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PAPER – V - ANATOMY AND EMBRYOLOGY

Unit - 3

Anther Development &Microsprogenesis

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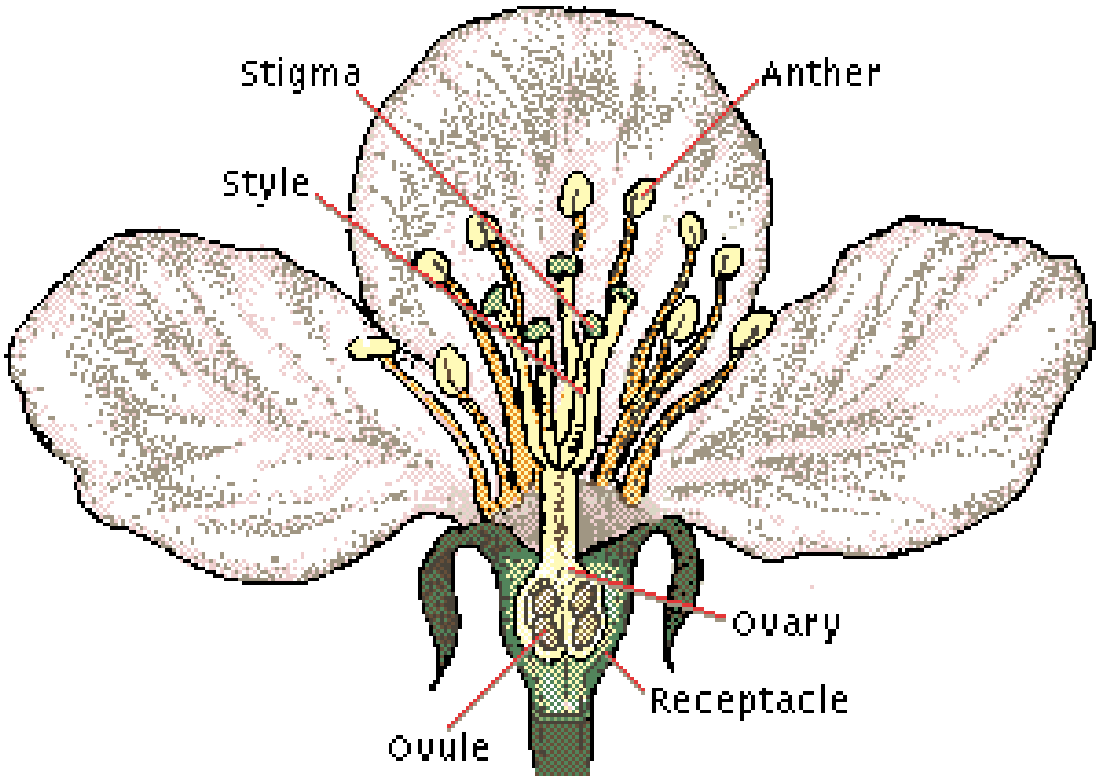
Parts Of Flower



The Stamen

Stamen in a flower consists of two parts, the long narrow stalk like filament and upper broader knob-like bi-lobed anther (Fig. 2.3 A).

The proximal end of the filament is attached to the thalamus or petal of the flower. The number and length of stamens vary in different species.

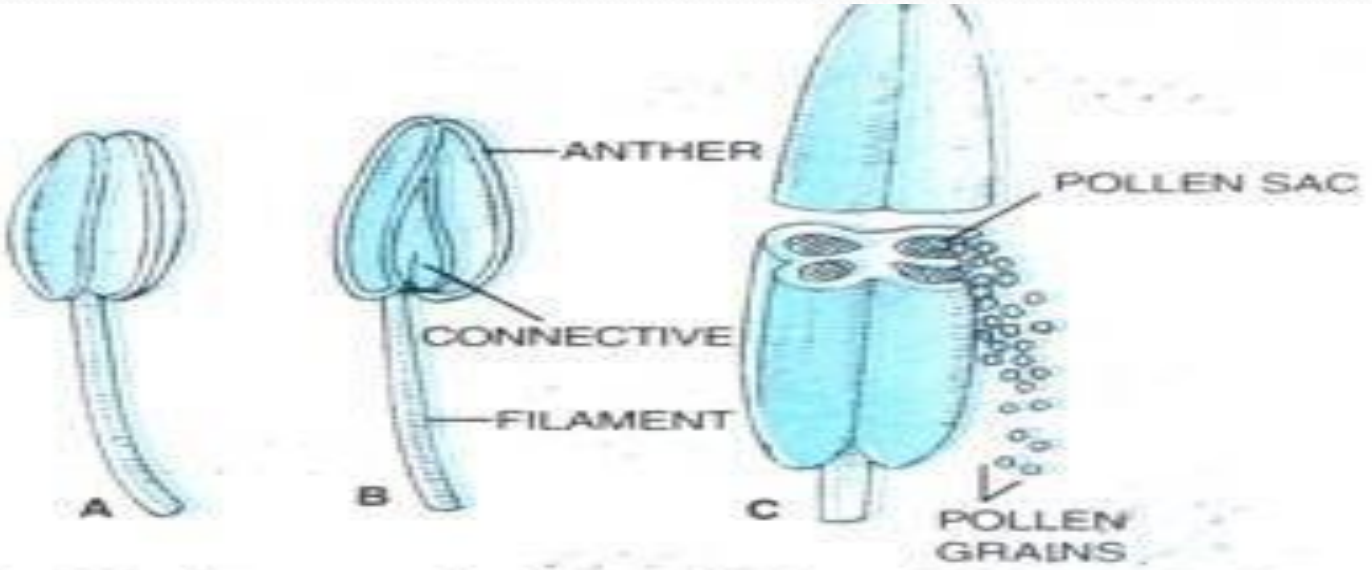
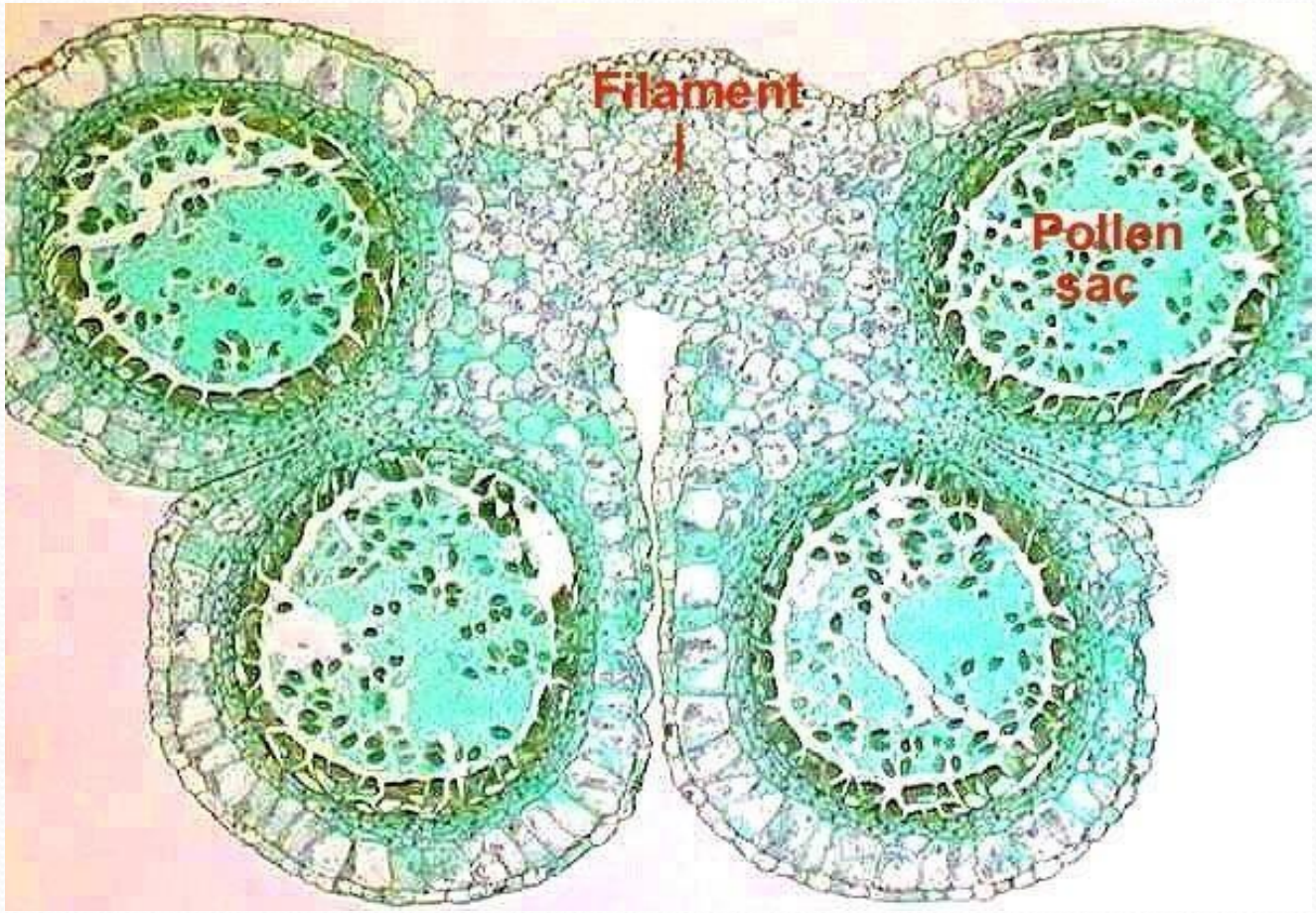


Fig. 2.3. Stamen. A. Ventral view; B. Dorsal view; C. Three dimensional cut section of Anther (Enlarged).

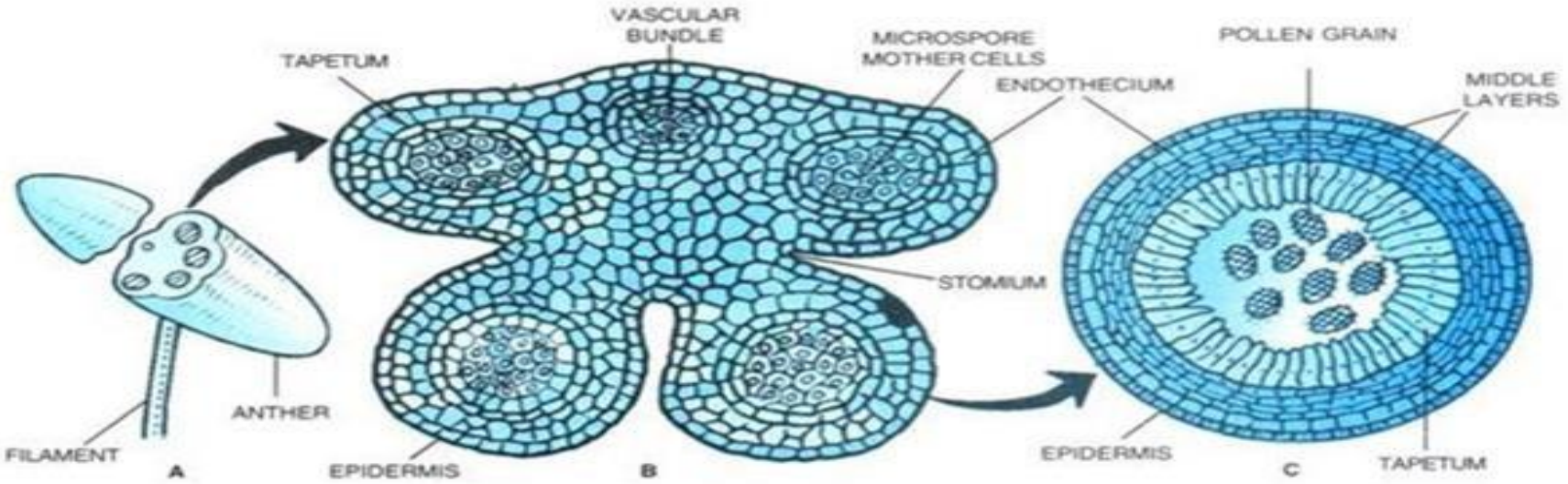
T.S. OF Anther



Structure Of Anther (Microsporangium)

- Bilobed and dithecus.
- A longitudinal groove separate the theca.
- In a cross- section anther is a tetragonal structure, consisting of 4 microsporangia, two in each lobes.
- Later two microsporangia of each lobe fuse as a pollen sac.

Structure of microsporangium (pollen sac)



T.S. anther, showing stomium and pollen grains.

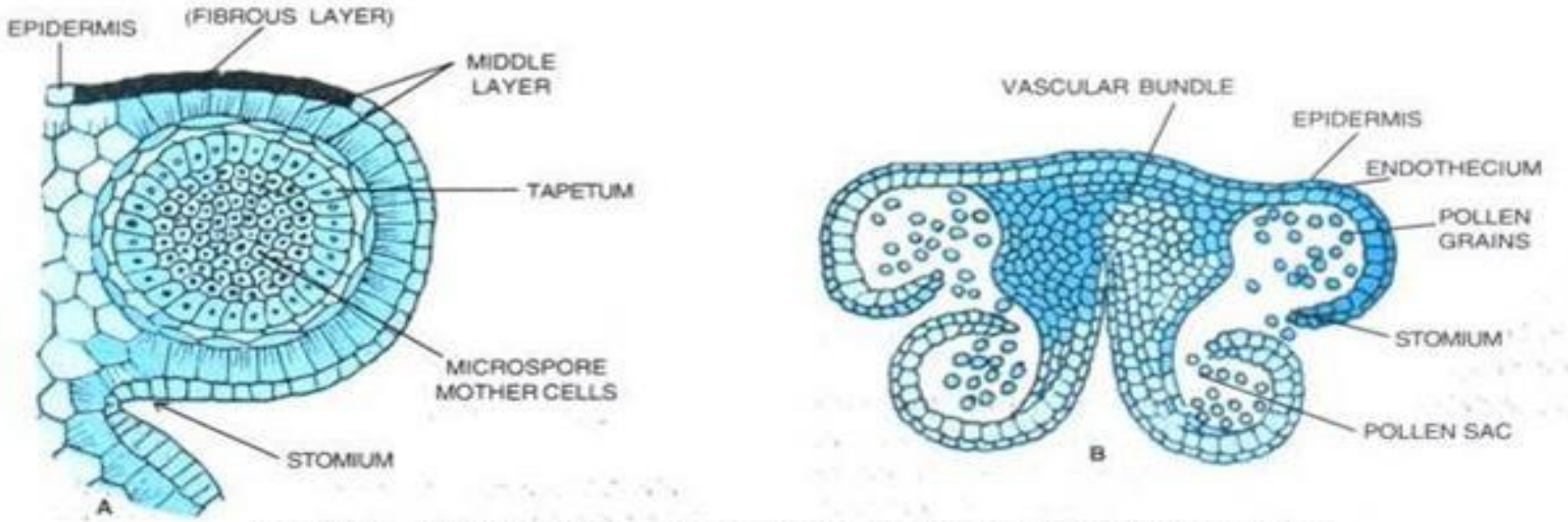


Fig. 2.5. A. Detailed structure of one young pollen sac; **B.** T.S. mature anther.

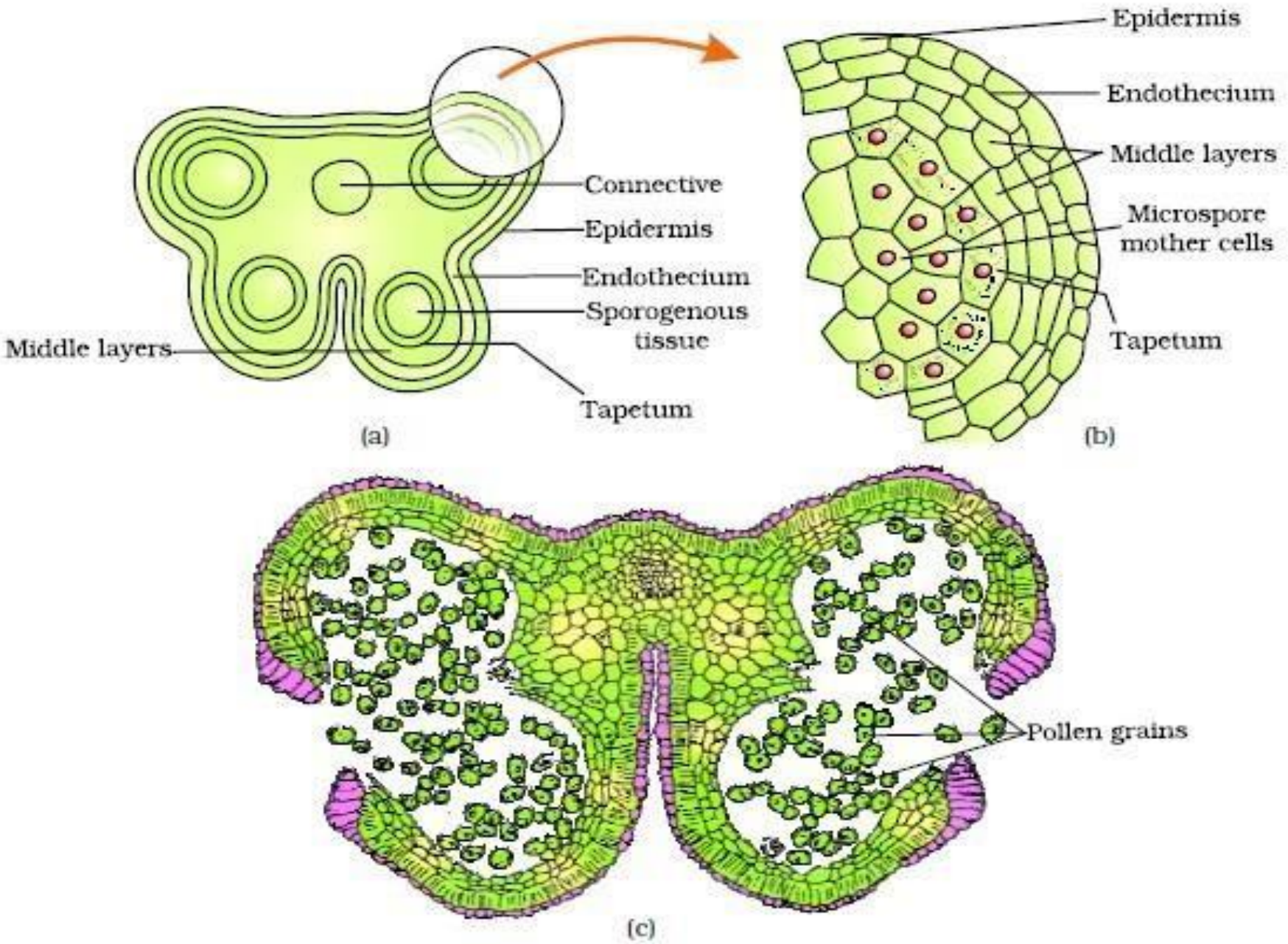
Structure Of Anther

- A microsporangium is circular and surrounded by 4 layers.
- These layers are -
  - Epidermis,
  - Endothecium,
  - Middle layers
  - Tapetum.
- Outermost layers protect the pollen and help in dehiscence of anther to releasepollen.

Function of anther cell and tissue types

Table1.1 : Function of anther cell and tissue types

Cell or Tissue Types	Major Function
Connective	Join anther thecae together; connect anther to filament, provide structure, support and morphology.
Circular cell cluster	Dehiscence
Endothecium	Structure and support; dehiscence.
Epidermis	Structure and support; prevent water loss; gas exchange; and dehiscence.
Microspore	Pollen grain and sperm cell development.
Middle layer	Structure and support; dehiscence.
Stomium	Dehiscence
Tapetum	Pollen wall components; nutrients for pollen development; enzymes for microspore release from tetrads.
Vascular Bundle	Connection between anther, filament, and flower; nutrient and water supply.



(a) Transverse section of a young anther; (b) Enlarged view of one microsporangium showing wall layers; (c) A mature dehisced anther

- Anther first appears as a cylindrical structure composed of a mass of meristematic cells.
- Which consists of three “germ’ layers designated as L1, L2 and L3, which gives rise to different anther tissues.
- Thus ones specified the development fate of L1, L2, and L3 layer derivatives is fixed

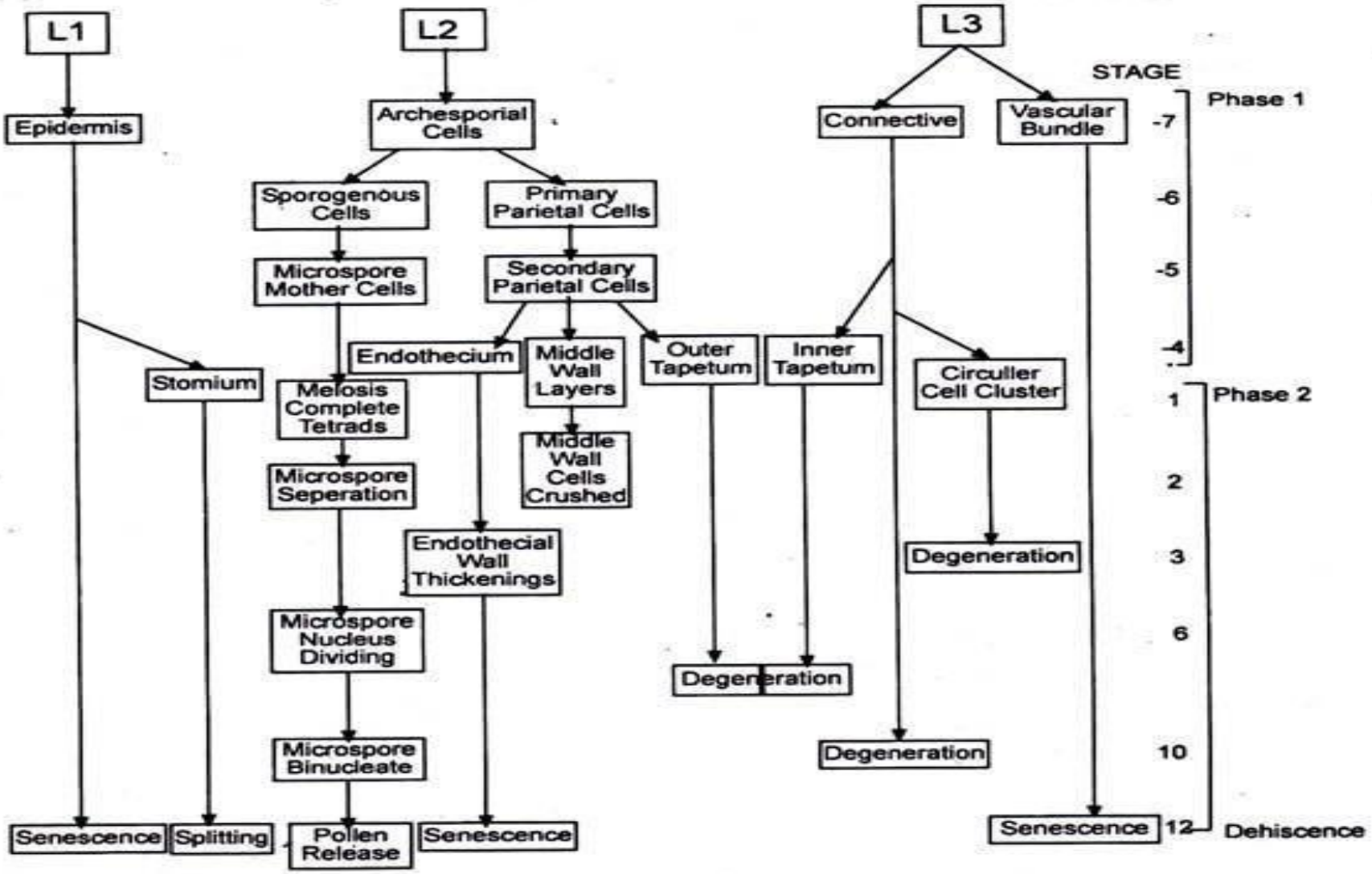


Fig. 1.2 : Cell lineage and major events that occur during anther differentiation and dehiscence along with histological observations of the L1, L2 and L3 derivatives of a tobacco stamen primordium.

