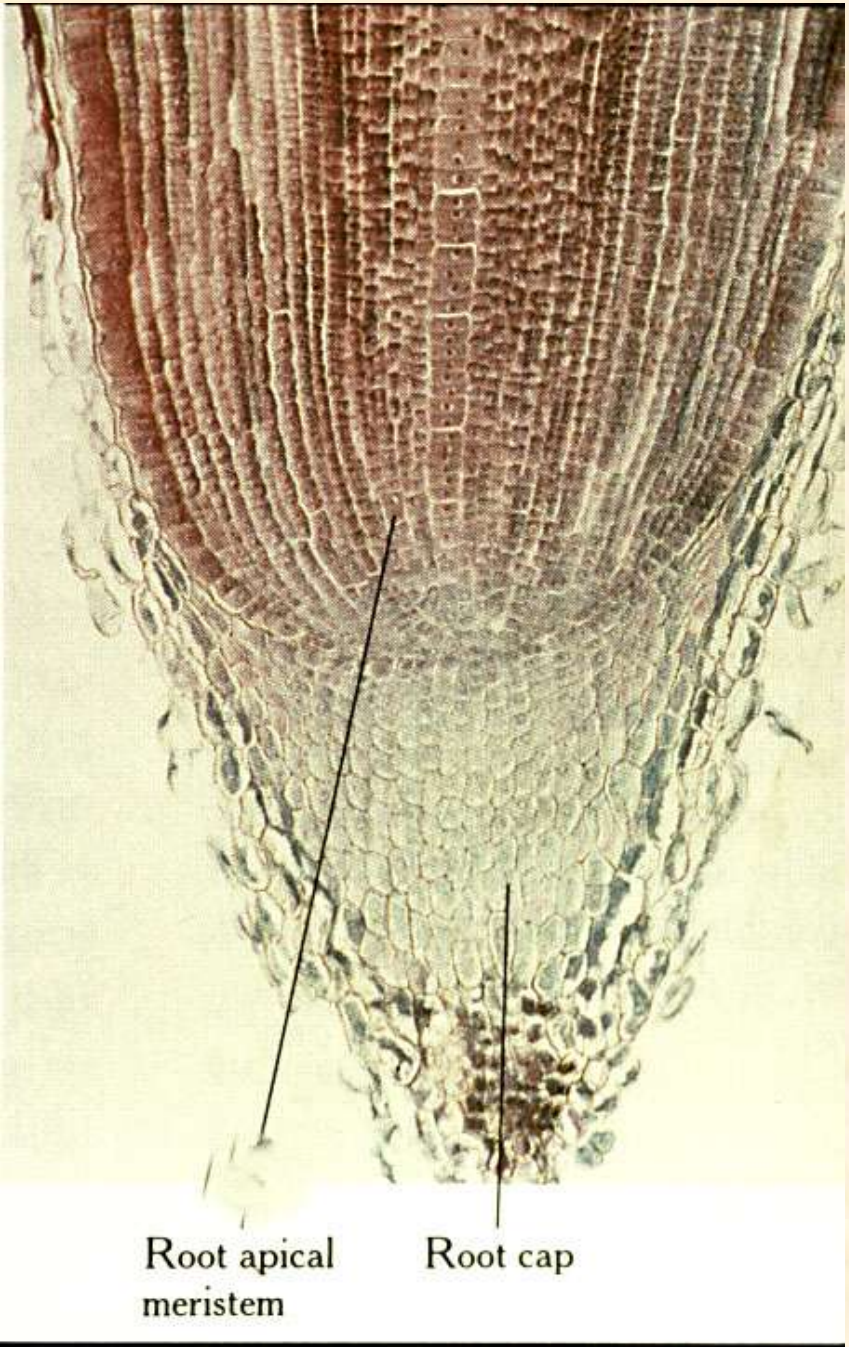
Aztekium ritteri: seed cells with a partial removed cuticle (h) and a detail (i)