- In most cases individual tissues and cell types are derived from a single germ layer.
- For instance L1 layer gives rise to the epidermis and stomium. The former is greatly stretched and flattened in a mature anther.
- The stomium is located between the two locules of each anther lobe, and the cells in this region are thin walled and in the form of a longitudinal slit.
- The L2 layer gives rise to the archesporial cells, microspore mother cells, endothecium, and middle wall layers that lie between the epidermis and the tapetum.
- The archesporial cells are hypodermal in origin and consist of one to more vertical rows of large cells with dense cytoplasm and deeply staining nuclei.
- The cells divide periclinally into primary parietal cell toward the periphery and sporogenous cell toward the inside

- The parietal cells undergo a series of periclinal and anticlinal divisions to form two to five concentric layers of anther wall [endothecium, middle wall layers (three layered) and outer tapetum].
- The L3 layer gives rise to the connective, vascular bundle, and circular cell cluster adjacent to the stomium.
- Both the L2 and L3 layers contribute to tapetum formation.
- Tapetal cells along the upper portion (inner) of the pollen sacs are specified from the L3-derived connective tissue, whereas those that line the lower portion (outer) of the pollen sacs are specified from the L2- derived archesporial lineage.
- Archesporial cells destined to differentiate into microsporangia and surrounding tapetum and endothecium tissue, arise simultaneously in each corner of the anther primordium,
- while the vascular tissues differentiate within the centre of the anther primordium and establish a connection with the filament.

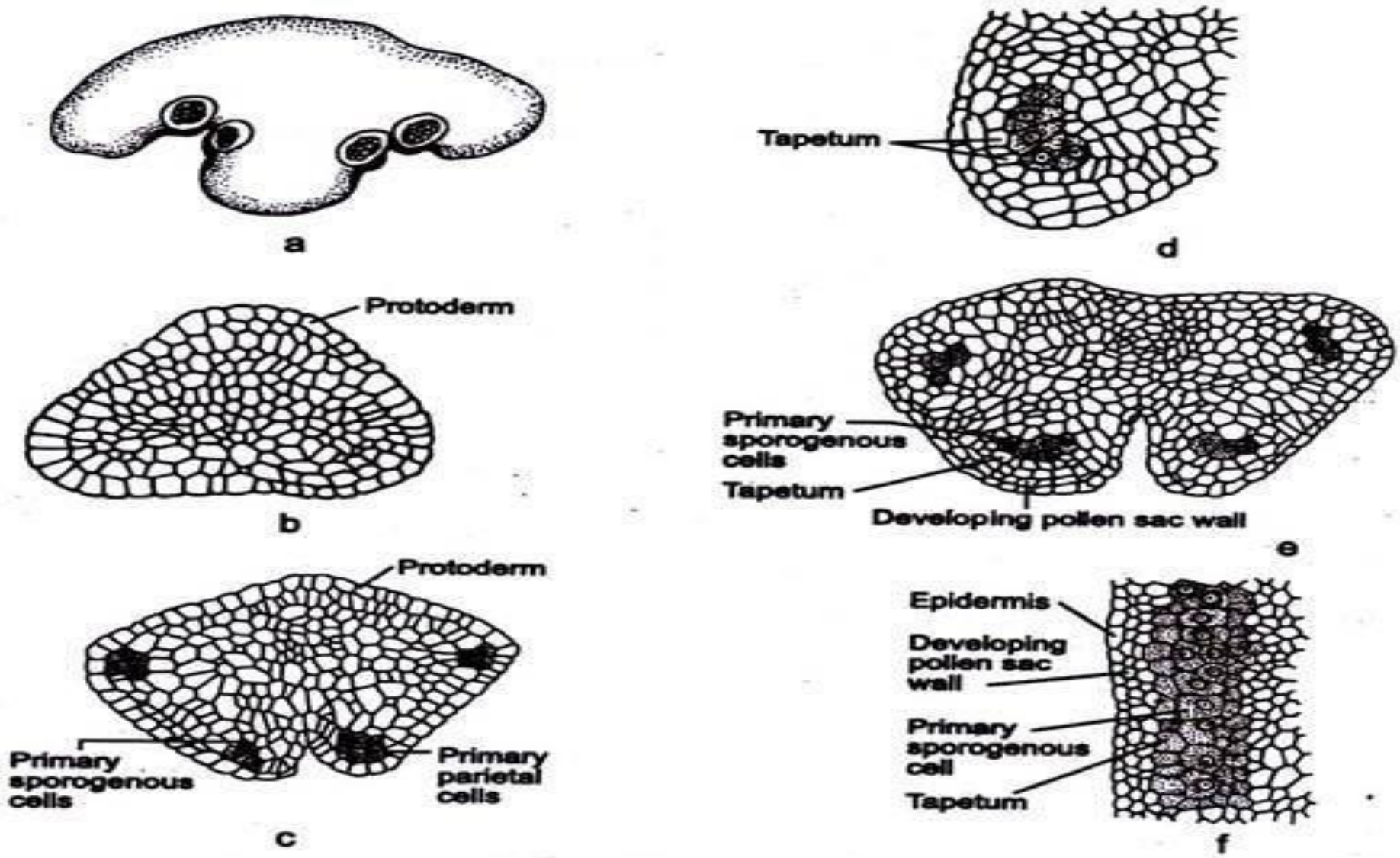


Fig. 1.3 : Development of different tissues of anther in *Vinca rosea*. a-e-cross section, and f- longitudinal section.

ANTHERWALL

- Epidermis – The epidermis is a single layered protective sheath of the anther. It divides anticlinally and tries to keep space with the enlarging internal tissues of the anther.
- It provides the structural integrity to the anther, assists in gaseous diffusion, prevents moisture loss, and in the dehiscence of the anther lobes.

ANTHERWALL

Endothecium

- The outer most layers of the descendants of the parietal cell located immediately below the epidermis are called the endothecium.
- It attains the maximum development before the dehiscence of the anther.
- The cells are radially elongated and decorated with fibrous bands
- The endothecium is associated with high proportion of α-cellulose and small amount of lignin at maturity.
- The specialized nature of the endothecium together with the stomium helps in the dehiscence of the anther.

Middle layers

- Next to endothecium are 1-3 middle layers.
- The cells of the middle layer are usually ephemeral and become flattened and crushed by early meiosis in the pollen mother cell.
- The layers persist in Ranunculus and Lilium, and the layer adjacent to the endothecium may even develop fibrous thickenings.
- In few instances it also serves to store starch that is later mobilized to the developing pollen

Tapetum- it is the innermost layer of anther wall and is usually derived from the parietal layer

- It is composed of single layer of cell characters by dense protoplasm and prominent nuclei.
- The tapetum surrounds the sporogenous tissue and attains maximum development when the microspores are in the tetrad stage, After which they go into decline that results in the collapse of the cells.

The cells of the tapetum are characterized as:

a. They are distinctly enlarged and always ephemeral.
b. The cytoplasm is rich in ribosomes, mitochondria, E.R., many vesicles and active organelles.
c. Cells may be multinucleate or polyploid and are comparatively rich in DNA.
d. There is irregular mitotic divisions and nuclear fusion.
e. They are characterized by rapid and intense activity with degeneration of their cytoplasm.

Behaviour of the Nucleus in the Tapetal Cells

- Tapetal cells undergo dynamic instabiliy during their short life span.
- The characteristic cytological feature of the tapetal cells, irrespective of the type, is the increase in the content of their DNA'
- which is initiated with meiosis in microsporocytes and extends through the meiotic division.
- DNA increase is not followed by regular mitotic division it results in certain cytological abnormalities, like multinucleate cells, endomitosis, polyploid nuclei, polyteny and endoreduplication.

Endomitosis

It is a condition where chromosome duplication and chromatid separation take place within the intact nuclear membrane and without the formation of a spindle. The consequence is the formation of a large polyploid nucleus.

Multinucleate condition

It is a common feature of the tapetal cells, where the nuclear division is synchronous in amoeboid type and asynchronous in secretory type of tapetum and is not accompanied by cytokinesis. Based on the number of nuclear divisions, cells may have 2, 4, 8, or 16 nuclei. In case of nuclear fusion cells outside the expected series of nuclei number may appear.

Restitution nuclei

Mitosis is normal up to the early stage of anaphase, from then onward the two chromosome sets are included within a common nuclear membrane, thus forming a restitution nucleus.

Polyteny

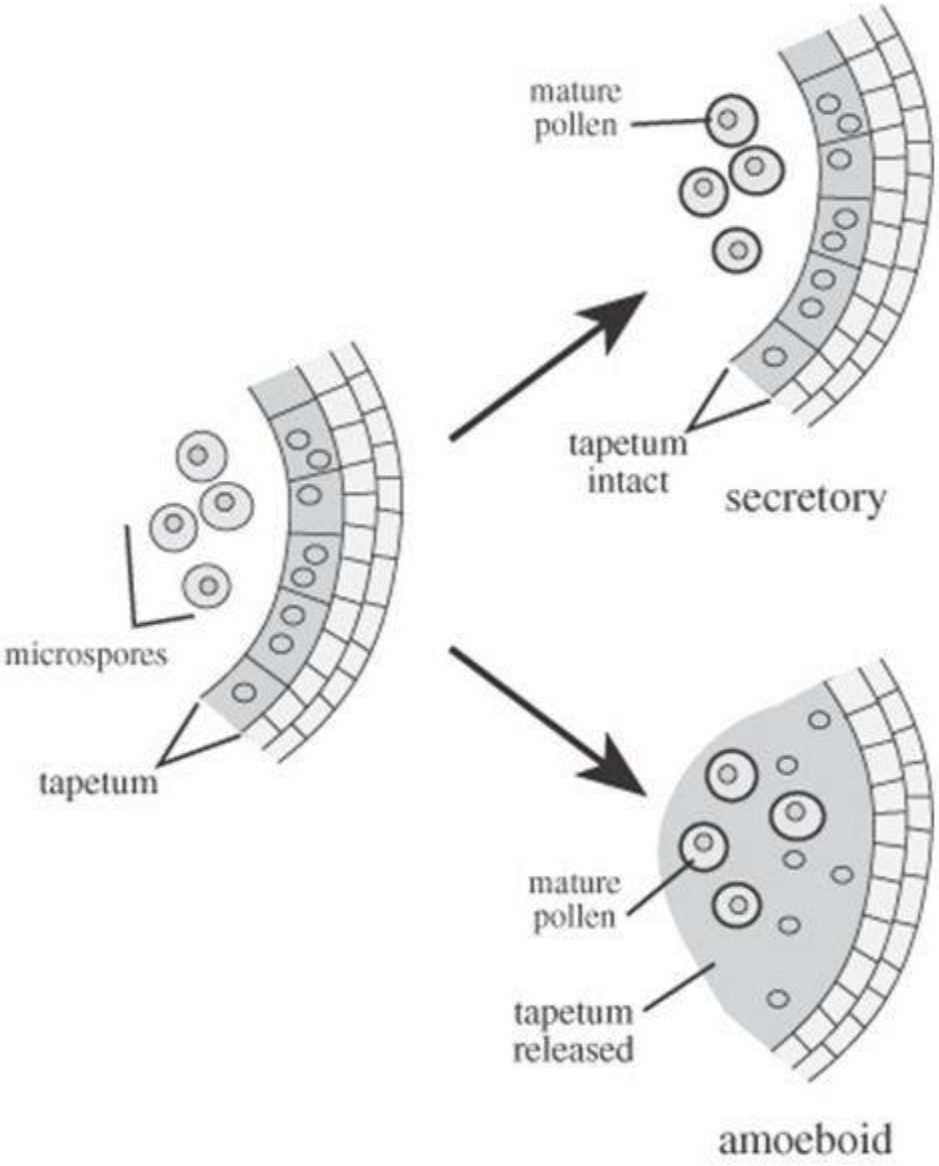
It is a case of increase in chromonemata number per chromosome, thus there is alternation in chromosome number per nucleus

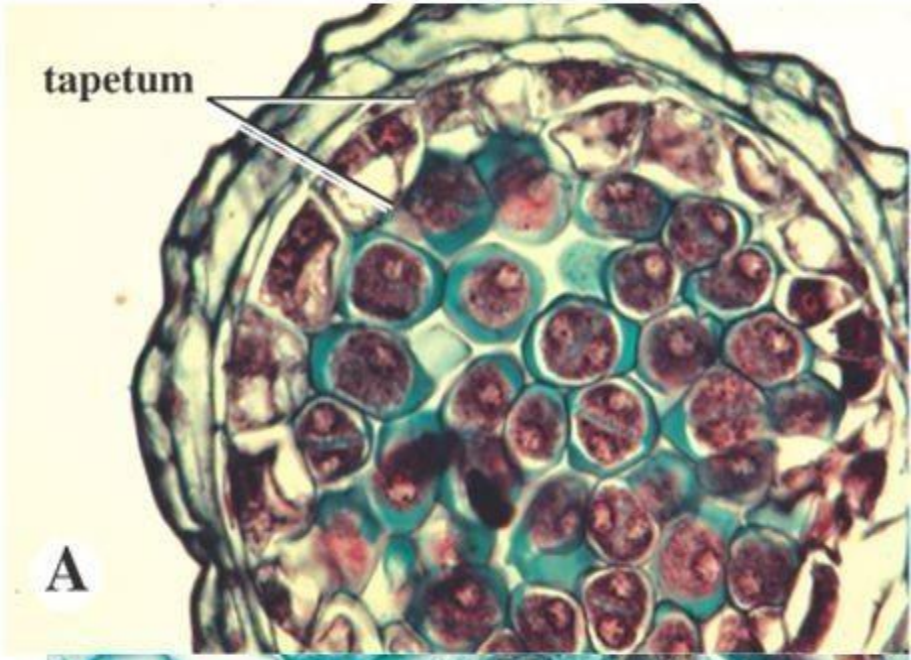
- Depending upon behavior tapetum is of 2 type

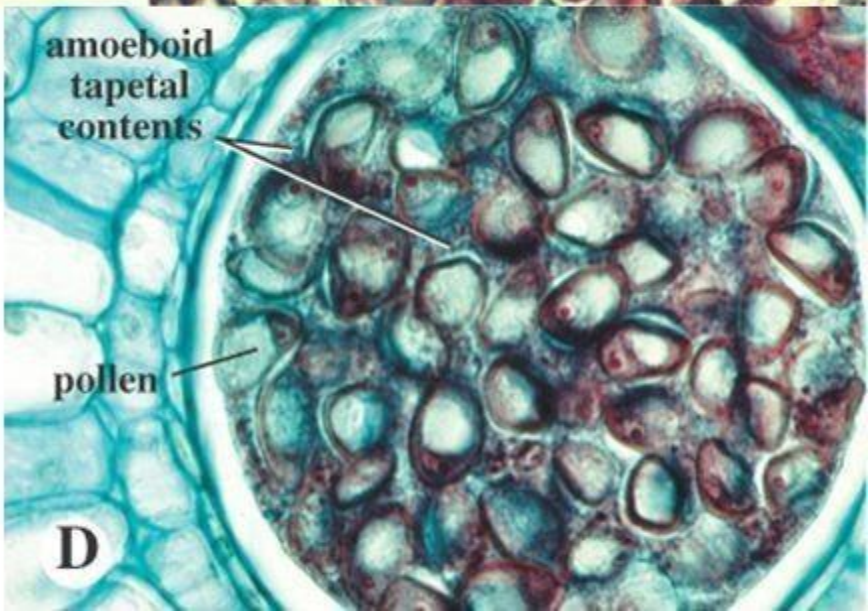
1. Amoeboid or Invasive or Periplasmodial Tapetum- it is of primitive type. later during the drying up process of anther, periplasmodium hydrates and deposits as tryphine on the wall of pollen grain.

1. Secretory tapetum-secretory tapetal cell remain attached to middle layer till the development of pollen grains . It is more common among angiosperm

Tapetum type







Function of tapetum

- It provide nourishment to the developing pollen grain
- It help in the formation of exine
- It hepls in the transport of food material to inside of the anther
- Tapetum helps in the formation of pollen wall
- It helps in the secretion of the enzyme callase (β-1,3- glucanase) to dissolve the callosic wall of the tetrad and set them free.

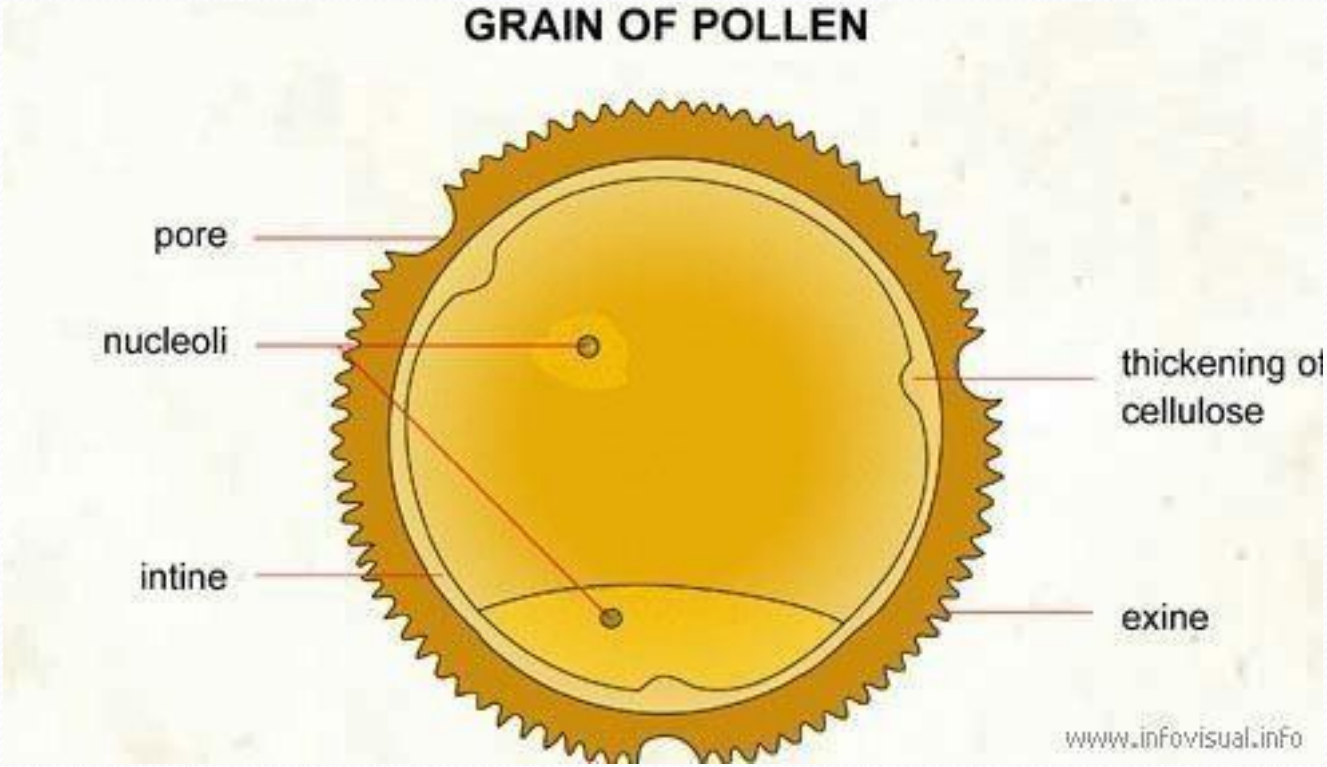
- Secretion of polysaccharides into the locules during the free microspore stage, which are absorbed by microspores
- The role of the tapetal cells in the secretion of sporopollenin precursor
- Onagraceae tapetal cells play a role in formation of fine flexible threads, known as viscin threads, in continuation with the outer layer of the exine
- Asteraceae the tapetum forms an acetolysis resistant membrane outside the sporogenous tissue
- Formation of Ubisch bodies.(small acellular structure of sporopollenin)
- Formation of pollenkitt, and tryphine, which are deposited on the pollen surface and helps to bind pollen grains together, and for efficient insect pollination.
- Formation of pollen wall during post- meiotic period

Sporogenous tissue

- Primary sporogenous tissue give rise to microspore mother cell
- Some of sporogenous cell remain non functional and serve as the food material for the developing microspore
- MMC under goes meiosis to form microspore tetrad which seprate out to form microspore or pollen grain
- The process of formation of microspore from MMC is called microsporogensis

Microsporogenesis

- The process of formation of microspores from a pollen mother cell through meiosis is called microsporogenesis.
- The cells of sporogenous tissue undergo meiosis to form **microspore tetrad** arranged in a cluster of 4 cells..
- As each cell of sporogenous tissue has potential to form tetrad, so each cell is a microspore mother cell (PMC).
- On maturation and dehydration of anther, the spores dissociate and develop into pollengrains.
- Pollen grains release with the dehiscence of anther.