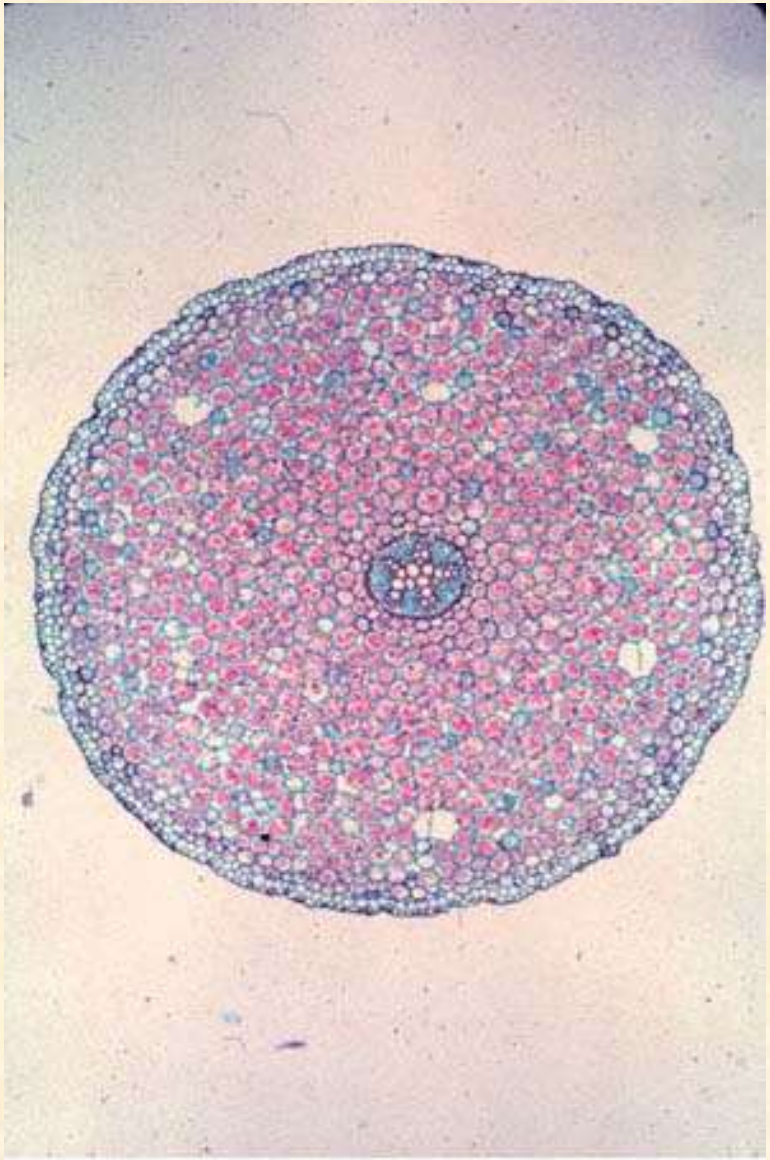
Root Anatomy





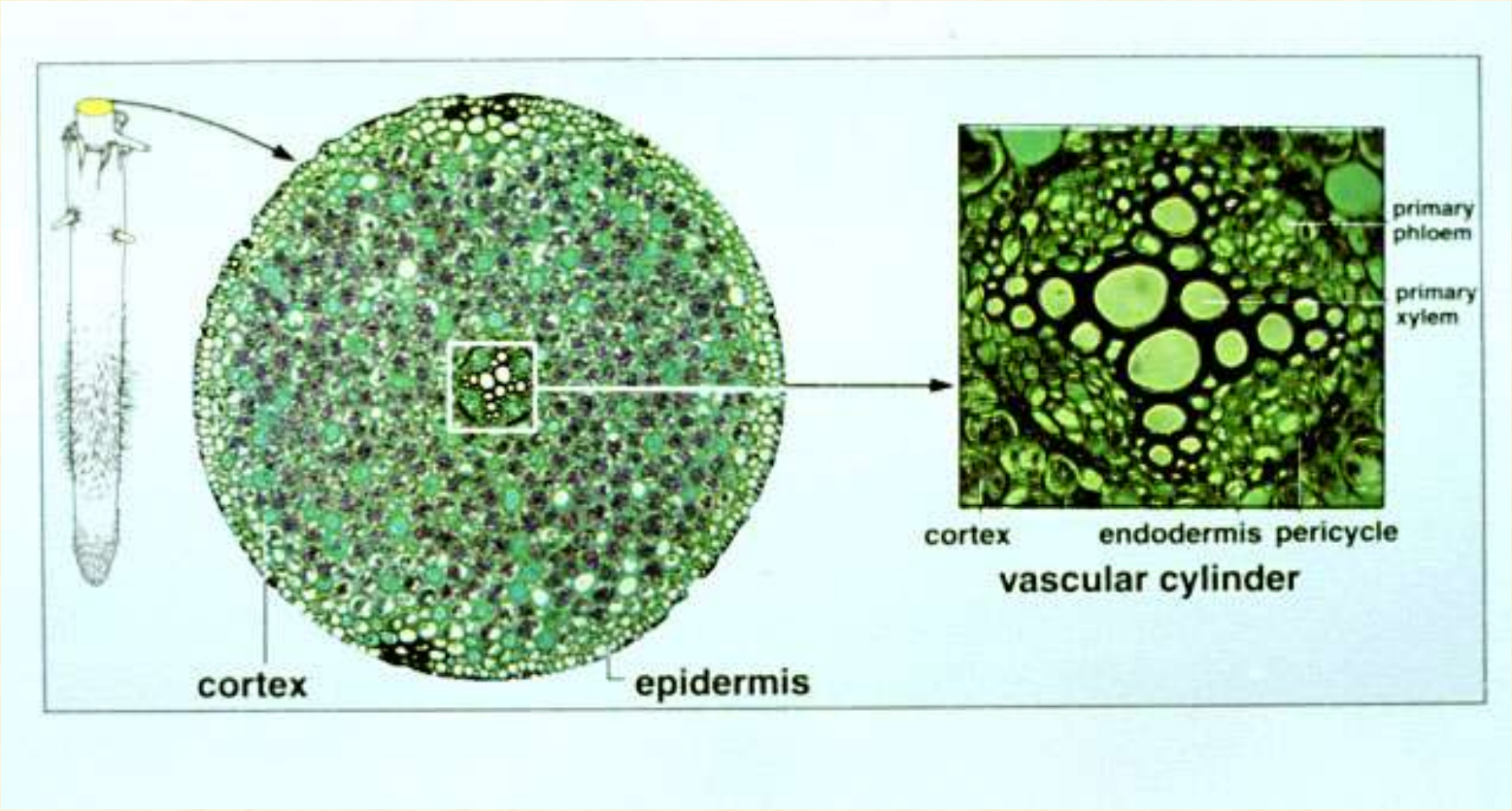
Root Anatomy

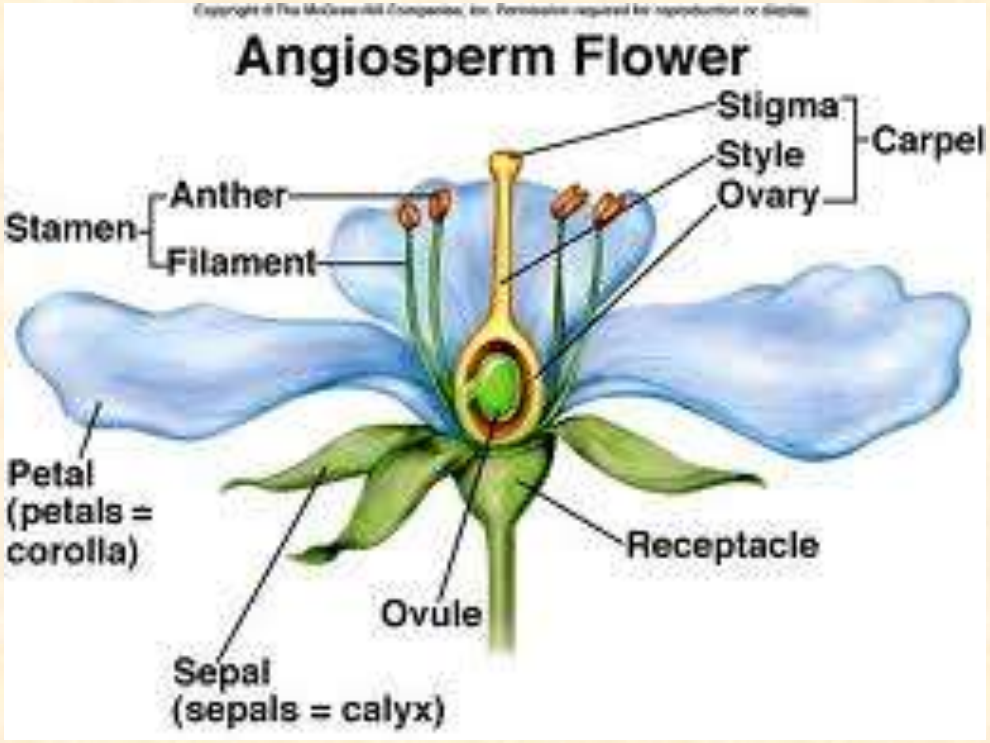




Mature Ranunculus root cross section.