GRAIN OF POLLEN
pore
nucleoli
intine
thickening of
cellulose
exine
www.infovisual.info

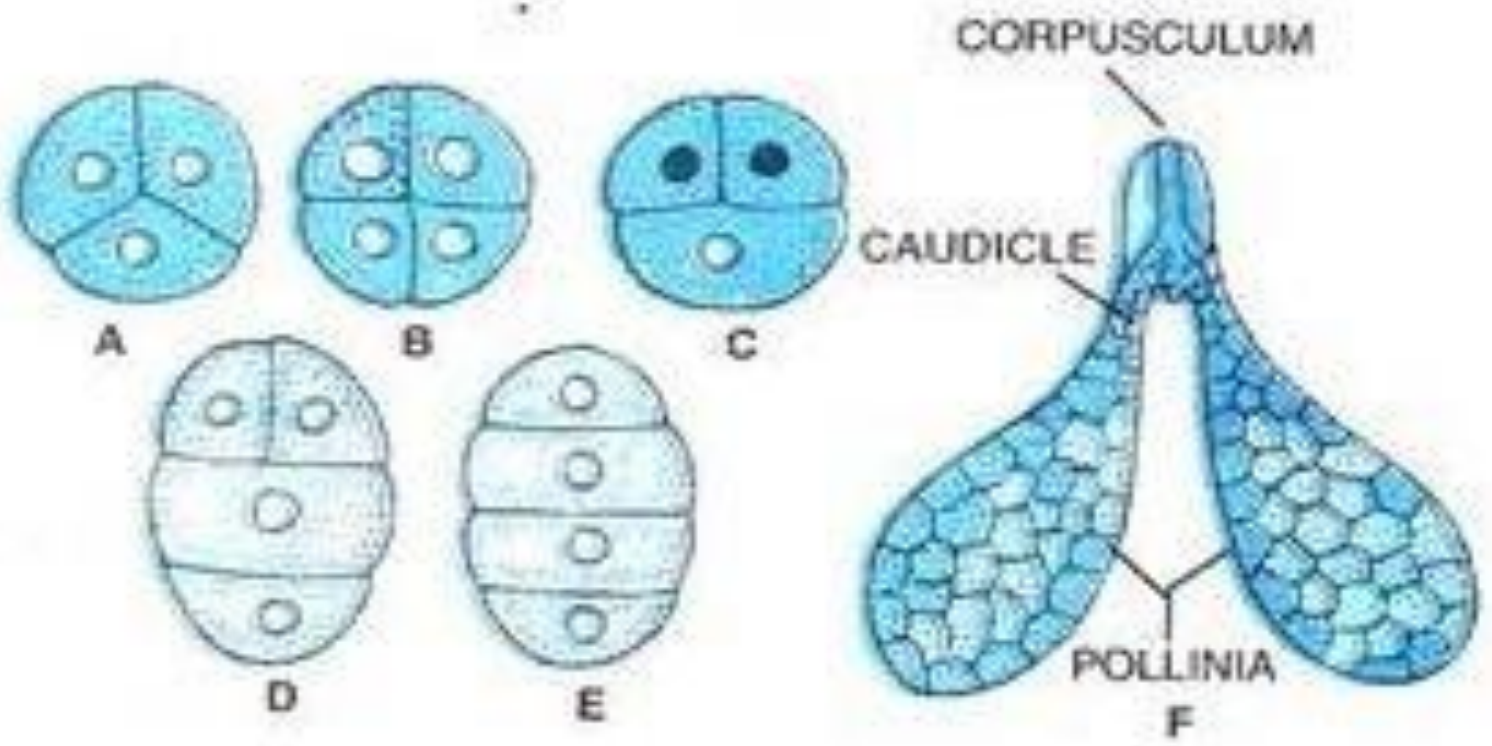
Pollen Grain (Male Gametophyte)

- Pollen grains develop from the diploid microspore mother cells in pollen sacs of anthers.
- pollen grain is a haploid, unicellular body with a single nucleus.
- Pollen grains are generally spherical measuring about 25-30 micrometeres in diameter
- Have two layered wall- outer hard **exine** layer and inner thin **intine.**
- **Exine-** made up of sporopolenin. Resistant to organic matter, withstand high temperature, acids, alkalis and enzymes. It has prominent apertures called **germ pores**, where sporopolenin is absent.
- **Intine-** It is thin, continuous layer, made of cellulose and pectin.

Pollen Grain (Male Gametophyte)

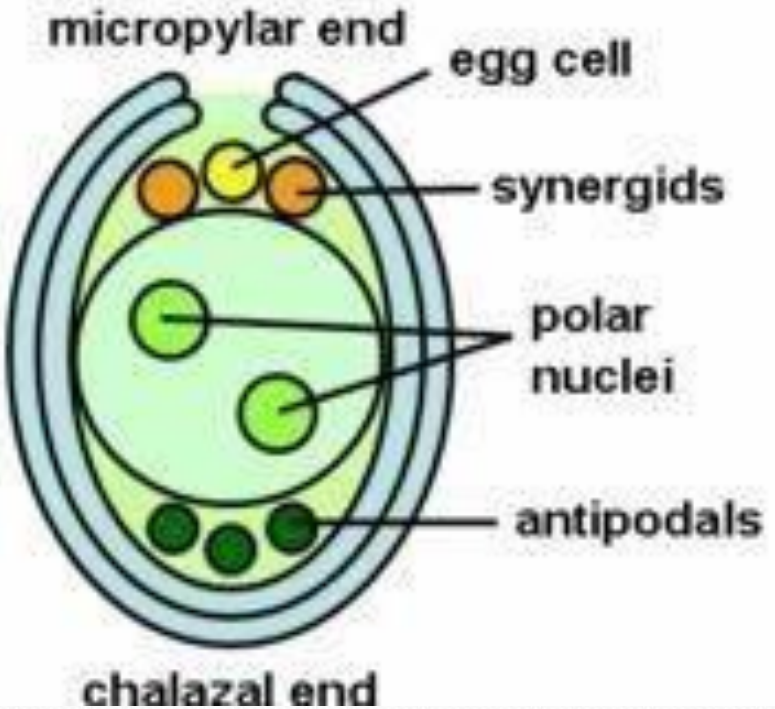
- Pollen grain cytoplasm is surrounded byplasma membrane.
- Mature pollen grain has 2 cells- (i) vegetative cell (ii) generative cell.
- Vegetative cell- bigger, abundant food reserve, large irregular nucleus.
- Generative cell- small, spindle shaped with dense cytoplasm and a nucleus, floats in vegetative cell cytoplasm.
- In 60% species pollen grains are shed in 2 celled stage where as 40% species shed in 3 celled stage in which generative cell divides mitotically into 2 male gametes.

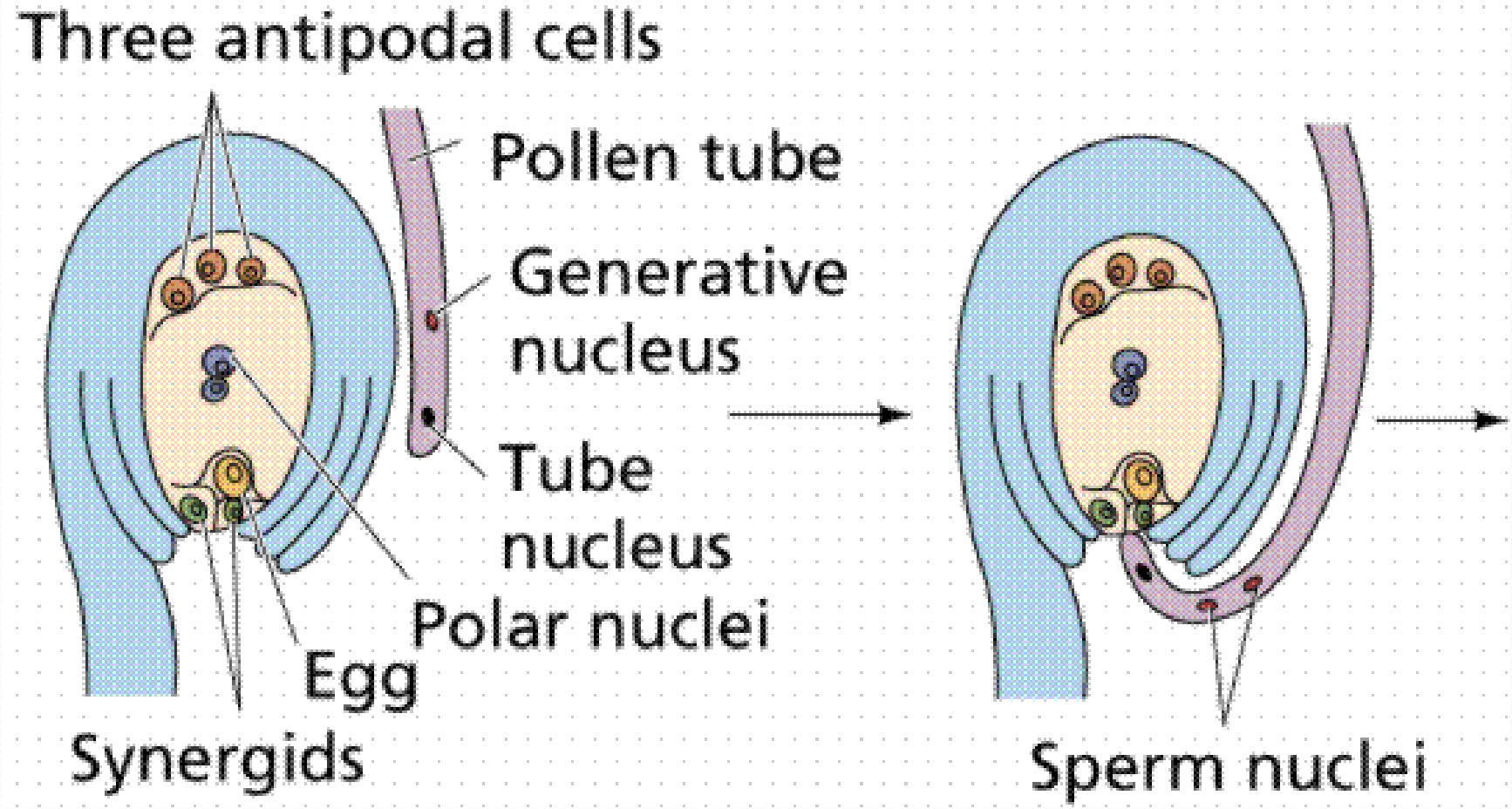
Kinds of microspore tetrads in Angiosperms



Kinds of Microspore tetrads in angiosperms. A—Tetrahedral tetrad; B—Isobilateral tetrad; C—Decussate tetrad; D—F shaped tetrad; E—Linear tetrad; F—Pollinium of Ak or *Calotropis*.

Embryo sac


micropylar end
egg cell
synergids
polar
nuclei
antipodals
chalazal end


Three antipodal cells
Pollen tube
Generative nucleus
Tube nucleus
Polar nuclei
Egg
Synergids
Sperm nuclei

Thank you

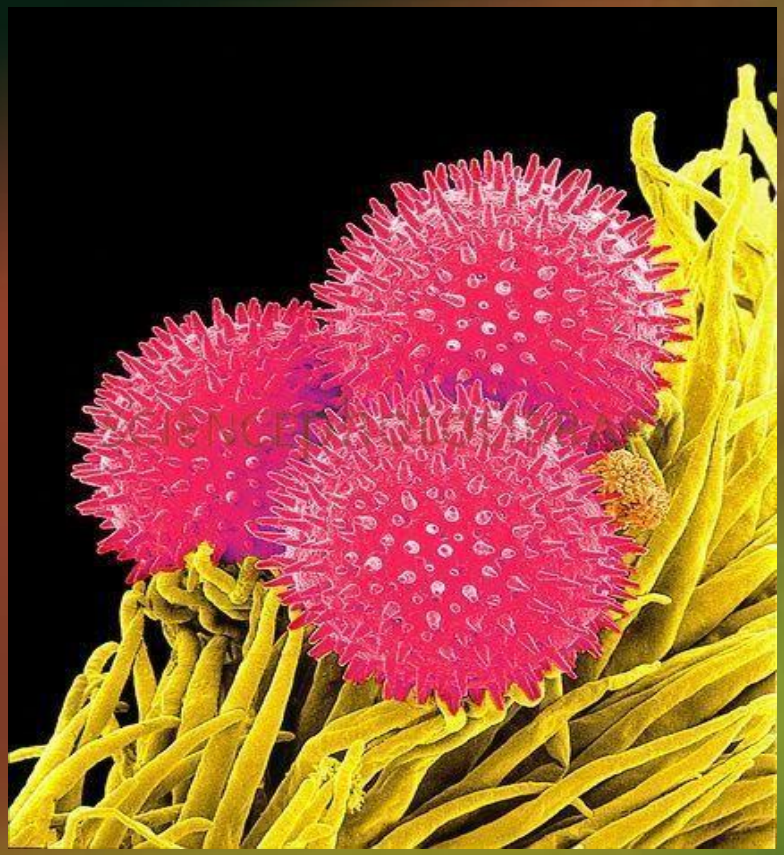
Palynology:
Pollen Morphology and Biology

By
Dr.K.Kalimuthu
Assistant Professor

Objectives

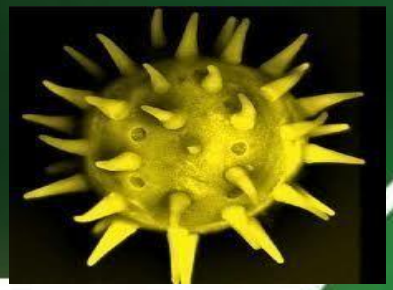
- Enumerate and identify important palynological features of angiosperms;
- Relate these features to plant systematics; and
- Demonstrate taxonomic evidence in palynology.

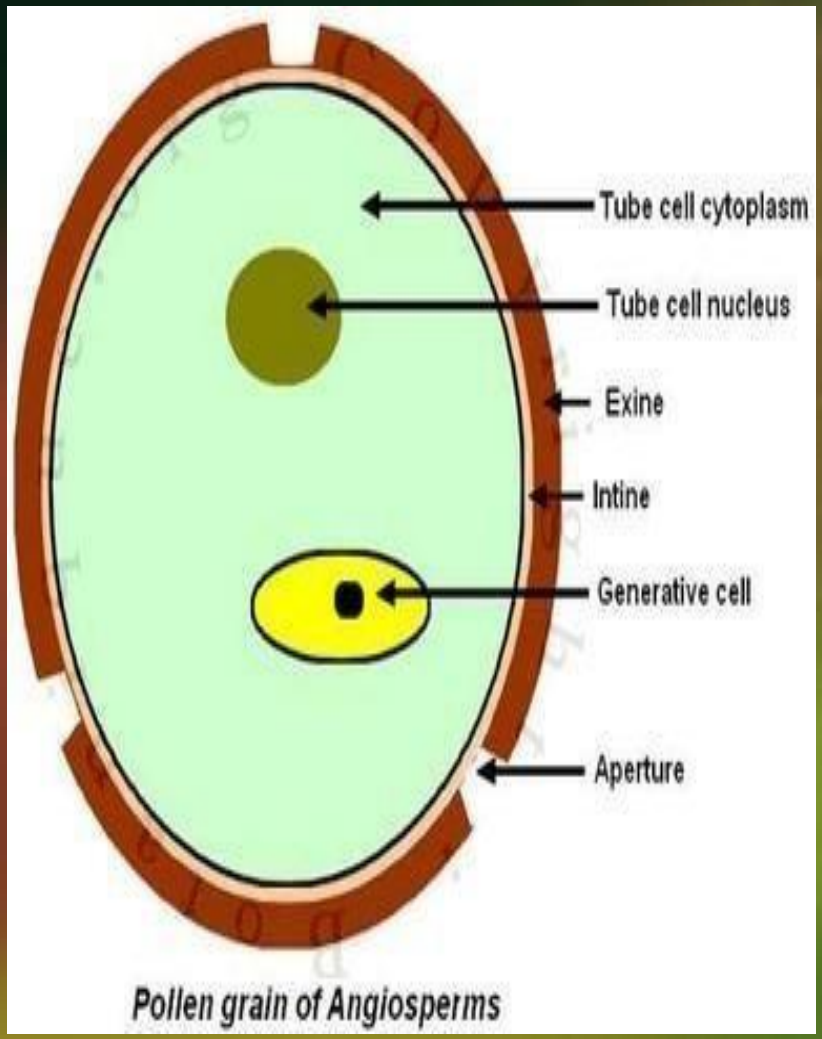
What is palynology?



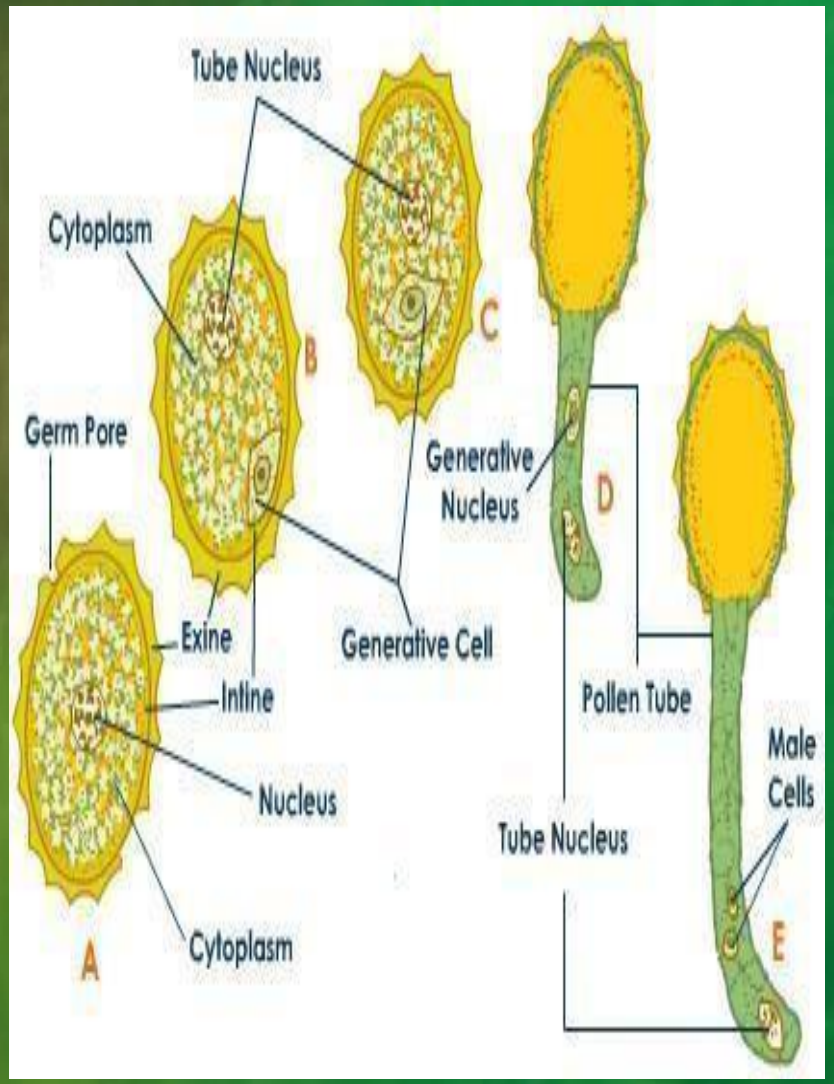
- *Palynology* (*palynos*, dust) is the science of pollen grains and spores.
- Pollen grains are male gametophytes or reproductive cells of a flowering plant.