Root Anatomy




Angiosperm Flower
Stigma
Style
Ovary
Carpel
Anther
Stamen
Filament
Petal
(petals =
corolla)
Receptacle
Ovule
Sepal
(sepals = calyx)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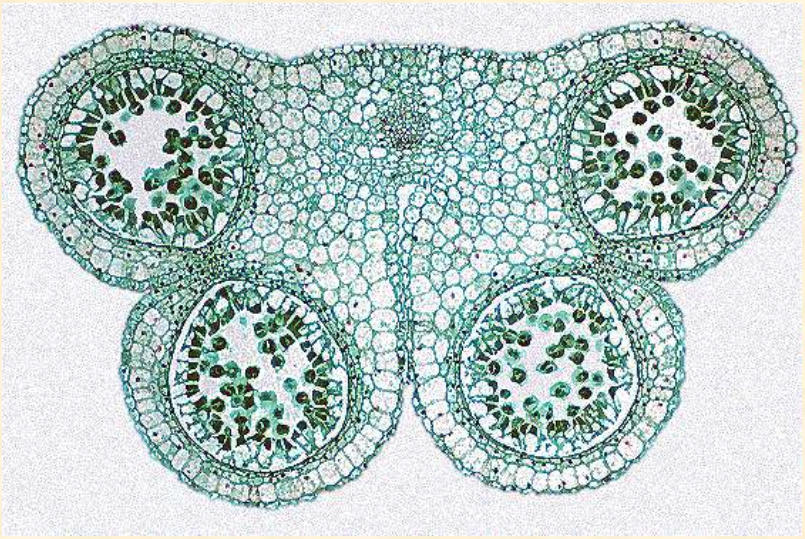
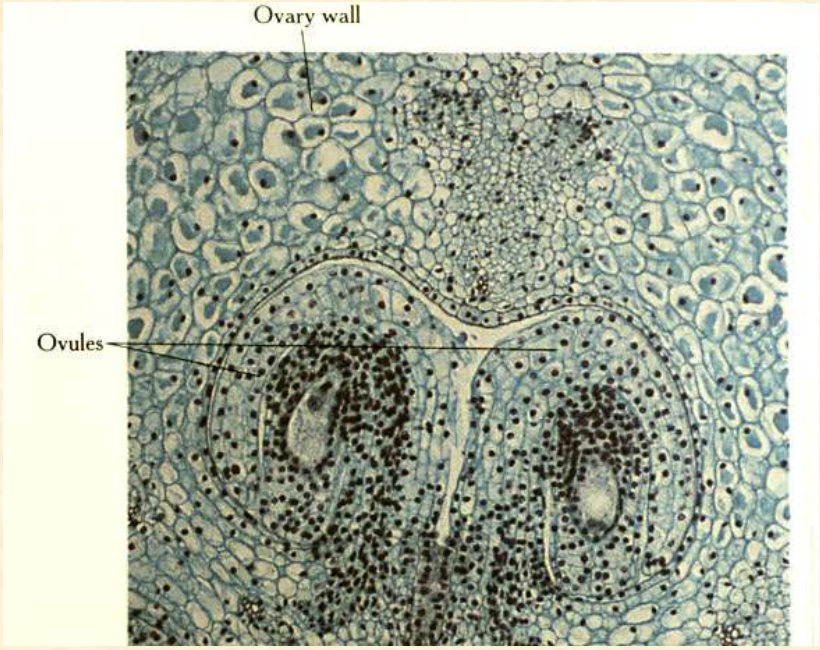
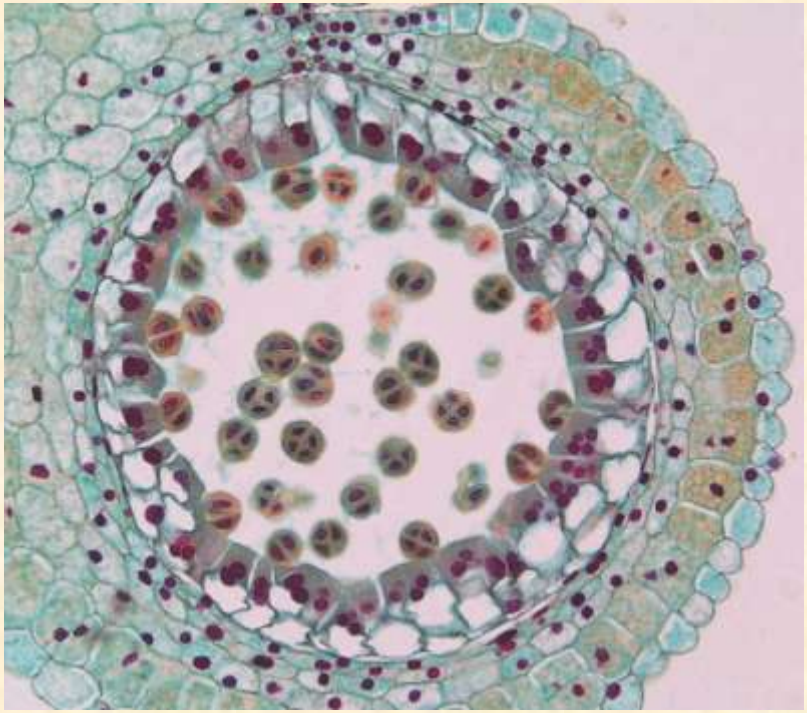
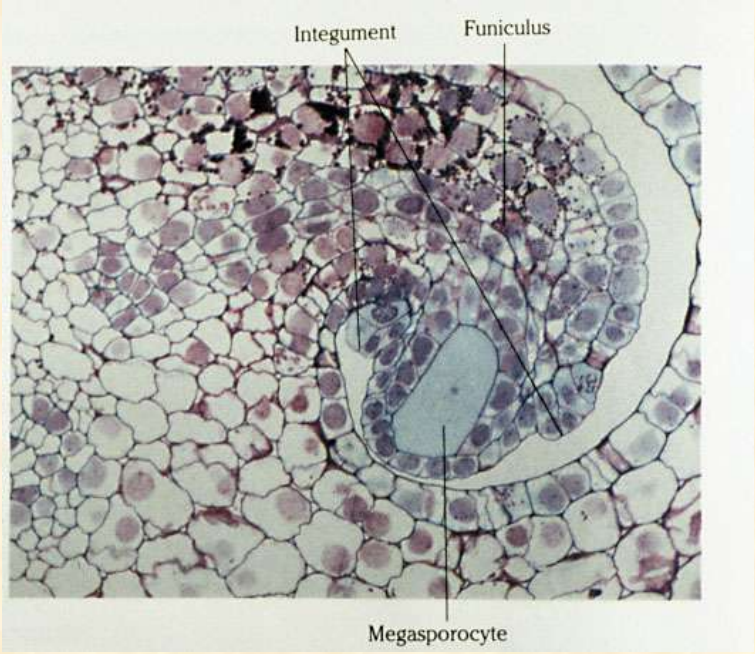
Lilium Anther