Pollen Biology

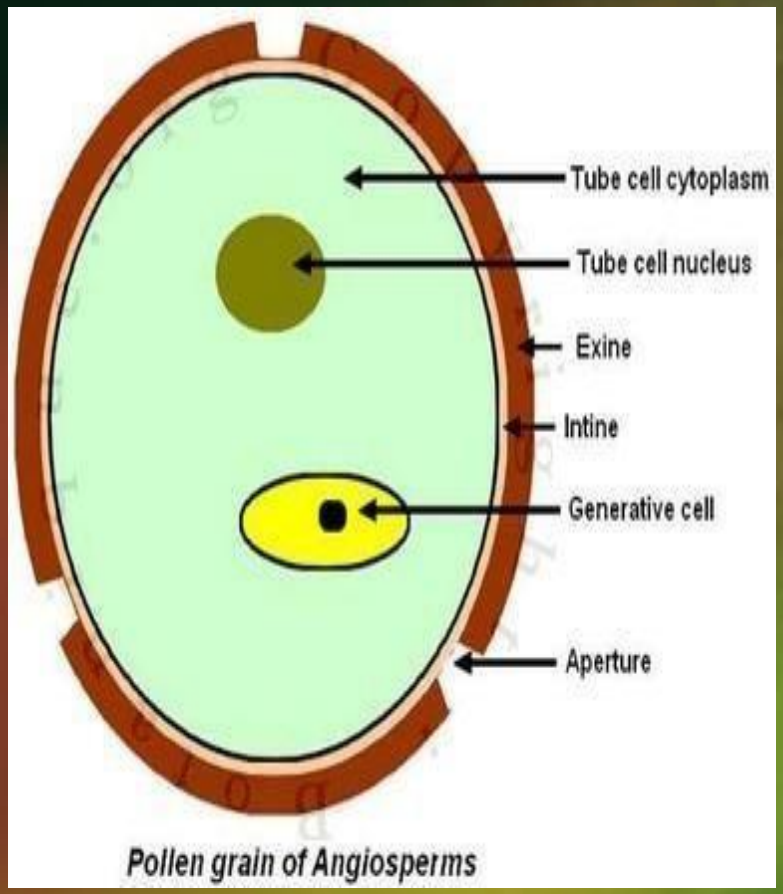




Pollen grain of Angiosperms



Pollen Biology



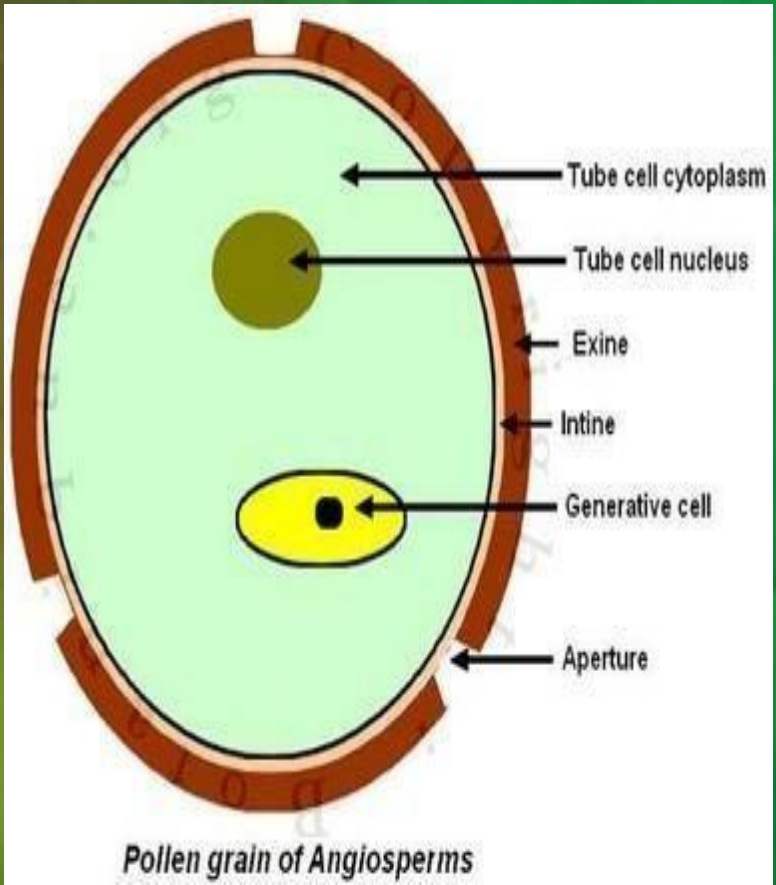
- Pollen grains consist of a hard outer wall (*exine*) and an inner softer wall (*intine*) which encloses the cytoplasm with its cells (nuclei) and organelles.

Pollen Biology

- A pollen grain contains the male gamete of the angiosperm plant.
- Pollen has two functions-reproduction and reward of visitors.
- The outer layer of a pollen and spores often contains a special compound, *sporopollenin,* which resists degradation by various chemicals, bacteria and fungi.

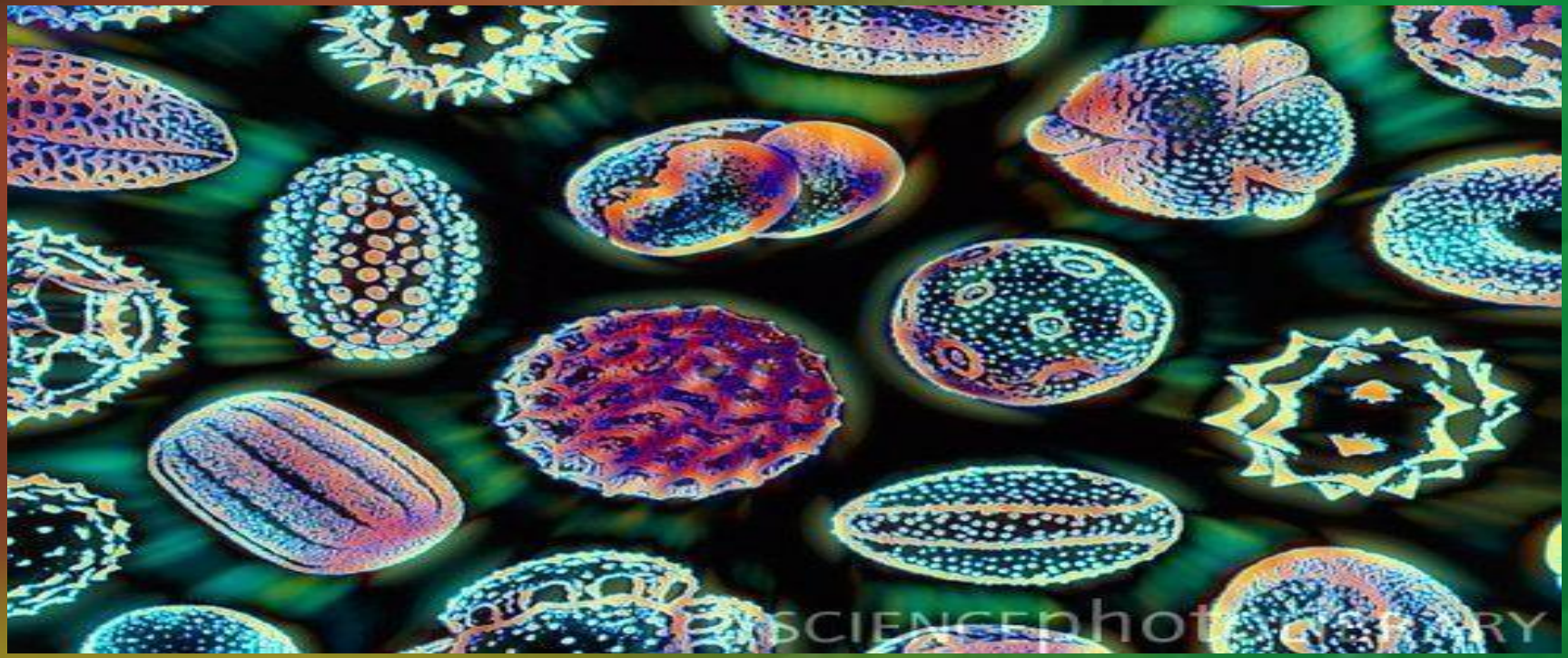
Pollen Biology

- The pollen wall is designated to protect the sperm nucleus from desiccation and irradiation during transport from the anther to the stigma.



Pollen Biology

- Pollen grains come in a wide variety of shapes (most often spherical), sizes, and surface markings characteristic of the species



Palynology and Systematics

- Palynology is used in phylogenetic analysis.
- It can be utilized in plant identification
    - Extant plants
    - Fossil plants
        - –Paleopalynology/paleobotany
        - – past plant communities, climate, biogeography, migration

Palynology and Systematics

- The morphology of pollen grains forms the basic criteria for their identification..
- The palynological features of a spore or pollen grain can often be used to identify a particular taxon.
- Pollen data provides information of changes in vegetation, climate, and human disturbance of terrestrial ecosystems.

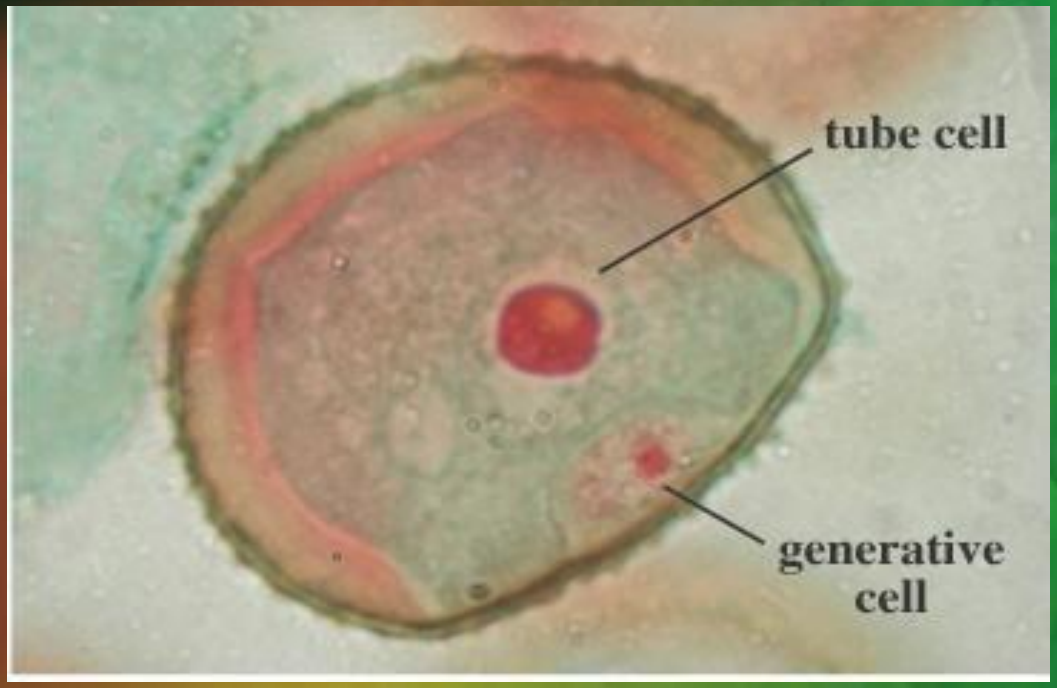
Pollen Analysis

- Sediments are collected
- Pollen grains are isolated from the sediment matrix via chemical treatments.
- Isolated pollen grains are mounted onto a glass slide, and they are identified and quantified under a microscope.

Palynological Features Used in Plant Systematics

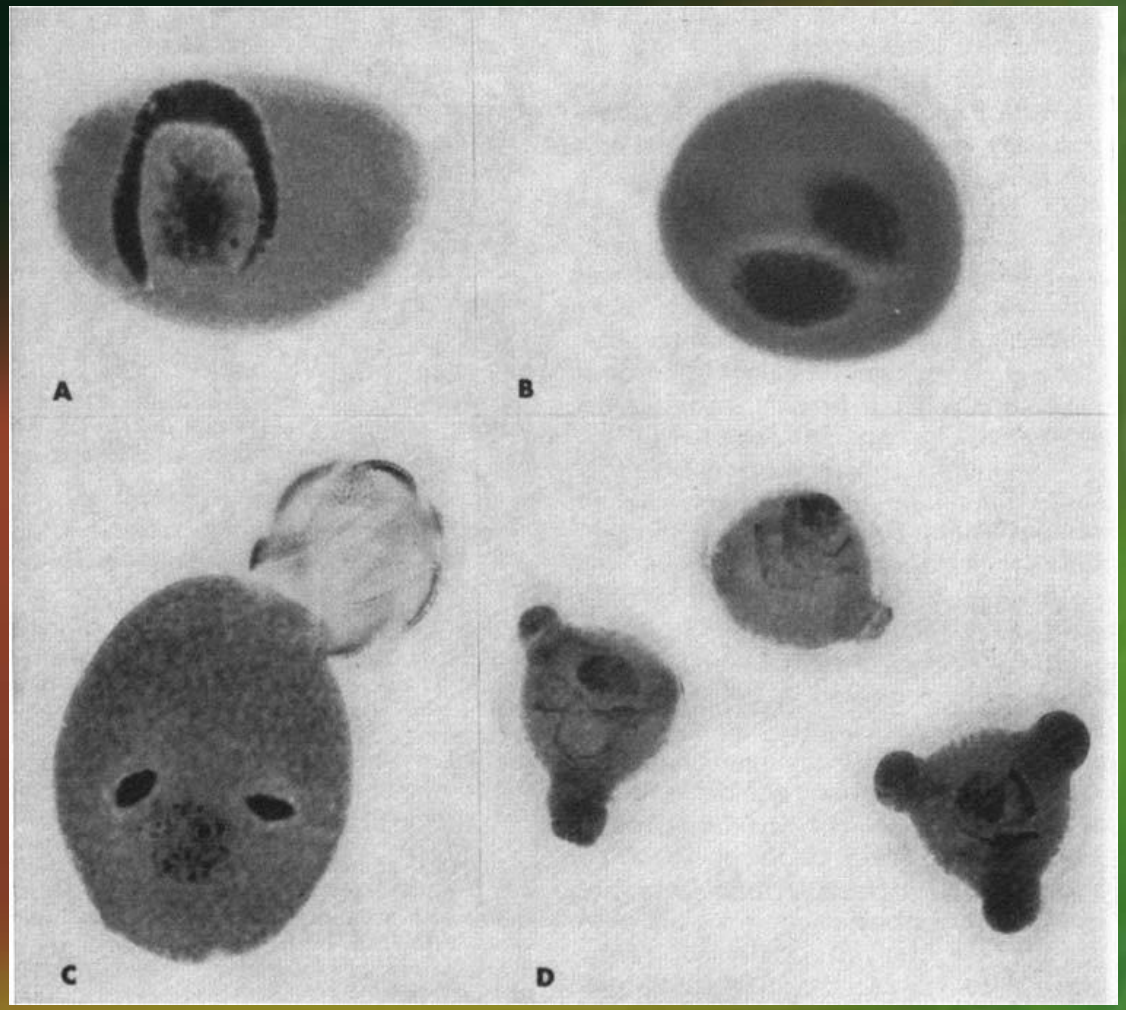
- Pollen Nucleus Number
- Pollen Storage Product
- Pollen Unit
- Pollen Polarity
- Pollen Aperture
- Pollen Size
- Pollen Shape
- Pollen Sculpturing
- Pollen Wall Structure

Pollen Nucleus No.



binucleate versus **trinucleate**

Binucleate Plant Families



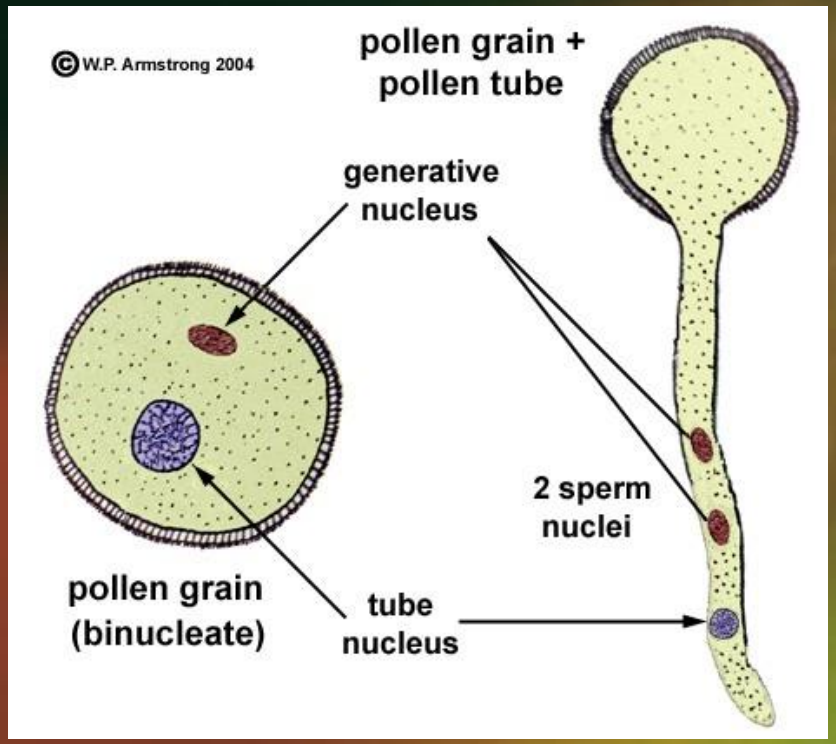
A. *Tradescantia virginia* (Commelinaceae)

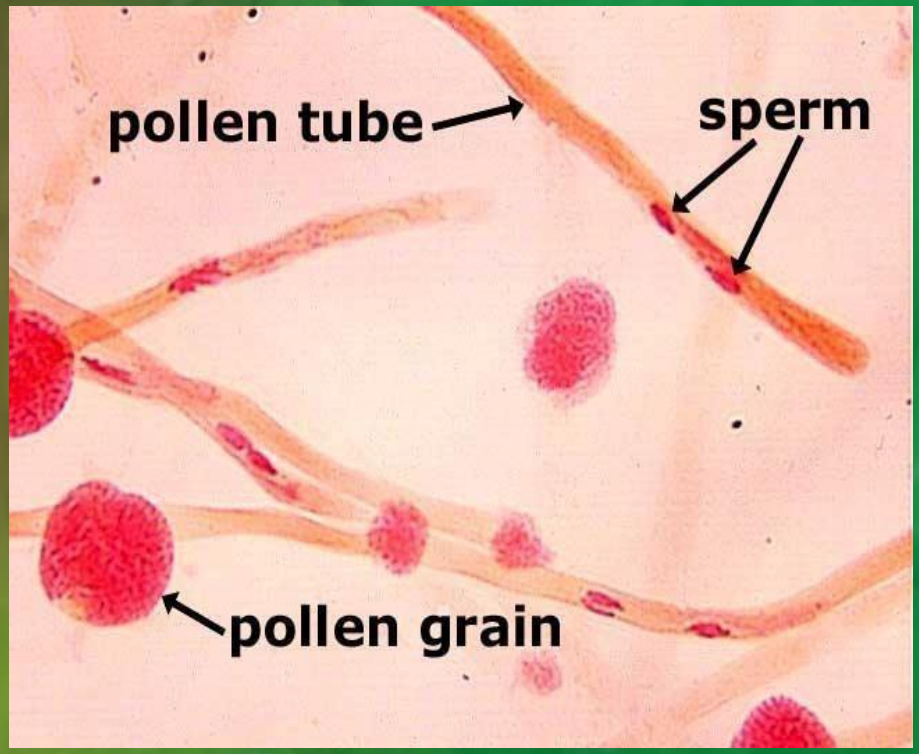
B. *Smilacina stellata* (*Liliaceae*)

C. *Rosaceae*

D. *Chrysanthemum* (*Asteraceae*)

Pollen Nucleus No.





Trinucleate

Pollen Nucleus No.

Trinucleate

(Caryophyllaceae-Pollen of pink family)

Pollen Storage Product

- Pollen grains contain high-energy storage reserves. These are composed of either

starch versus **oil**

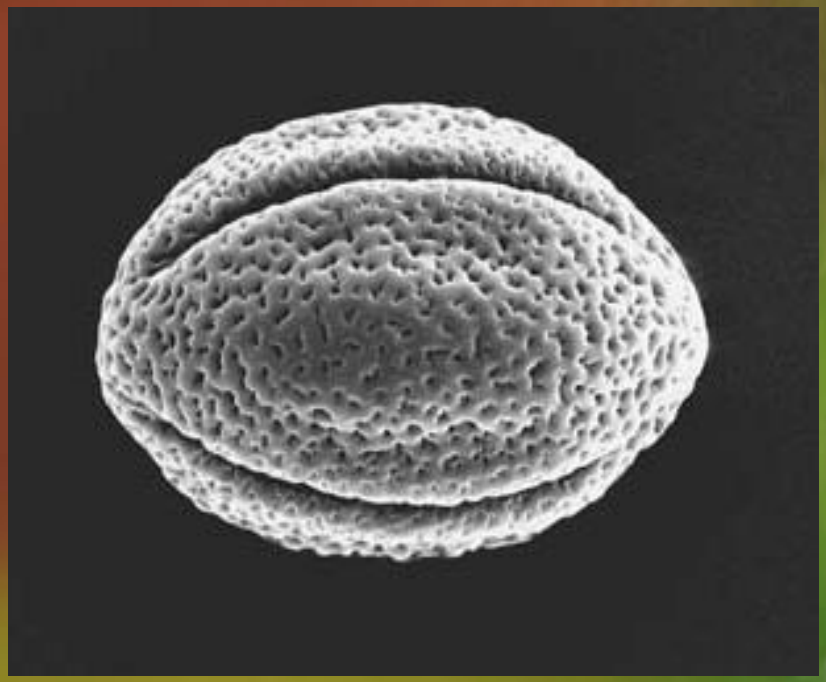
(Poaceae & Rhizophoraceae)(Sonneratiaceae)

- This distribution can be phylogenetically informative in angiosperms.

Pollen Unit

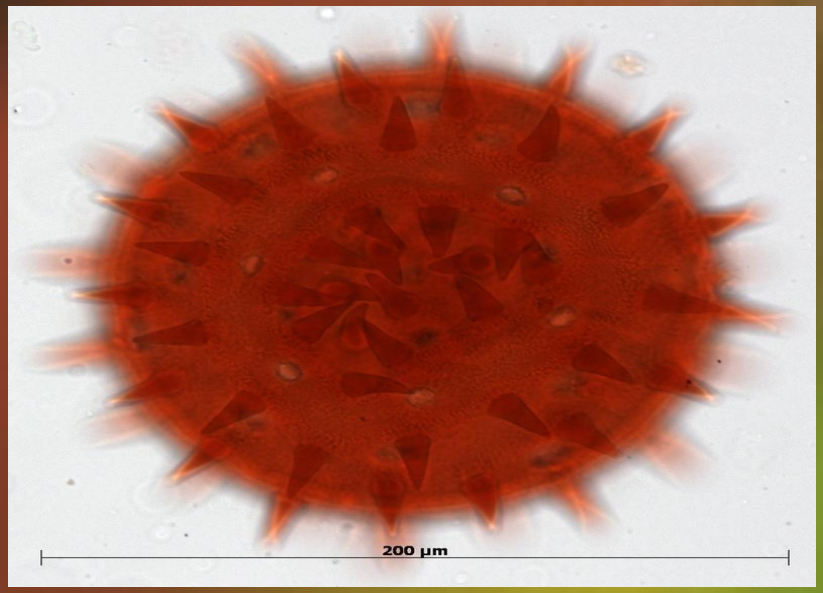
- Pollen unit refers to the number of pollen grains united together at the time of release.

Monad (single pollen unit)

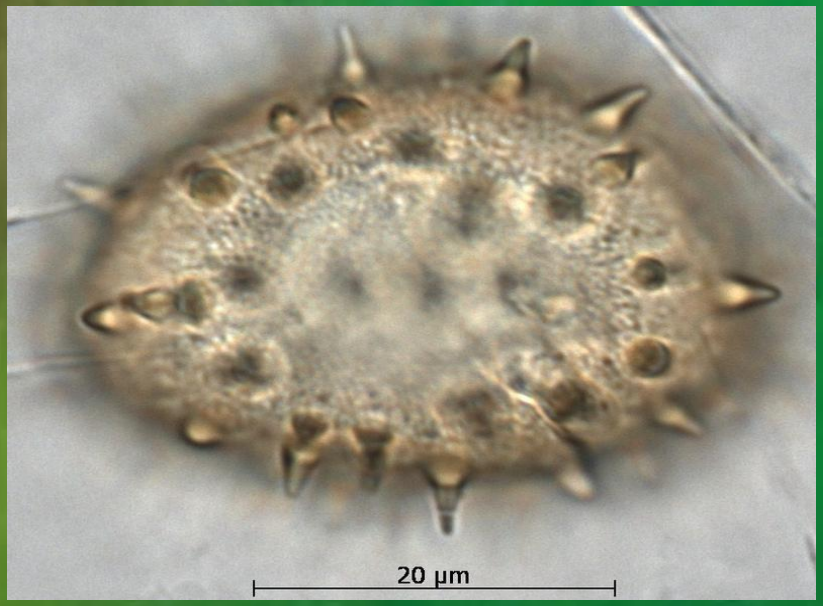


Monad

- Single and unfused pollen grain
- Examples (majority of angiosperms)



Hibiscus trionum, Malvaceae



Nypa fruticans, Arecaceae

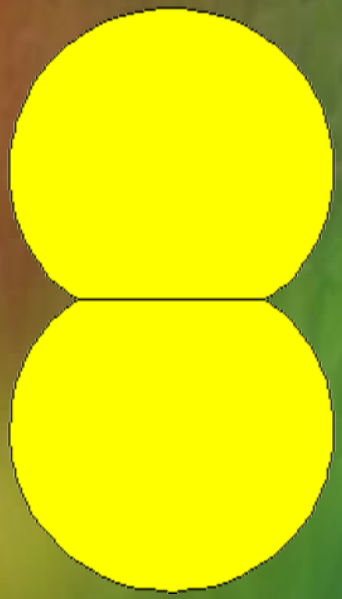
Pollen Unit (Monad)

Research study in pollen morphology conducted in DLSU-Dasma "Documentation and Identification of Pollen Found at DLSU-Dasma" (Bognot, et. al,. 2003)

Family	Pollen Size (µm)	Pollen Shape	Pollen Unit	Pollen Sculpturing
Begoniaceae	18.75	Oblate	Monad	Striate
Lythraceae	37.5	Oblate	Monad	Striate
Rubiaceae	12.5	Spheroidal	Monad	Perforate
Caricaceae	50	Spheroidal	Monad	Psilate
Malvaceae 1	112.5	Spheroidal	Monad	Echinate
Malvaceae 2	312.5	Spheroidal	Monad	Echinate
Euphorbiaceae 1	50	Spheroidal	Monad	Reticulate
Euphorbiaceae 2	50	Spheroidal	Monad	Reticulate
Euphorbiaceae 3	37.5	Spheroidal	Monad	Reticulate
Oxalidaceae	12.5	Spheroidal	Monad	Psilate

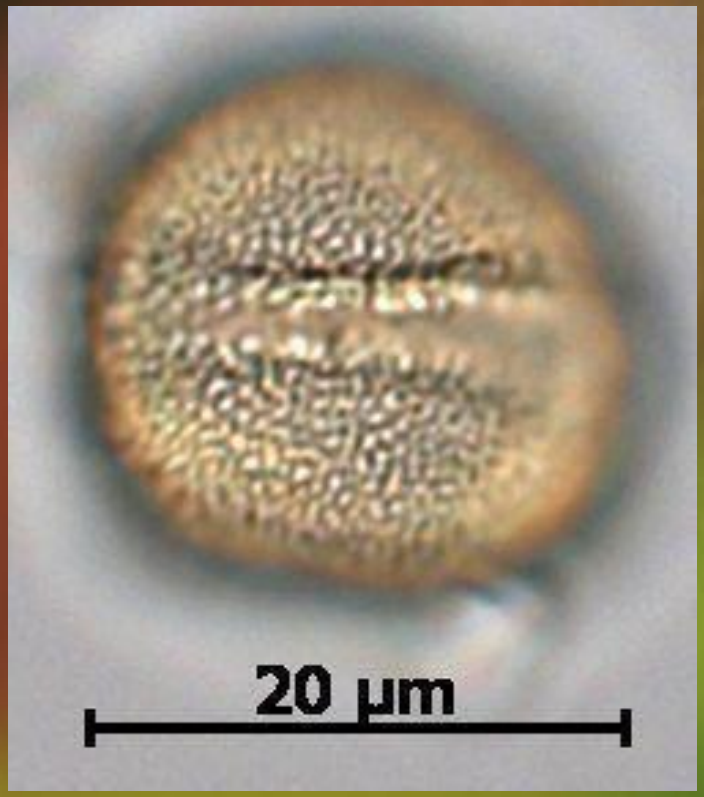
Pollen Unit

Dyad



Pollen Unit

Dyad

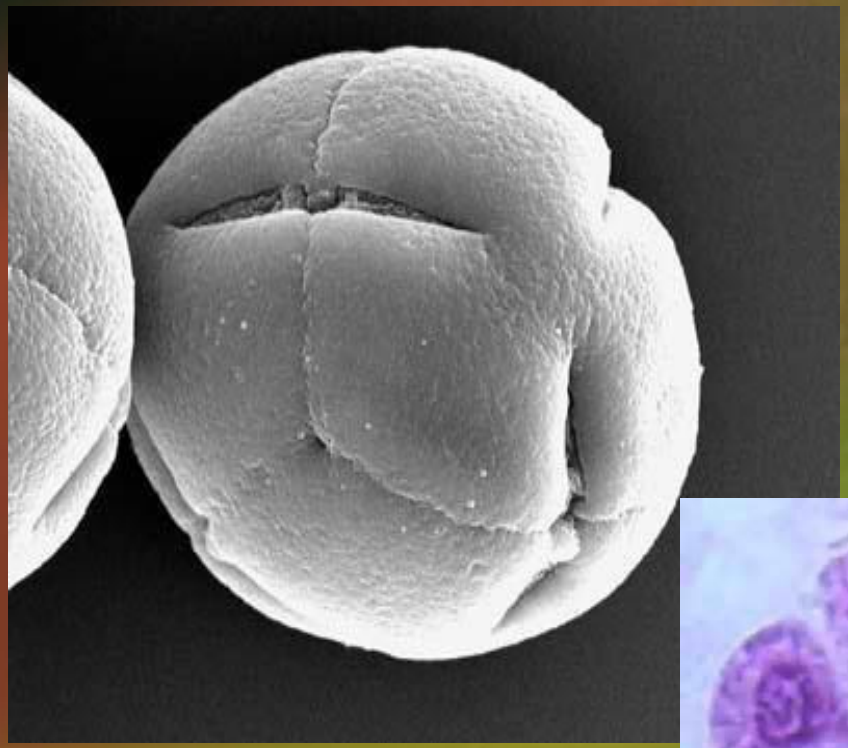


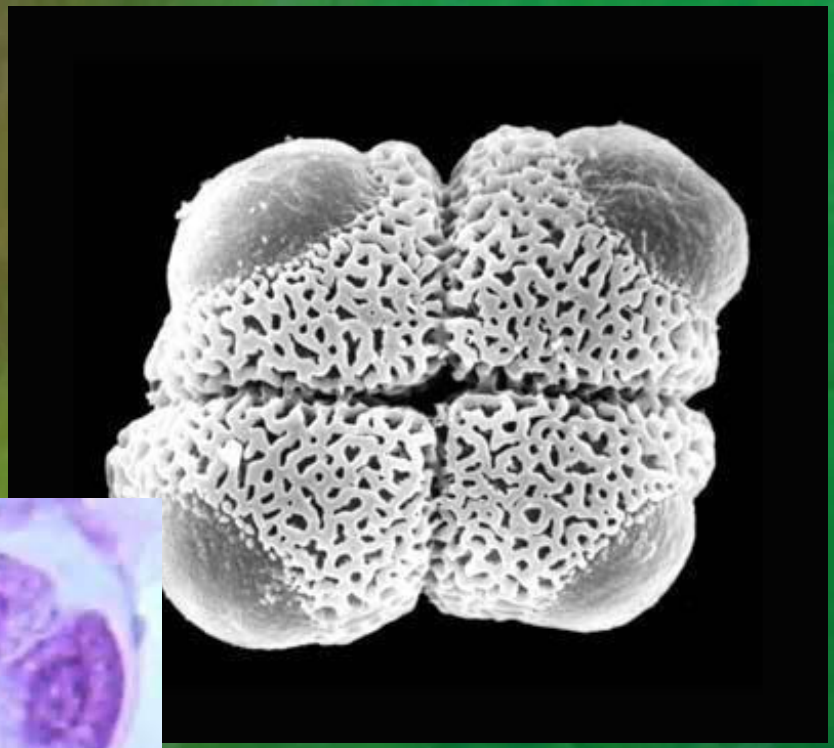
Ascarina philippinensis
(Chloranthaceae)

Pollen Unit

Tetrad

(four pollen grain fused together)



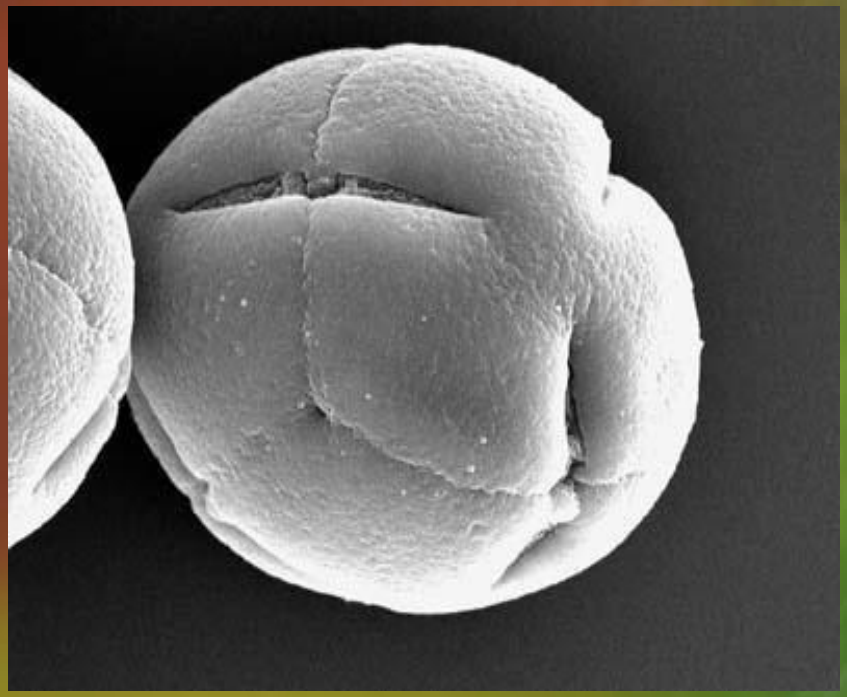


Tetrahedral

Tetragonal

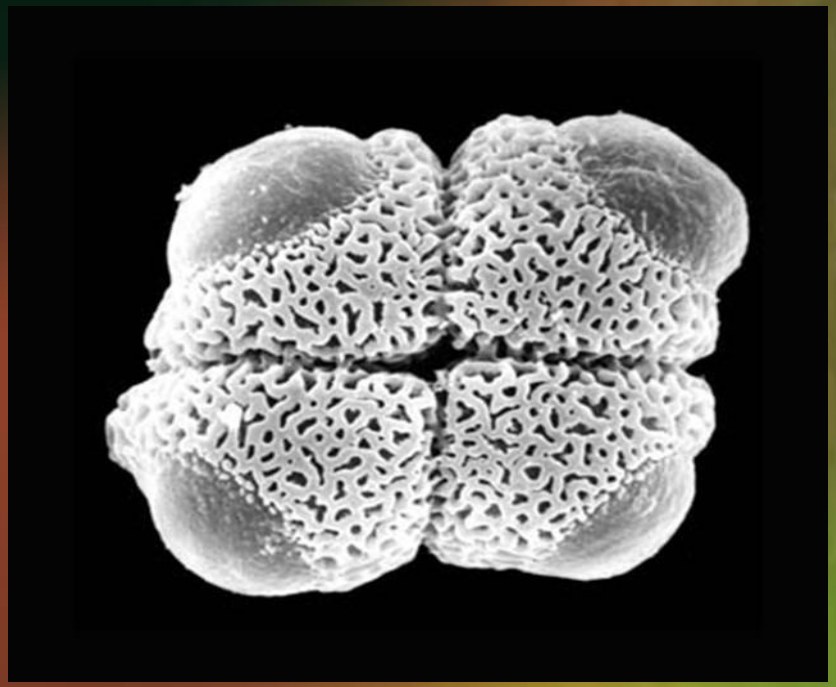
Example of tetrad

- Tetrahedral tetrad-Ericaceae (mint family)
- Tetragonal tetrad-Philydraceae and Fabaceae

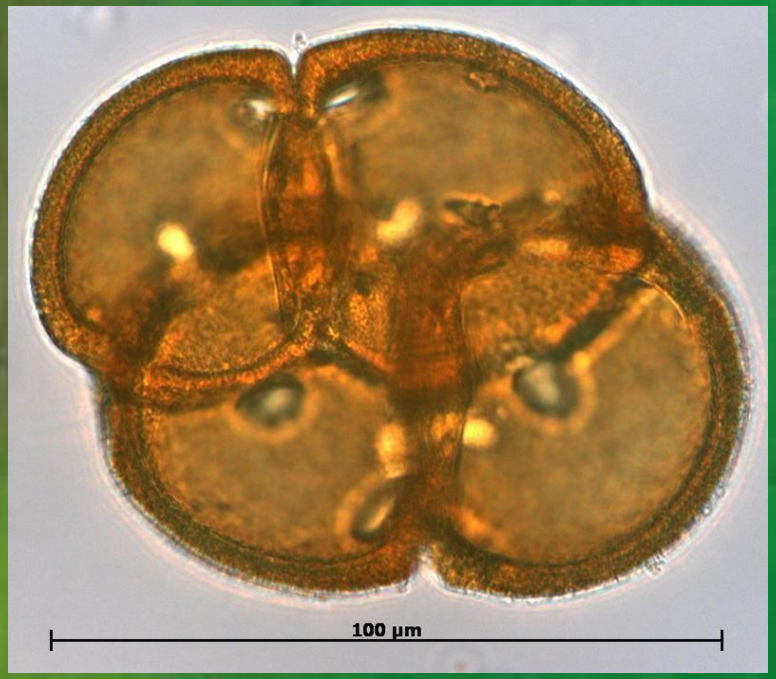


Tetragonal tetrad
(Mimosa pudica)
Fabaceae

Pollen Unit (Tetrad)



Tetragonal tetrad
Philydraceae
(Pollen of mint family)



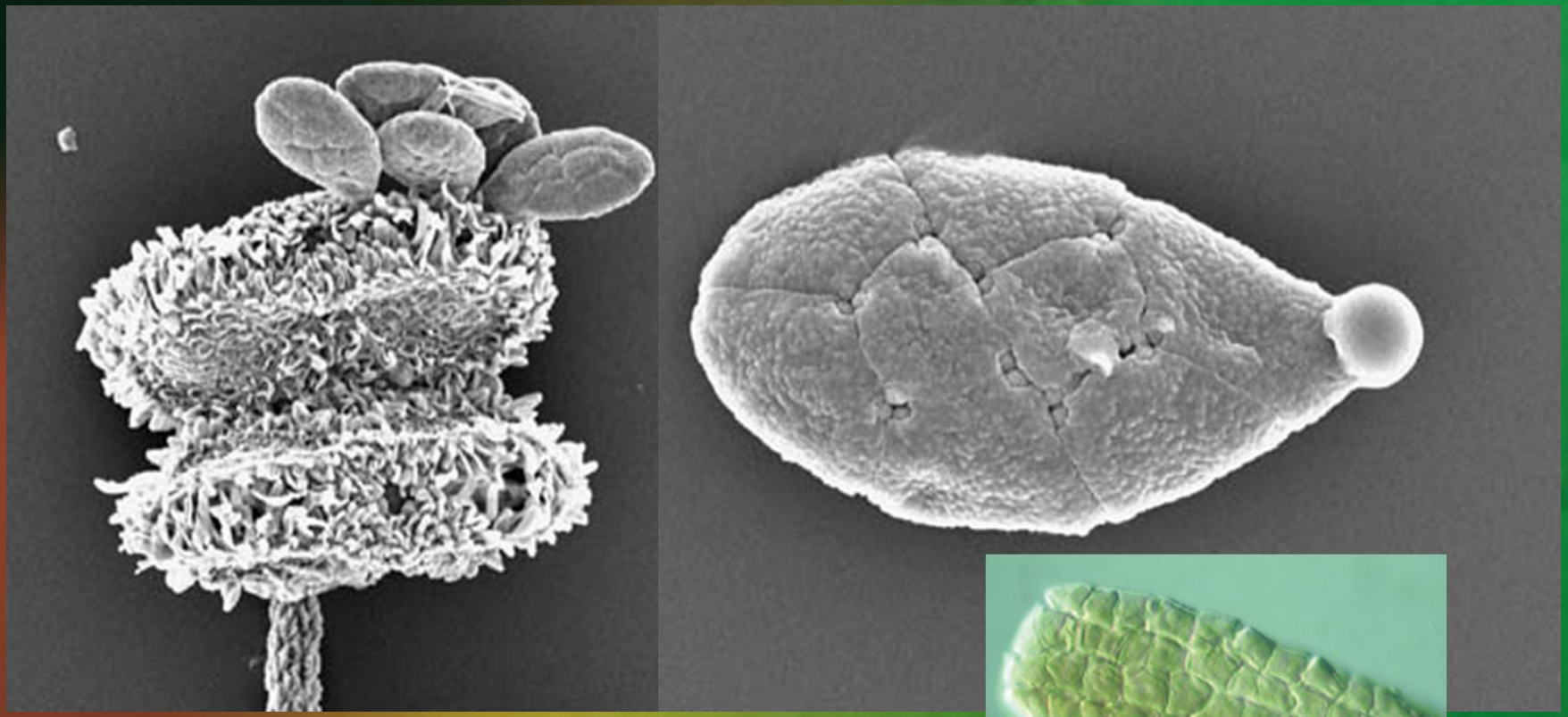
Tetragonal tetrad
Goodeniaceae

Pollen Unit

Decussate tetrad-pollen grains are in two pairs arranged at right angles to one another

Lachnanthes, Haemodoraceae

Pollen Unit



Polyad (multiple of 8 fused grains)

Pollen Unit (Polyad)

- **Research Studies on Pollen Unit and Systematics "Pollen Morphology of Family Fabaceae (Leguminosae) in DLSU-Dasma Campus" (Guiao, et. al, 2003)**

Common Name	Pollen Unit	Pollen Shape/Size	Aperture	Polarity
Acacia	Polyad	Prolate/Spheroidal	Inaperturate	Isopolar
Alibangbang	Monad	Oblate spheroidal	Tricolpate	Isopolar
Pine Tree	Massulae polyad	Prolate/Spheroid		Isopolar
Dapdap	Monad	Oblate spheroidal	Triporate	Isopolar
Makahiya	Tetrahedral tetrad	Oblate	Syncolpate	Isopolar
Ipil-ipil	Monad	Prolate	Tricolpate	Isopolar

Polyad

Parkia speciosa

(Fabaceeae)

Pollen Unit (Polyad)

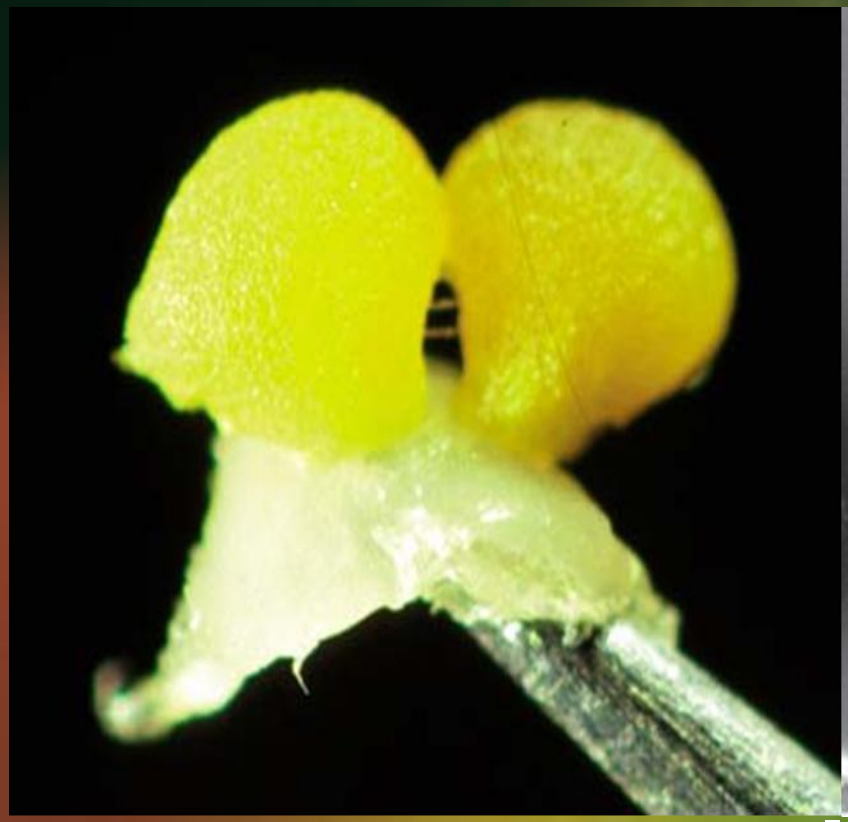
- **Research Studies on Pollen Unit and Systematics**

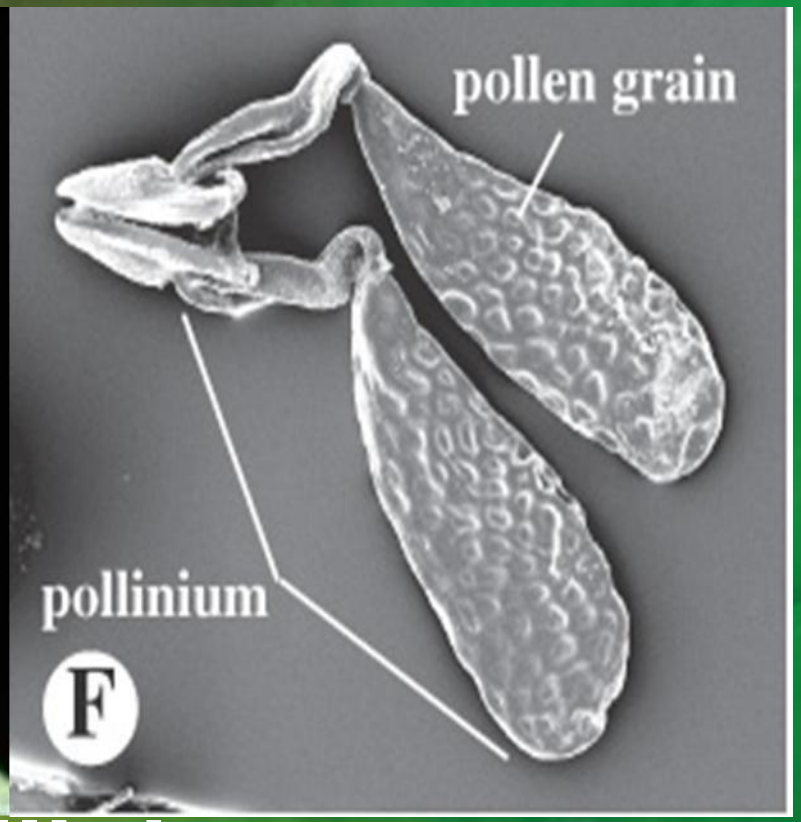
"Key to Pollen Identification in DLSU-Dasma Campus"

(Aquino, et. al, 2003)

Family Name	Dispersal Unit
Annonaceae	Decussate and tetragonal tetrad
Moraceae	Tetrad
Onagraceae	Polyad/Tetrad
Portulaceae	Tetrahedral tetrads
Sterculiaceae	Polyad

Pollen Unit





Pollinium

(Apocynaceae and Orchidaceae)

Let’s remember!!!