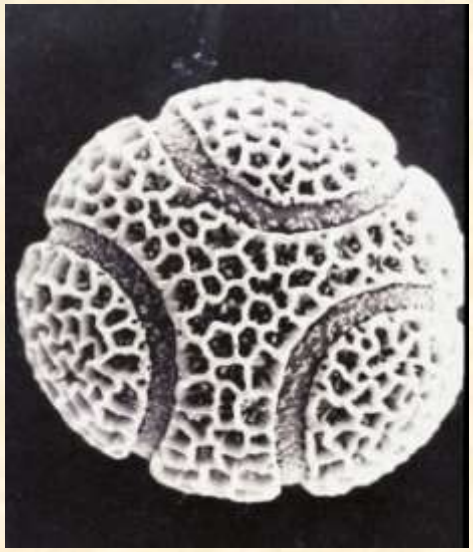


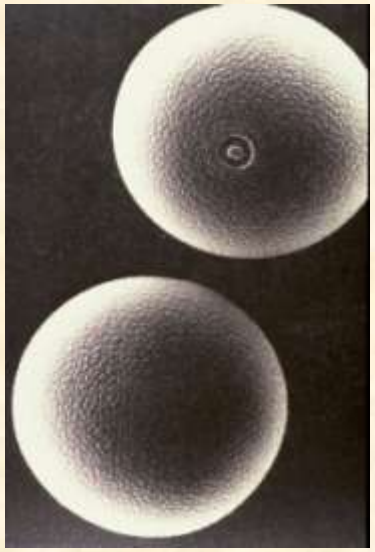


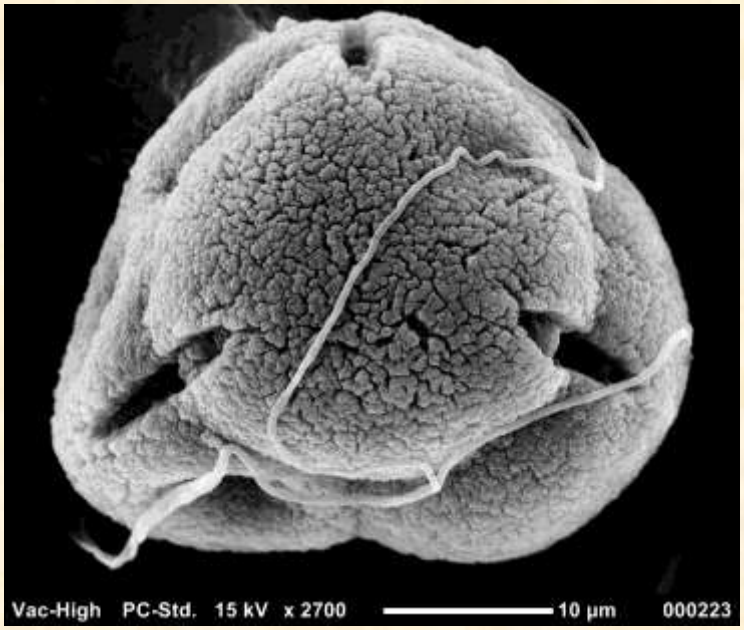




Pollen







http://davidbogler.com/Pollen/pollen.html
simultaneous microsporogenesis
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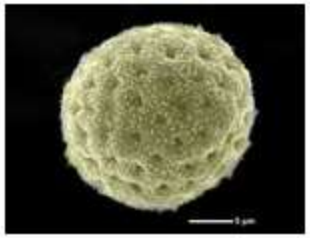
Favorites
Missouri Pollen Project
Page Safety Tools

Missouri Pollen Project

Welcome to the Missouri Pollen Project (MPP). Here you will find illustrations, descriptions, and keys to identification of pollen grains from plants of Missouri and much of the Midwestern United States. The goal is to provide a means of identifying pollen, as well as summarizing what is known about pollination biology of Missouri plants. The MPP is part of a larger long-term project to develop baseline data on pollen and pollinators in natural and altered communities, information that may be useful in a changing world. The keys and images will also be useful to botanists, entomologists, archeologists, paleobotanists, allergists and many others.