Pollen Units

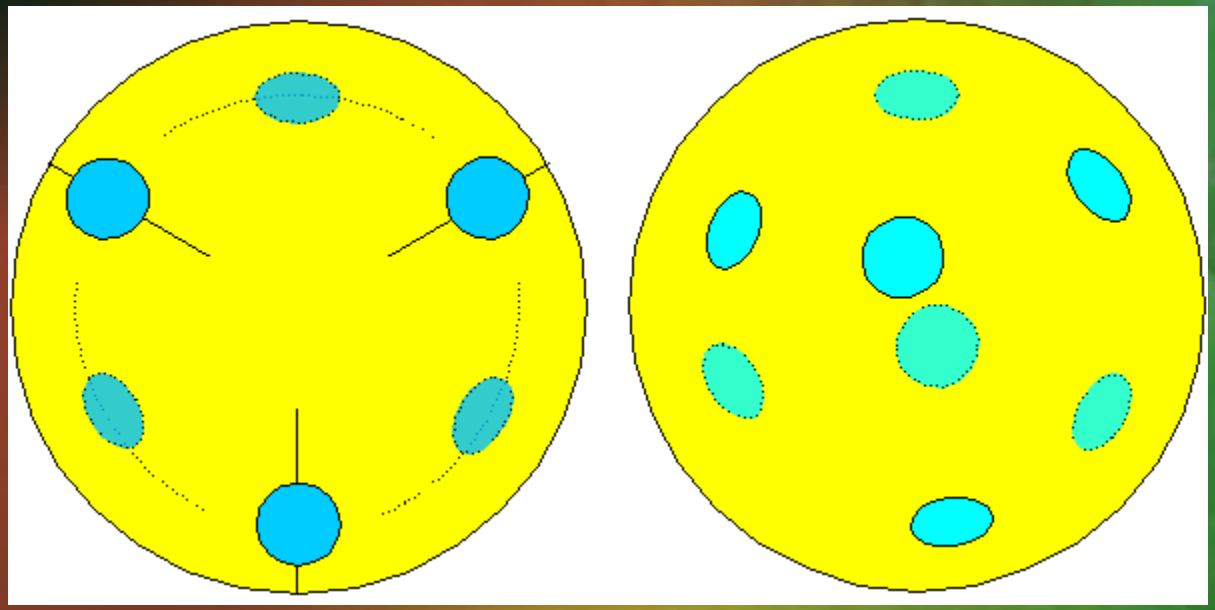
- Monad
- Dyad
- Tetrad (tetrahedral, tetragonal, decussate)
- Polyad
- Pollinium

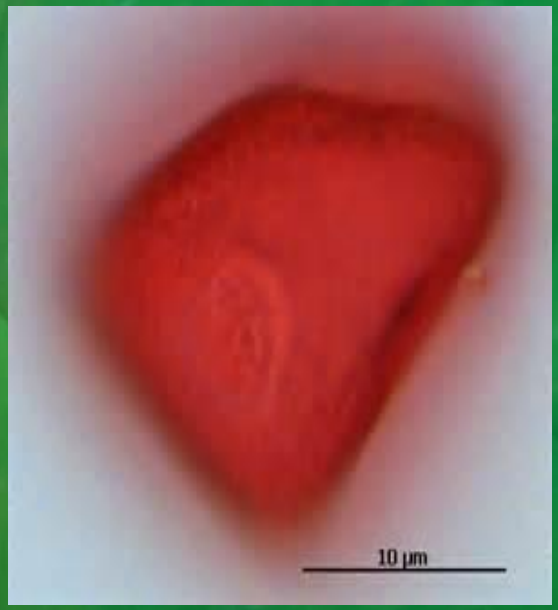
Pollen Polarity

- It refers to the position of one or more apertures relative to spatial reference.
- Observing a pollen grain from the direction of a pole is known as *polar view*; observing from the equatorial direction is an *equatorial view*.

Types of Pollen Polarity

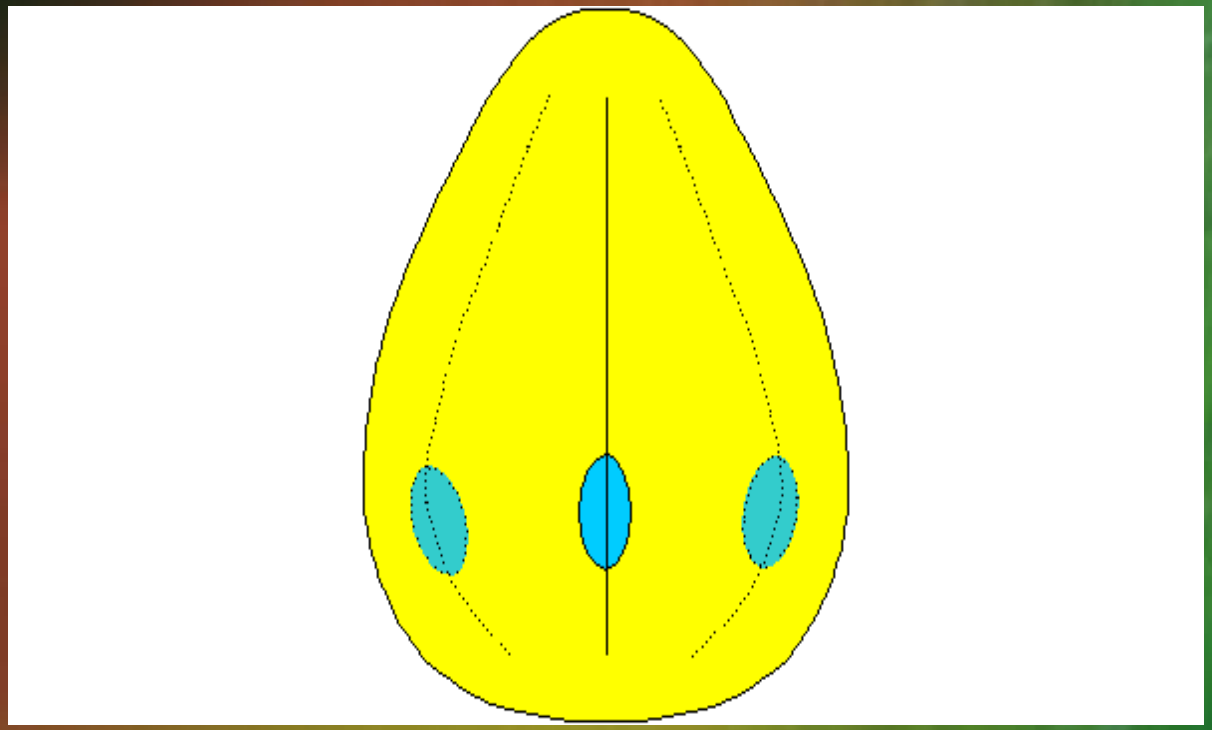
Apolar





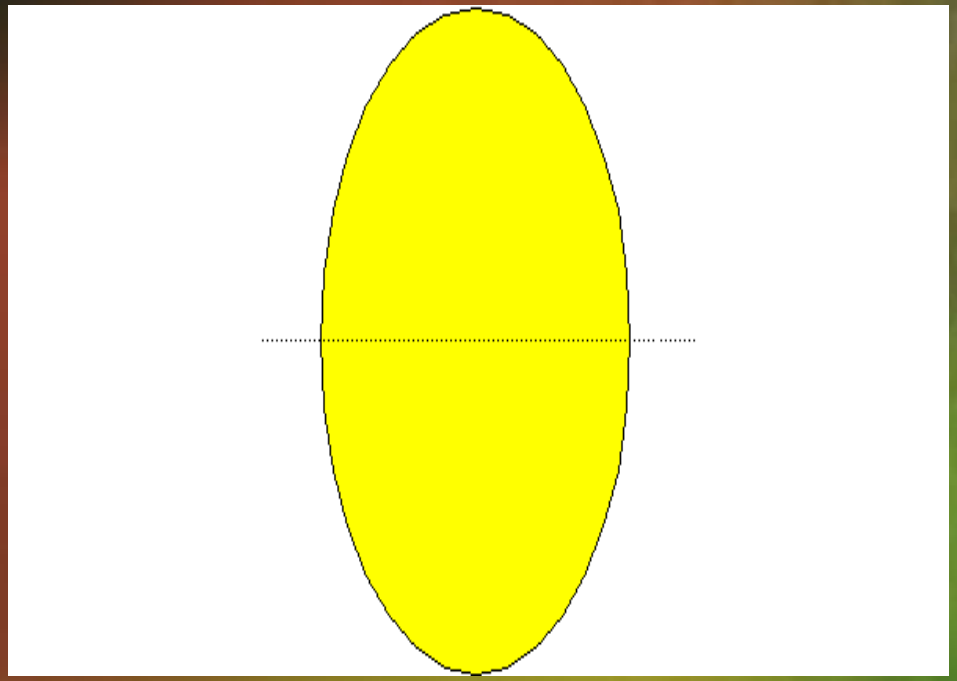
Types of Pollen Polarity

Heteropolar



Types of Pollen Polarity

Isopolar

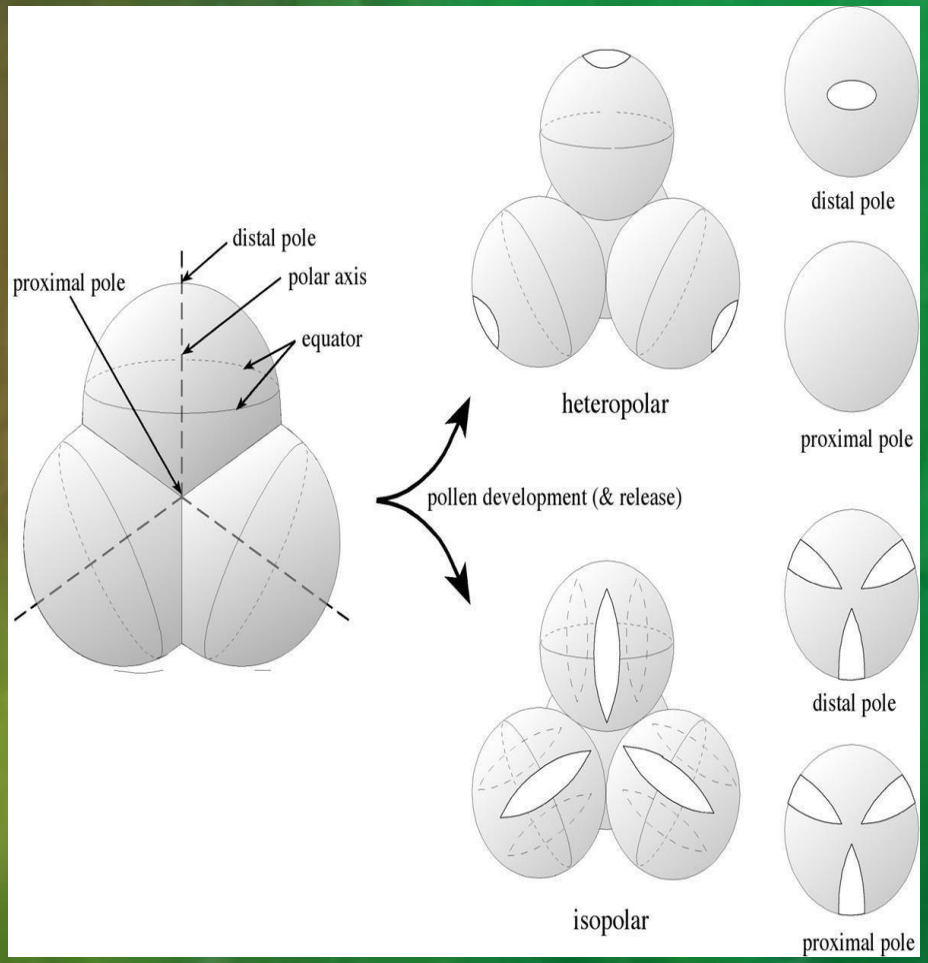


Cucurbitaceae

Let’s remember!!!

Pollen Polarity

- Apolar
- Heteropolar
- Isopolar



Pollen Aperture

Aperture - specially delimited region or an opening in a pollen grain wall; colpus (elongated) or pores (rounded)

*Colpi are regarded as more primitive than pores. (Takhatajan)

Function:

-Point of pollen tube exitus, where pollen tube grows out.

- Harmomegathy (resistant to decay)

Pollen Aperture

- Simple apertures are more primitive than compound.
- Few apertures are more primitive than several.

Pollen Aperture

- Colpus-elongated aperture or a sulcus-slit or groove aperture occurring at the distal pole
- Porus-circular aperture
- The number of apertures of any shape can be designated by appending the prefix mono-, di-, tri-, tetra-, penta-, hexa- or poly- to the terms colpate or porate.

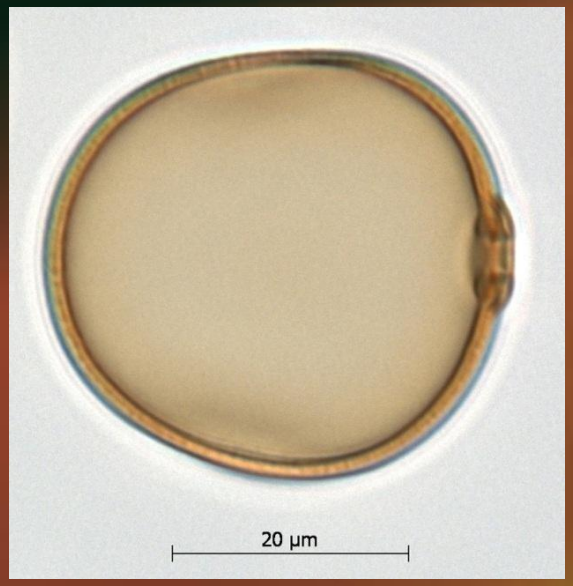
Pollen Aperture

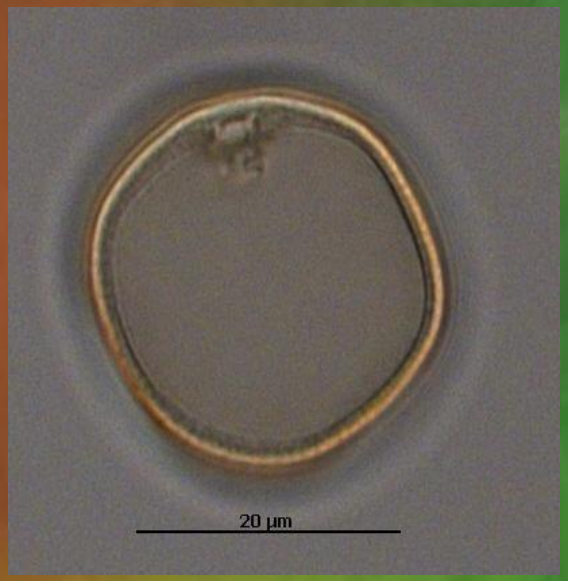
Monocolpate (Magnoliaceae)

Pollen Aperture

Monocolpate (Asteraceae)

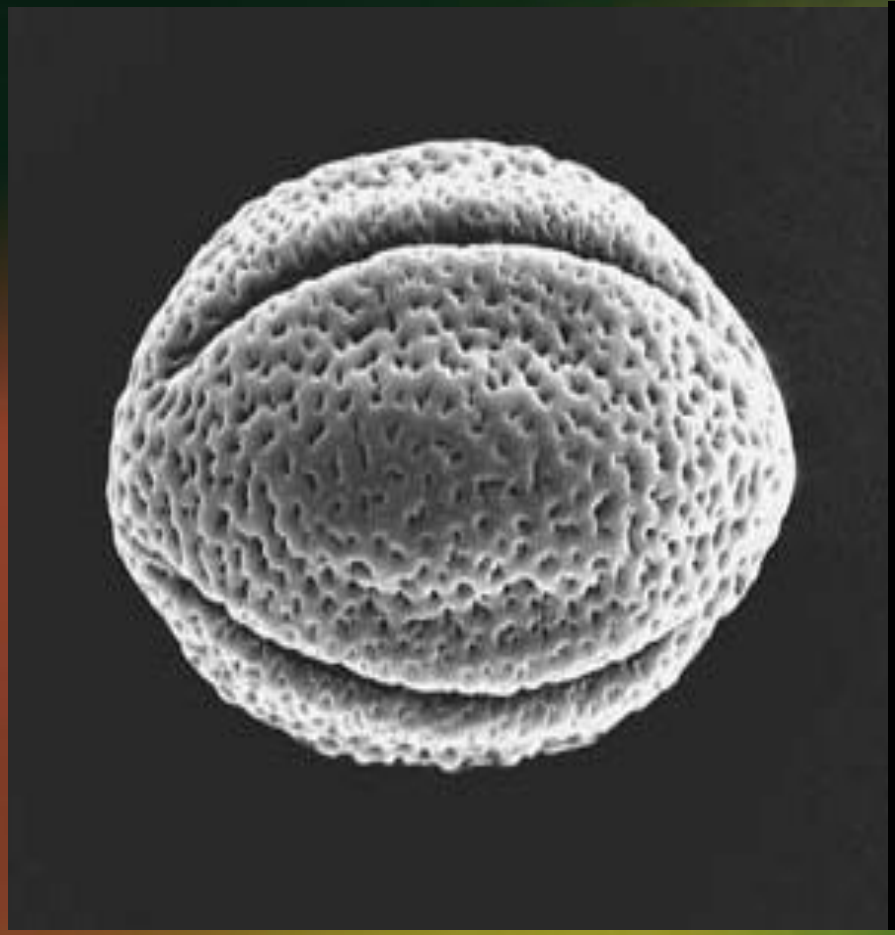
Pollen Aperture

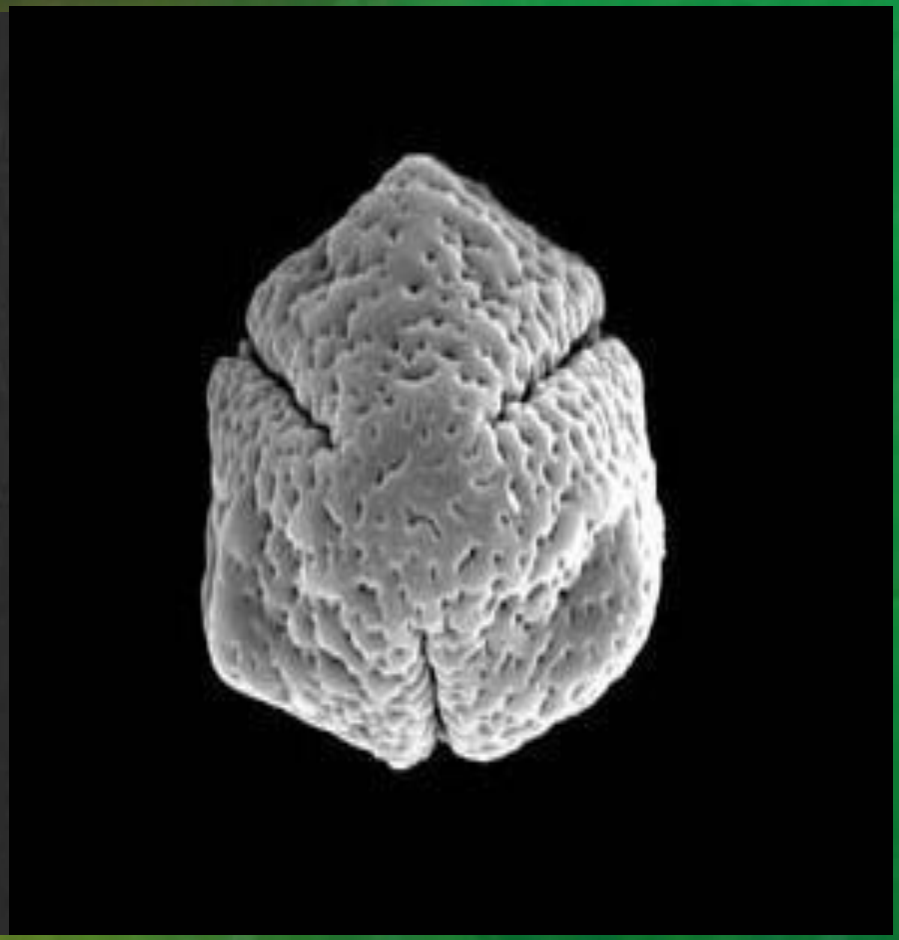




Monoporate (Poaceae)