Navigating the MPP pages is quite simple. Individual pages for each genus are accessed through the **Interactive Pollen Key**. Here you will find a list of pollen characters on the left and a list of plant taxa on the right. You may scroll down the list of

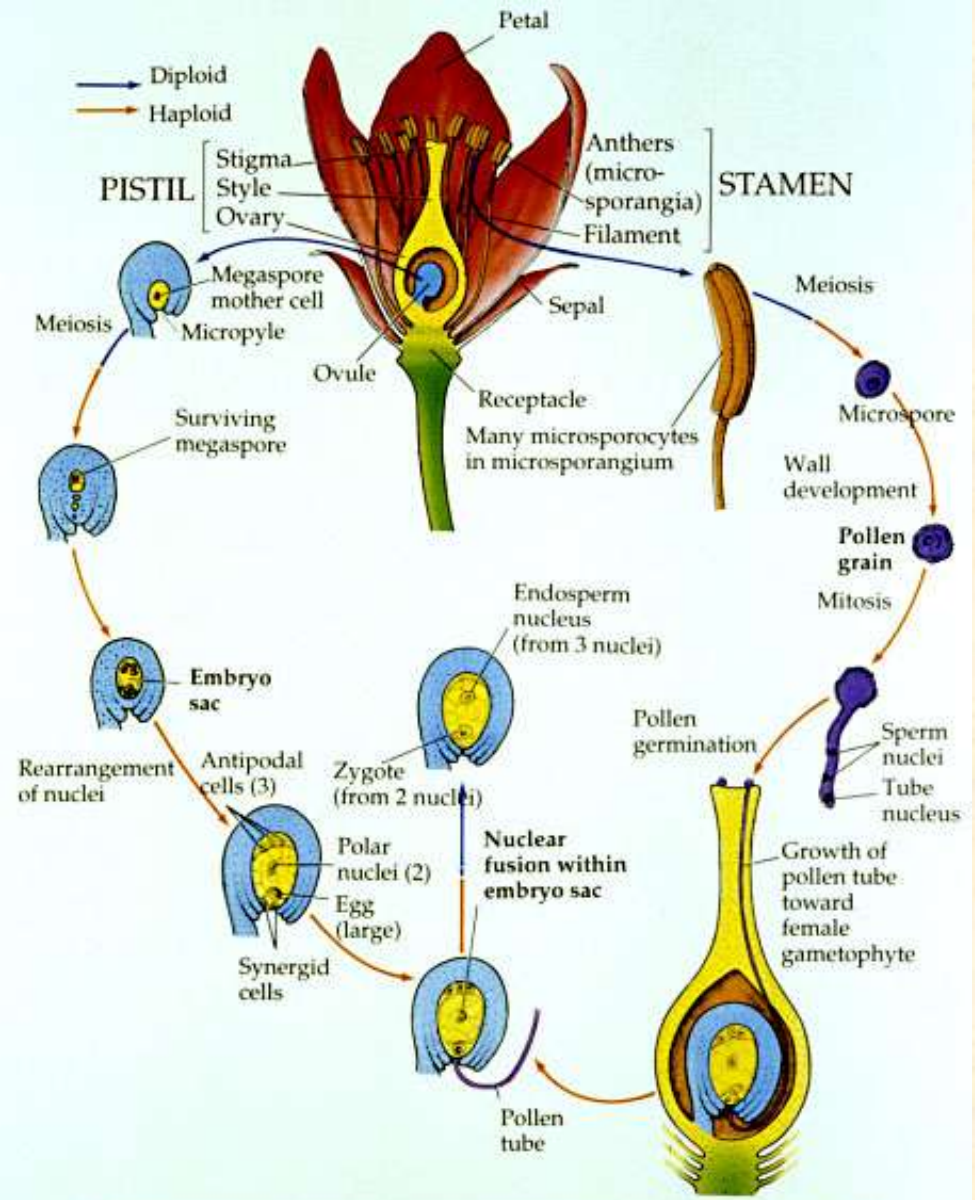
New Arrivals



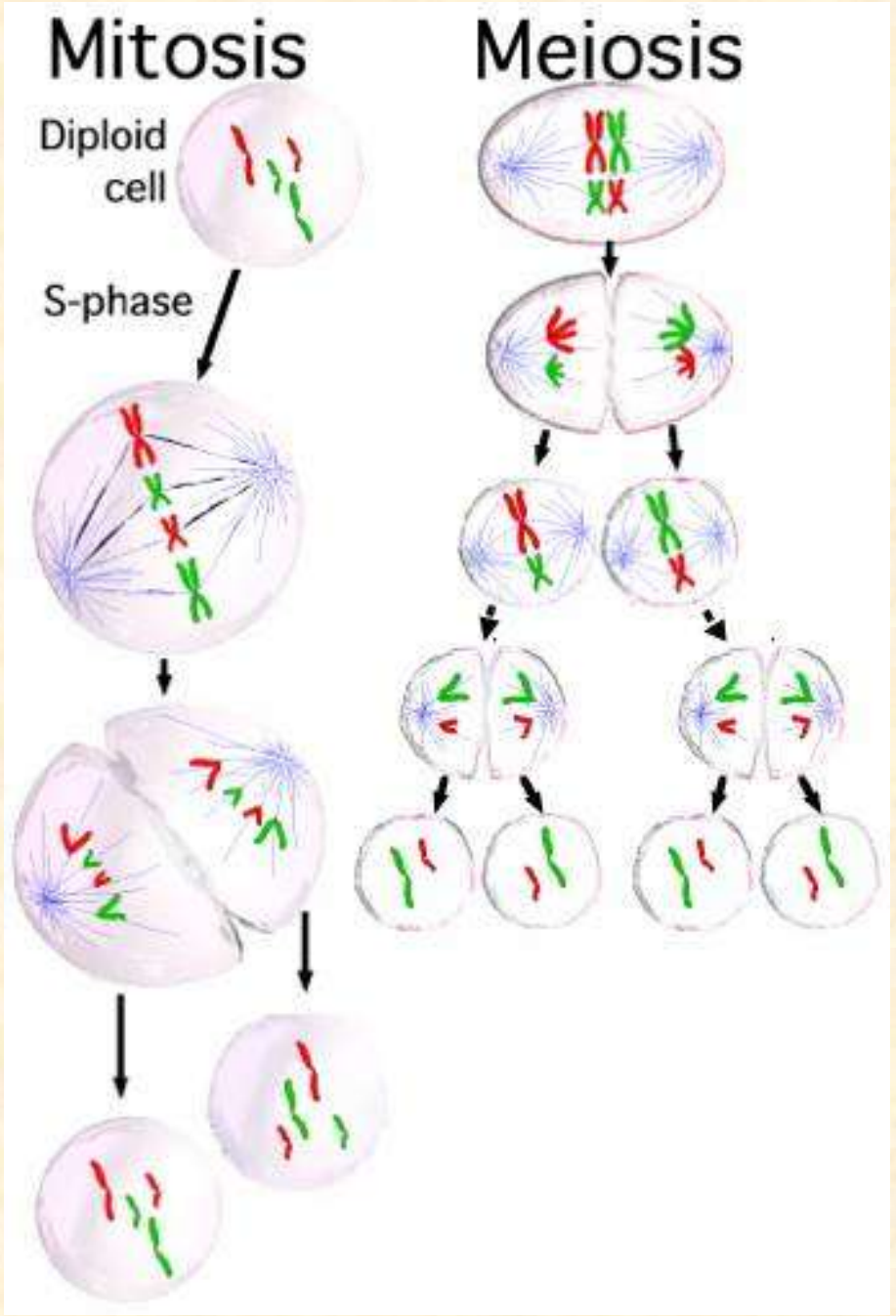
Chenopodium

Celastrus

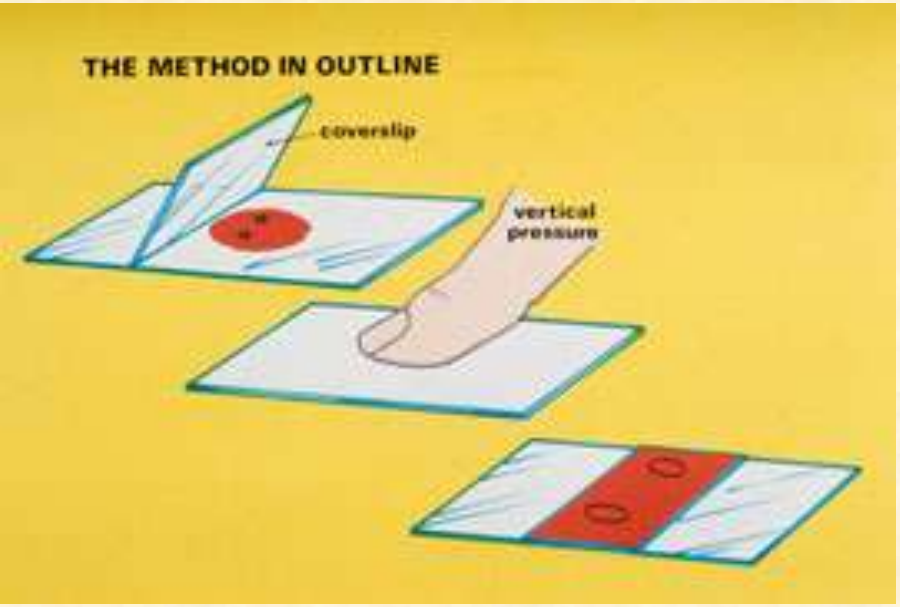
Internet 100%

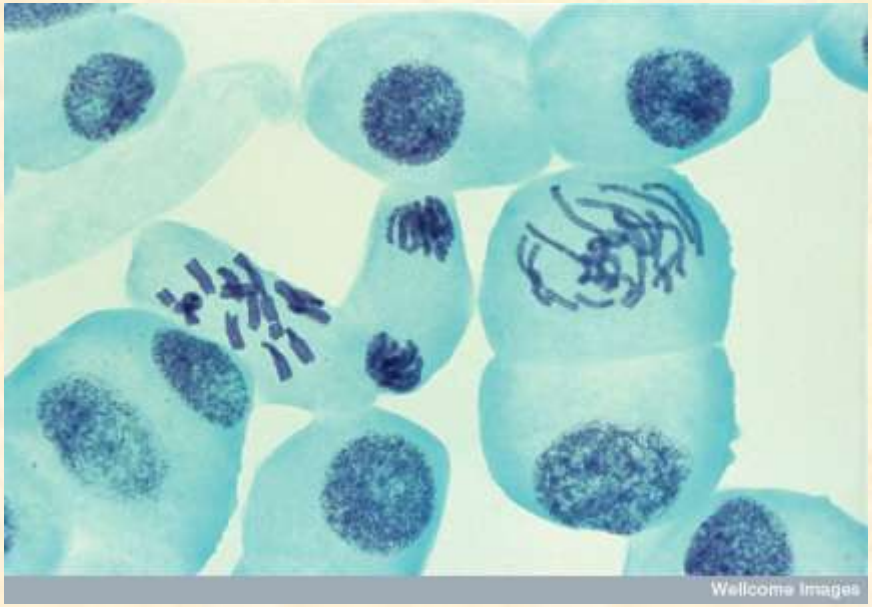


183 Development of Gametophytes and Nuclear Fusion, Figure 34.1



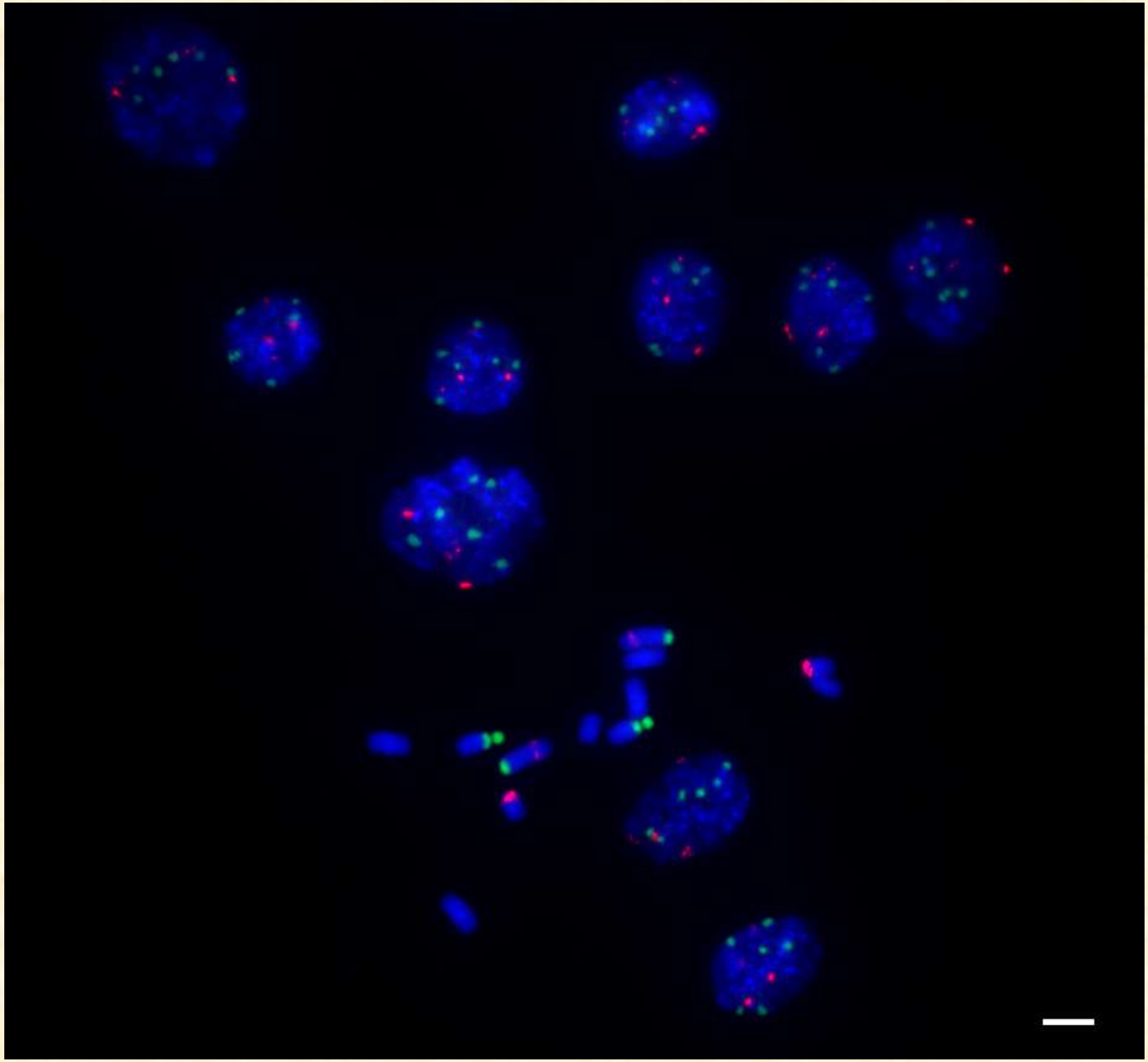
Root Tip Squash





FISH – Flourescence In Situ Hybridization

Tragopogon



End