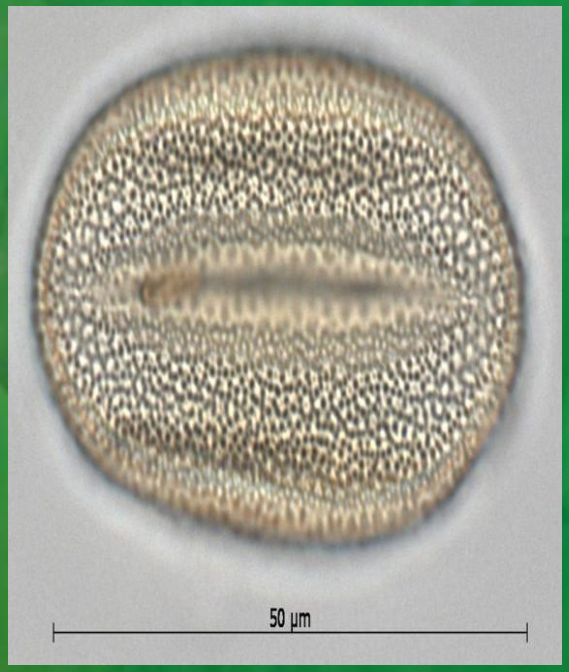
Pollen Aperture





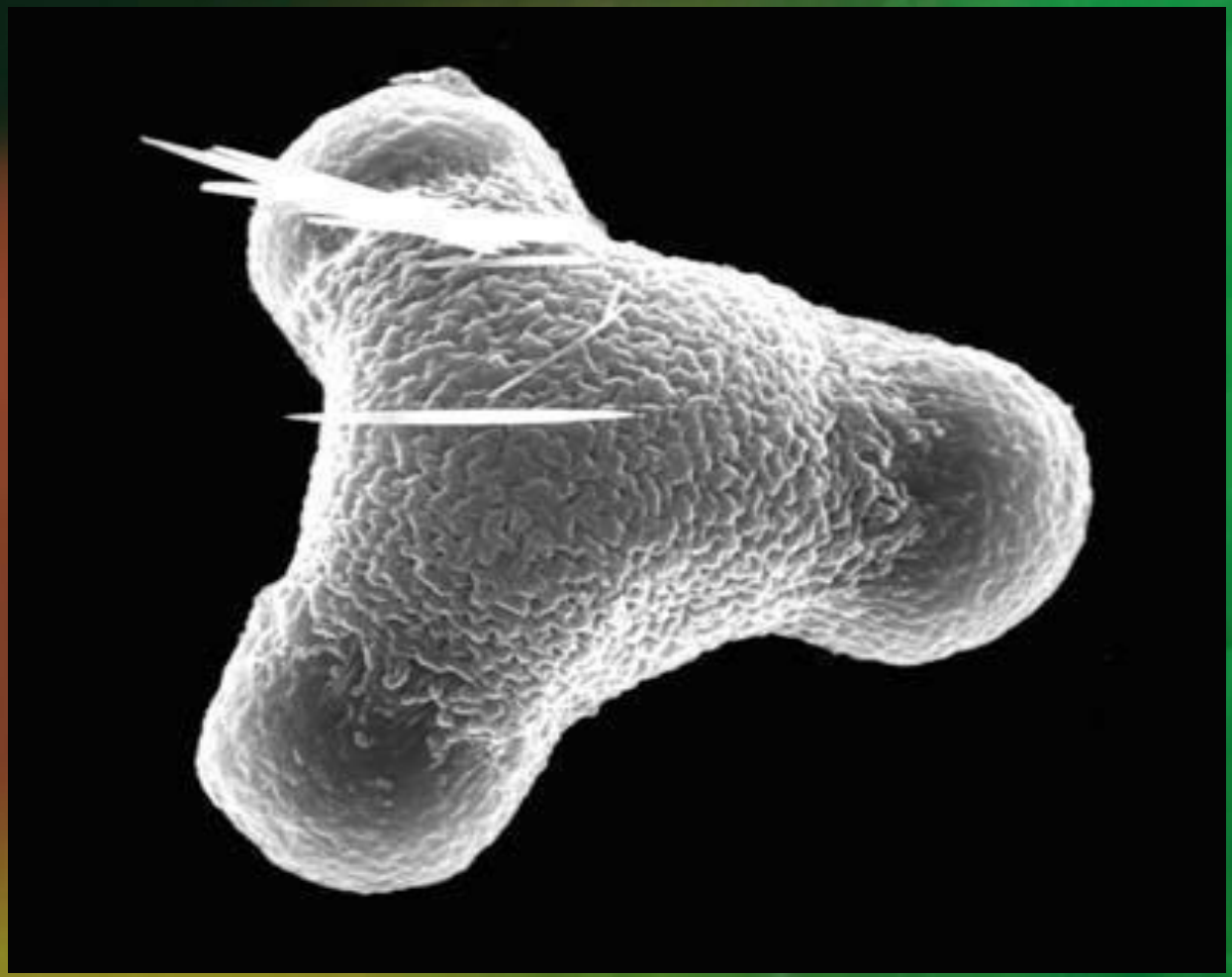
Tricolpate

Pollen Aperture (Tricolpate)



(Acanthaceae)

Pollen Aperture

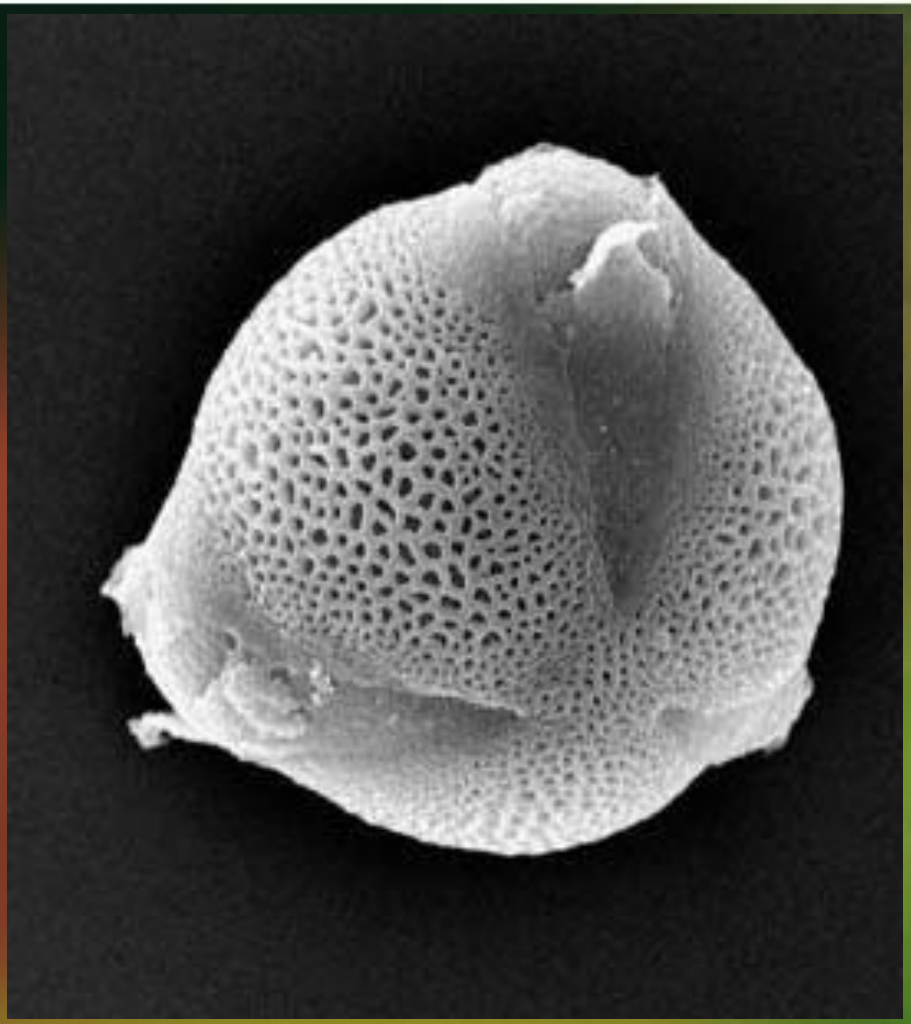


triporate

Pollen Aperture (Triporate)

Cucurbitaceae

Pollen Aperture

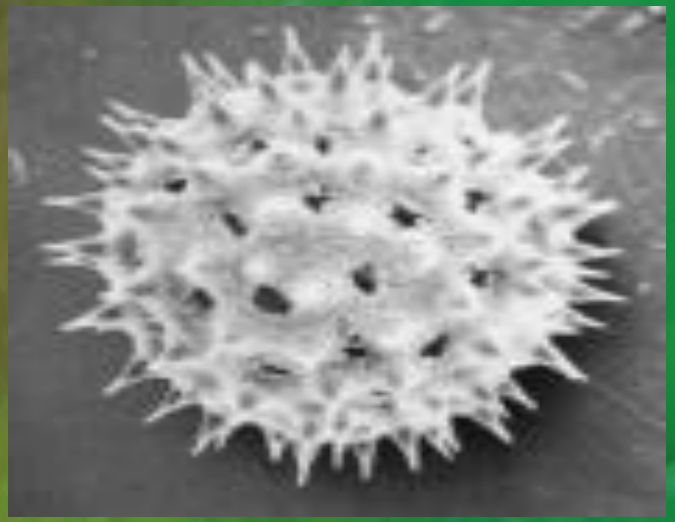


Tricolporate (Goodenaceae)

Pollen Aperture

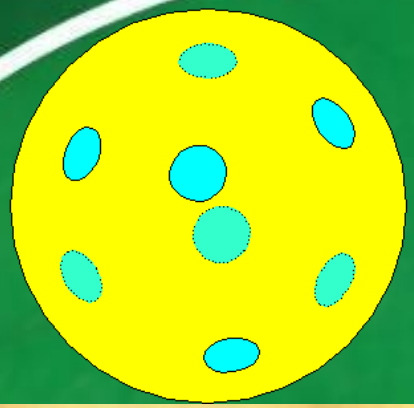
Polyporate

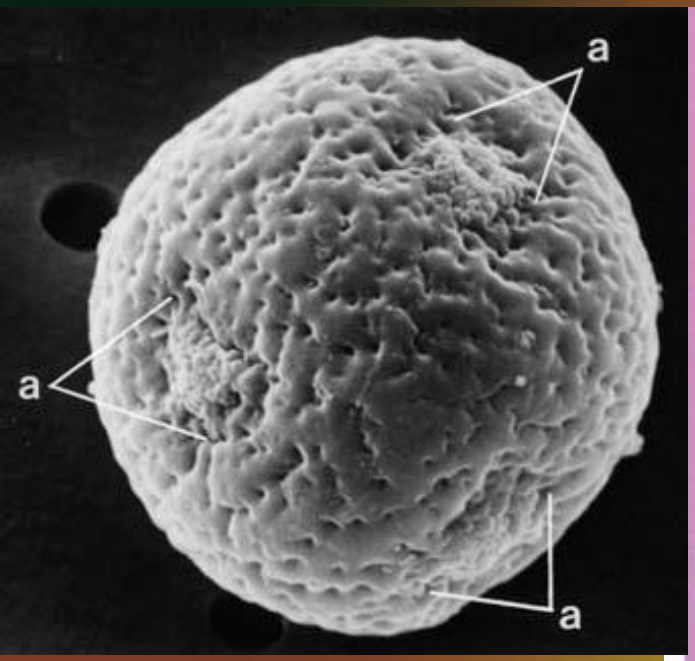
Amaranthaceae

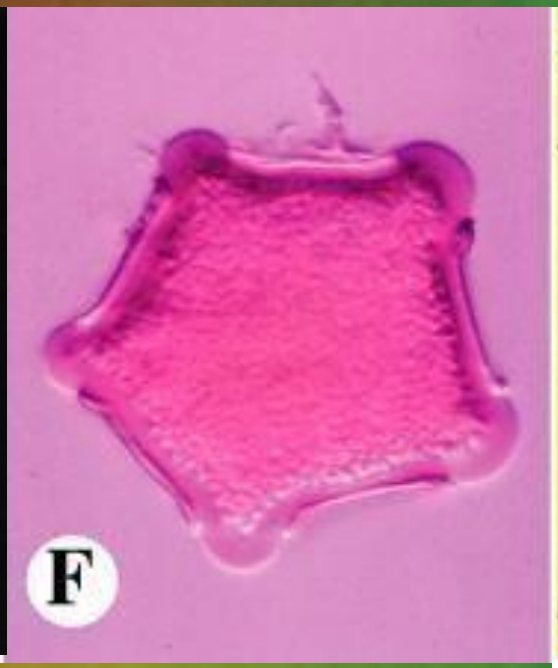


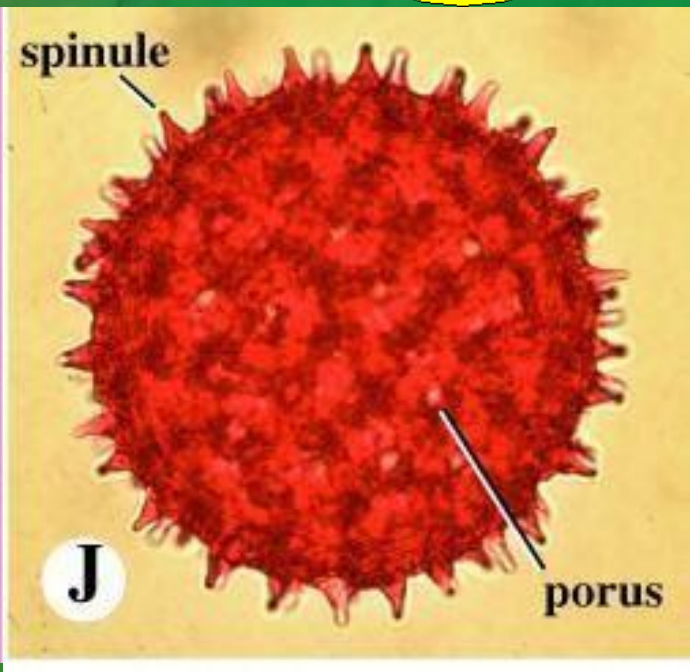
Convolvulaceae

Pollen Aperture









Pantoporate (pori occur globally on the pollen grain surface)

Pollen Morphology and Systematics

- Research Study

  “Morphological Characteristics of Mangrove Pollen”

  The study revealed a crucial relationship between pollen and mangrove families.

  (refer pages 3-4 of the abstract)

Let’s remember!!!

Pollen Apertures

- Monocolpate
- Monoporate
- Tricolpate
- Tricolporate
- Polyporate
- Pantoporate

Pollen Size

- Pollen size can vary tremendously across taxa. Size is typically measured in terms of both the polar diameter and the equatorial diameter.
- Typical pollen grains = 25-50 µm
- Pollen diameter ranges < 5 µm to > 200 µm

Pollen Size

- Grain size tends to have a moderate phylogenetic component.

Plant	Pollen grain diameter (μm)
Myosotis	5
Acacia (polyad)	30-50
Echium	12
Bauhinia	100
Cucurbitaceae	100-200
Malvaceae	150-200

Pollen Size

- It can be inferred from the table that borage family has small pollen while mallow and cucumber families have large pollen.

Pollen Size

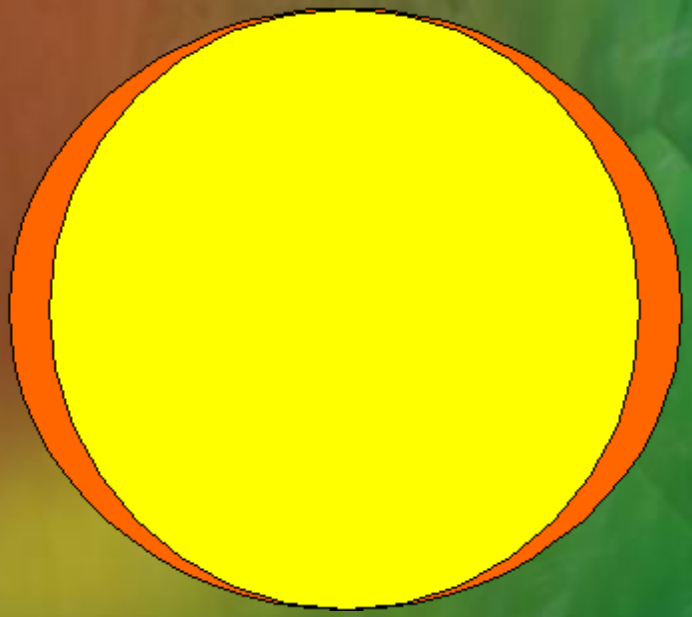
- Plant Families in DLSU-Dasma with single pollen units "Documentation and Identification of Pollen Found at DLSU-Dasma" (Bognot, et. al,. 2003)

Family	Pollen Size (µm)	Pollen Shape	Pollen Unit	Pollen Sculpturing
Begoniaceae	18.75	Oblate	Monad	Striate
Lythraceae	37.5	Oblate	Monad	Striate
Rubiaceae	12.5	Spheroidal	Monad	Perforate
Caricaceae	50	Spheroidal	Monad	Psilate
Malvaceae 1	112.5	Spheroidal	Monad	Echinate
Malvaceae 2	312.5	Spheroidal	Monad	Echinate
Euphorbiaceae 1	50	Spheroidal	Monad	Reticulate
Euphorbiaceae 2	50	Spheroidal	Monad	Reticulate
Euphorbiaceae 3	37.5	Spheroidal	Monad	Reticulate
Oxalidaceae	12.5	Spheroidal	Monad	Psilate

Pollen Shape

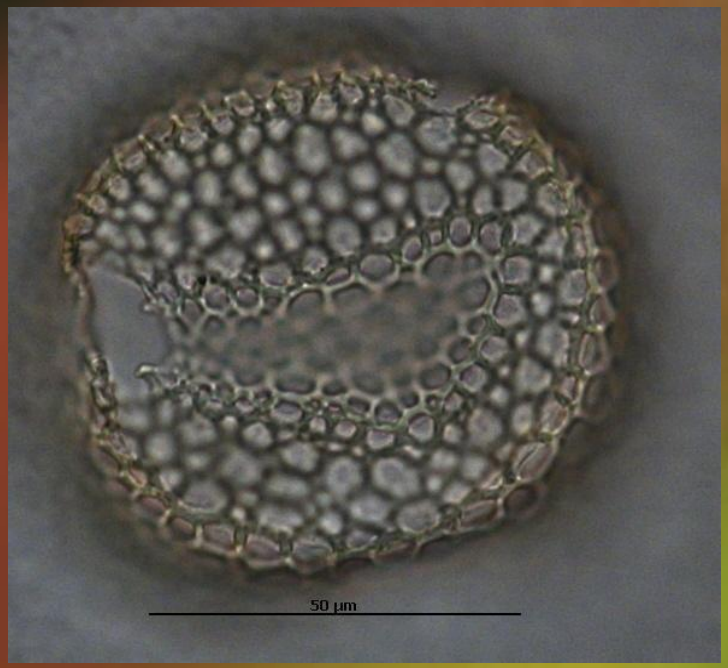
Spheroidal

(globose or ball-shaped)



Pollen Shape

Spheroidal



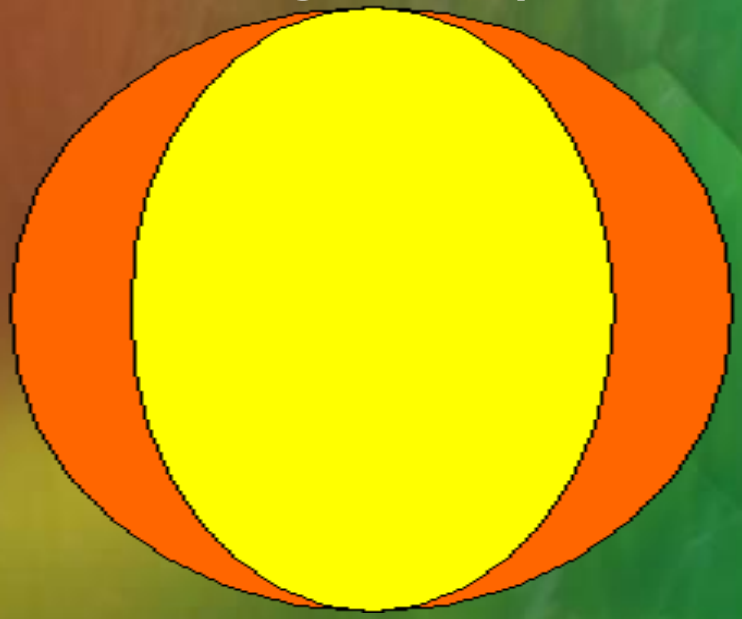
Rubiaceae

Cucurbitaceae

Pollen Shape

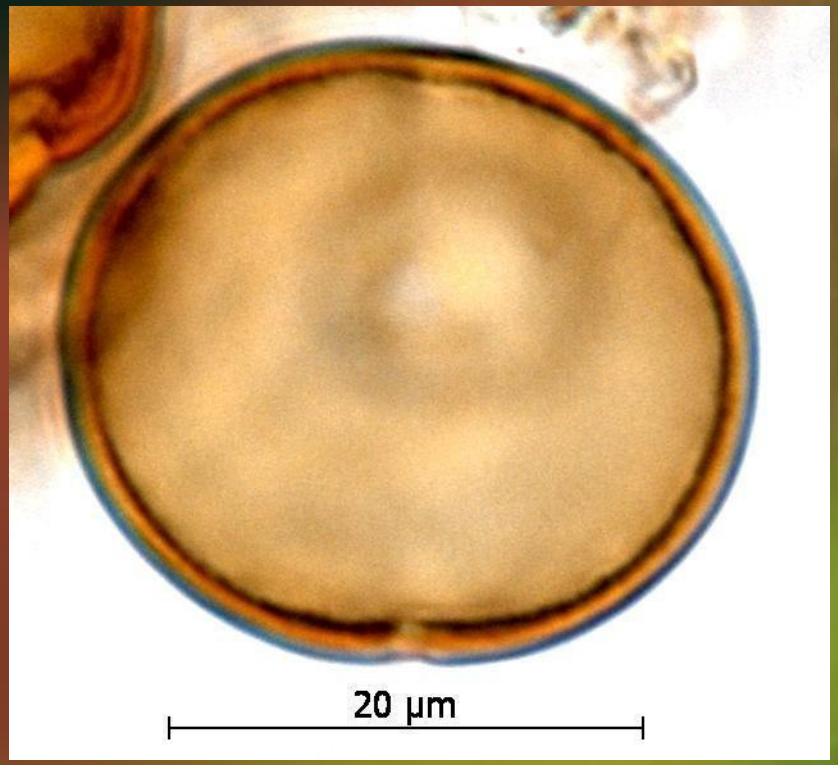
Oblate

(compressed along the polar axis like a tangerine)

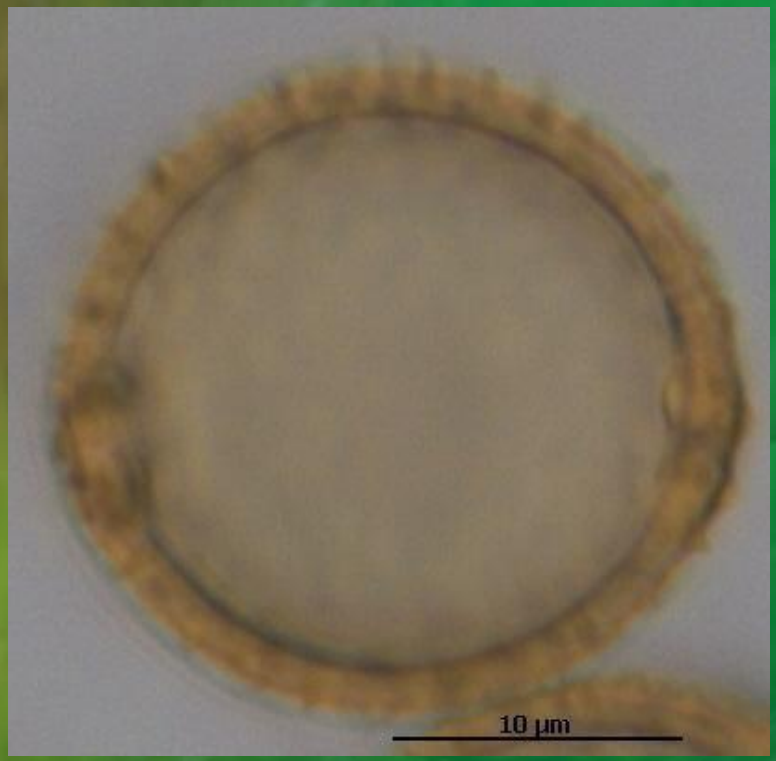


Pollen Shape

Oblate



Apocynaceae

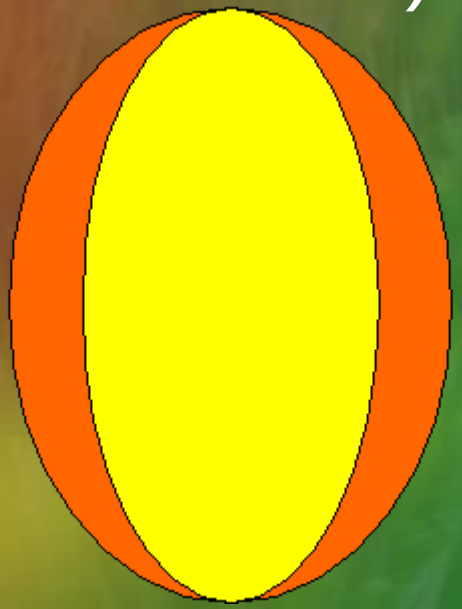


Euphorbiaceae

Pollen Shape

Prolate

(elongated along the polar axis like a cucumber)



Pollen Shape

Prolate

Euphorbiaceae

Rhizophoraceae

Sonneratiaceae

Pollen Shape

- Plant Families in DLSU-Dasma with single pollen units "Documentation and Identification of Pollen Found at DLSU-Dasma" (Bognot, et. al,. 2003)

Family	Pollen Size (µm)	Pollen Shape	Pollen Unit	Pollen Sculpturing
Begoniaceae	18.75	Oblate	Monad	Striate
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Euphorbiaceae 3	37.5	Spheroidal	Monad	Reticulate
Oxalidaceae	12.5	Spheroidal	Monad	Psilate

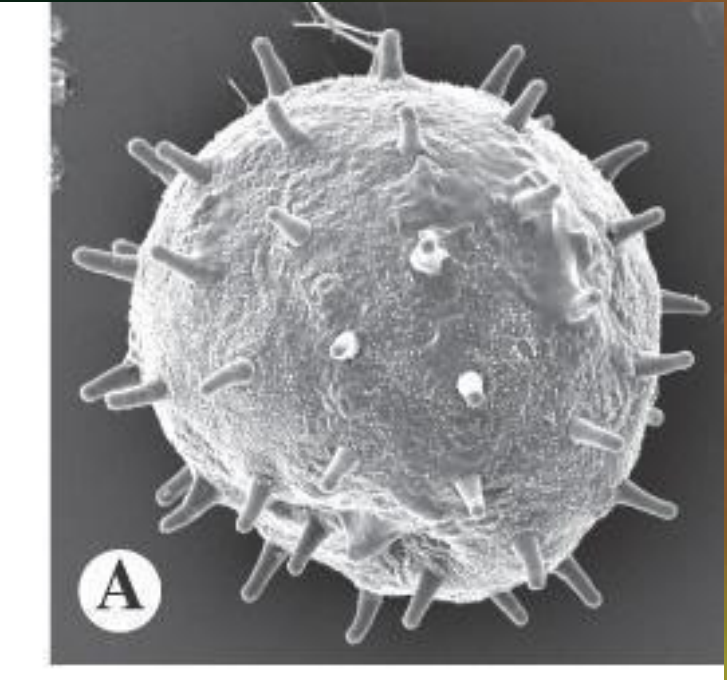
- Research study on Mangrove Pollen (pages 3-4)

Let’s remember!!!

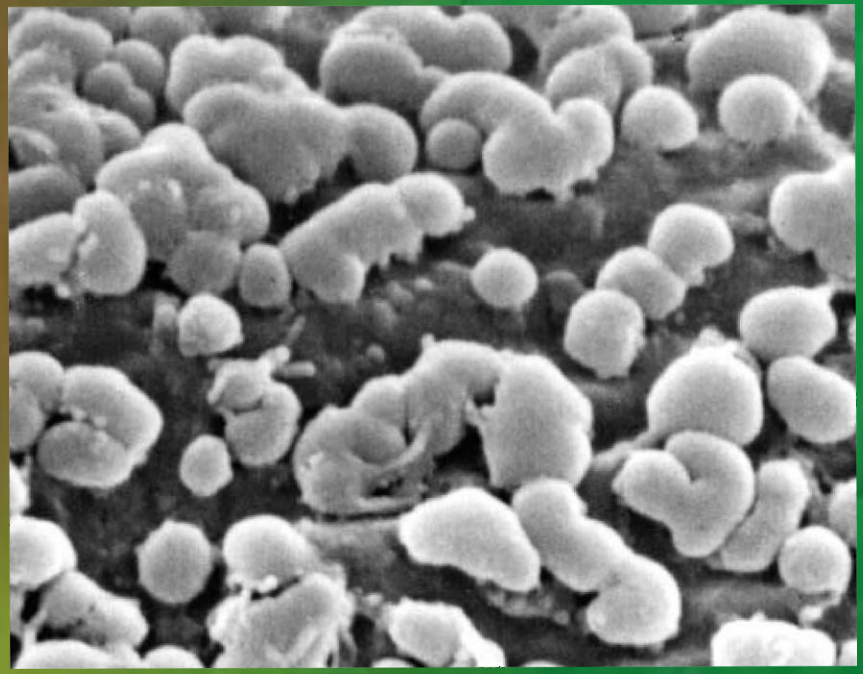
Pollen shape

- Spheroidal
- Oblate
- Prolate

Pollen Sculpturing



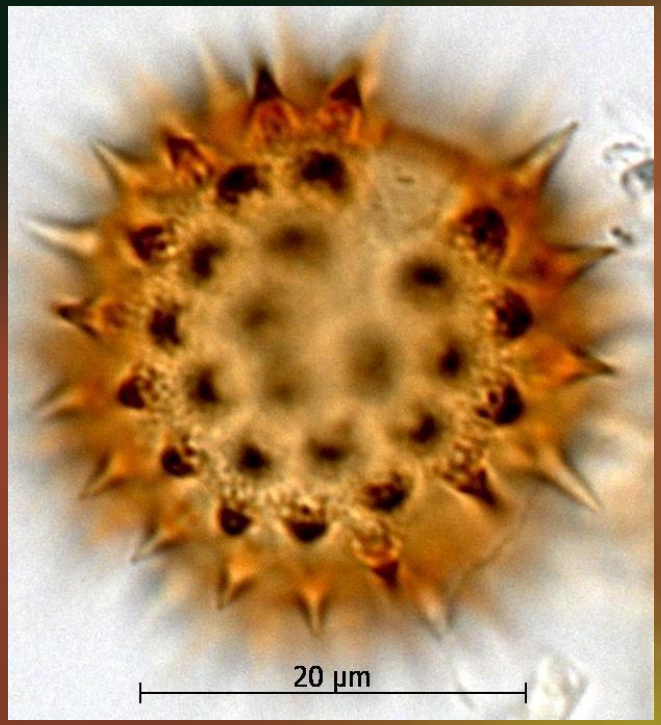
Echinate
(spinelike)

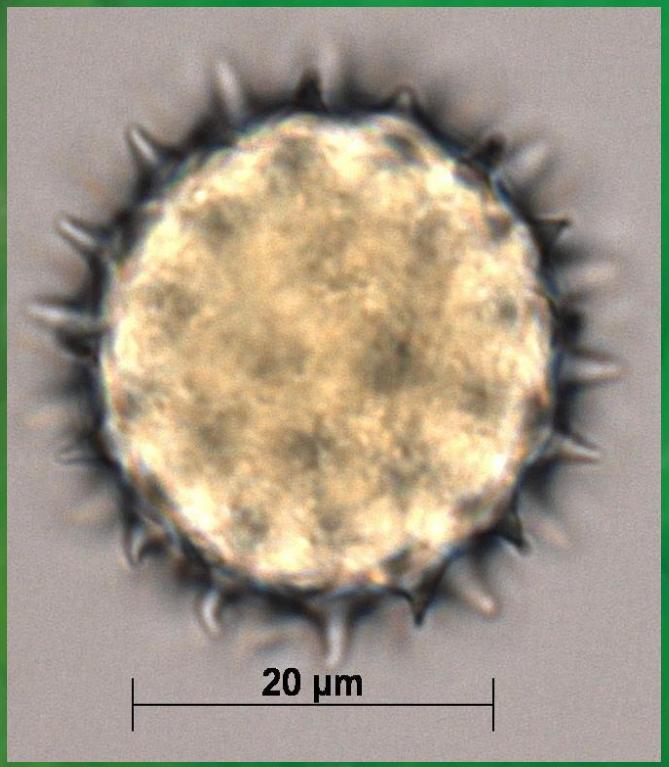


Verrucate
(wart-like)

Pollen Sculpturing

Echinate

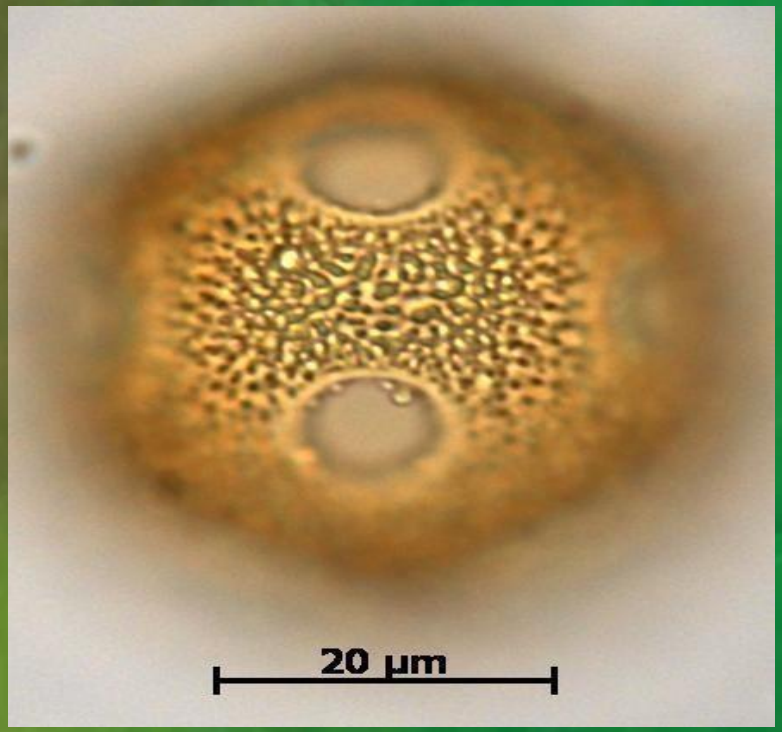




Asteraceae

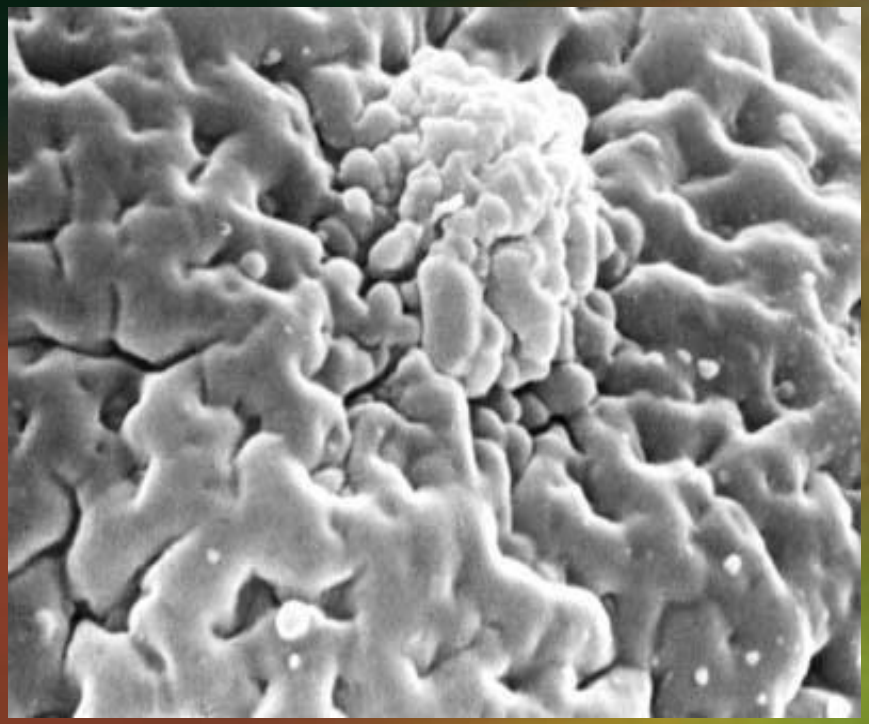
Pollen Sculpturing

Verrucate

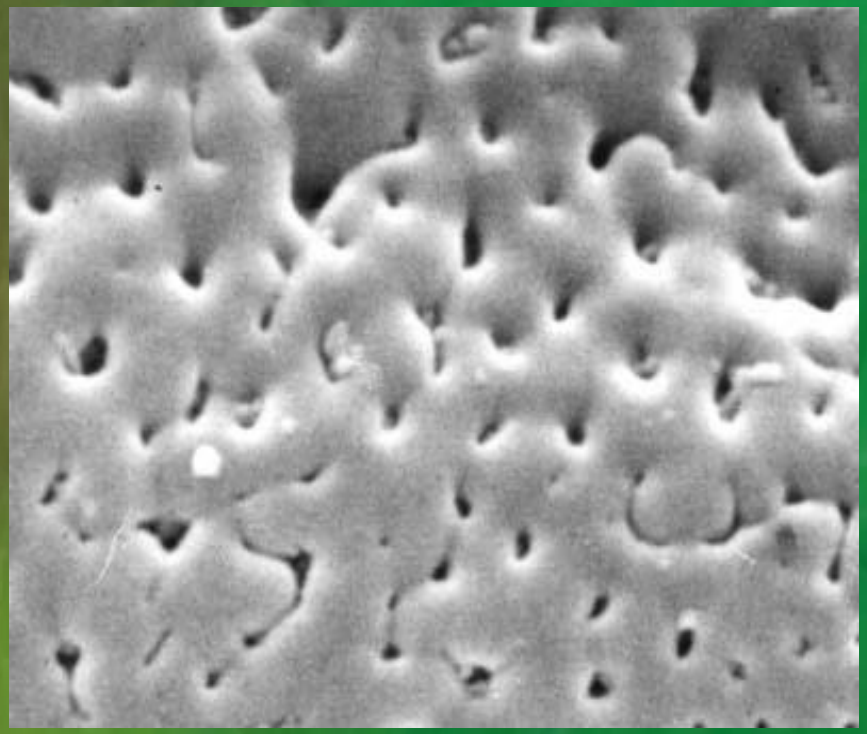


Caryophyllaceae

Pollen Sculpturing



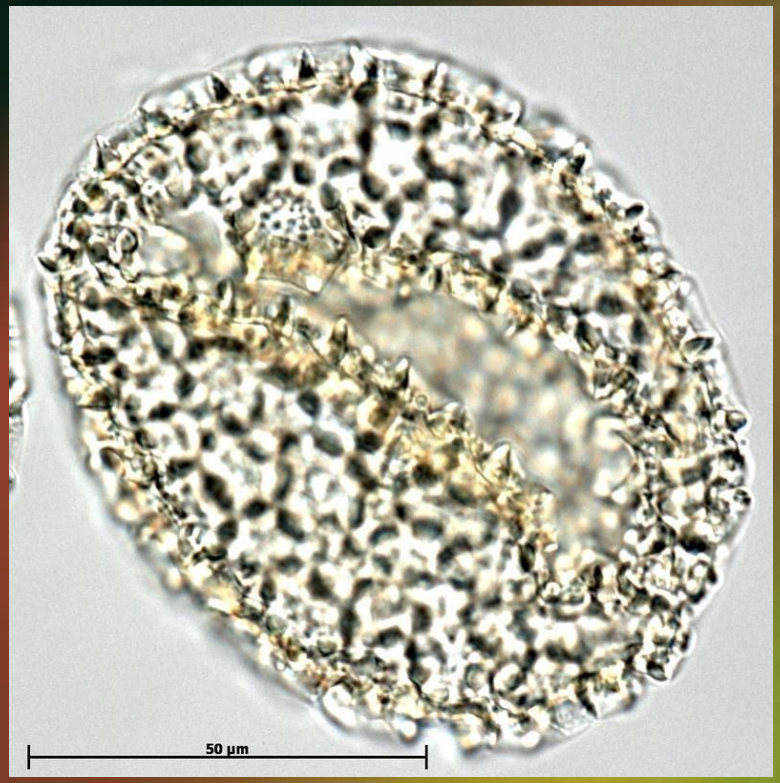
Rugulose
(brainlike)



Foveolate
(pitted surface)

Pollen Sculpturing

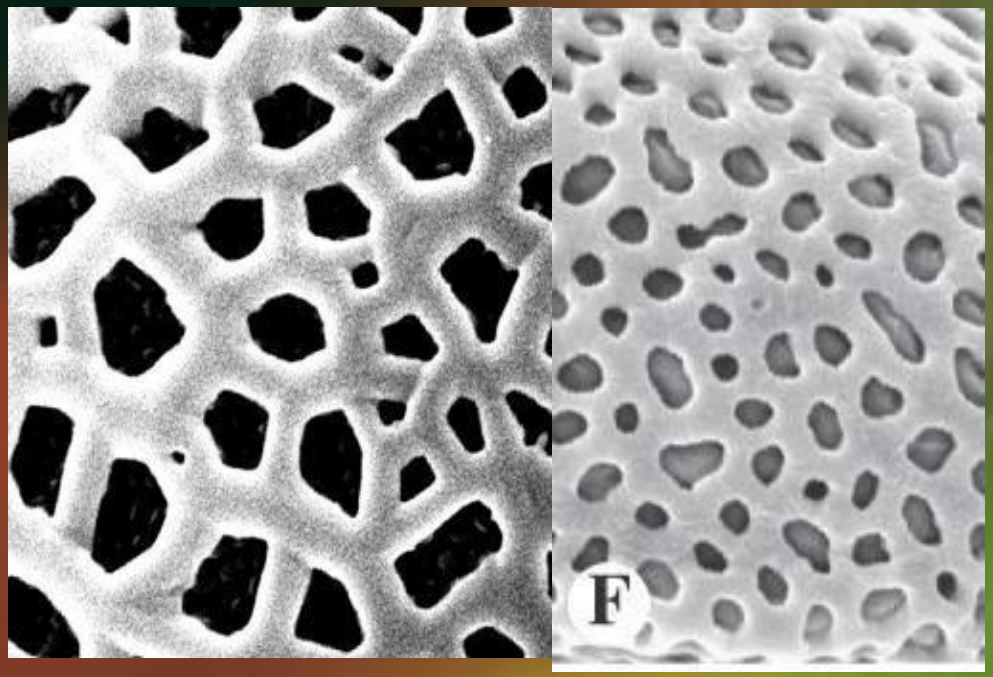
Rugulate



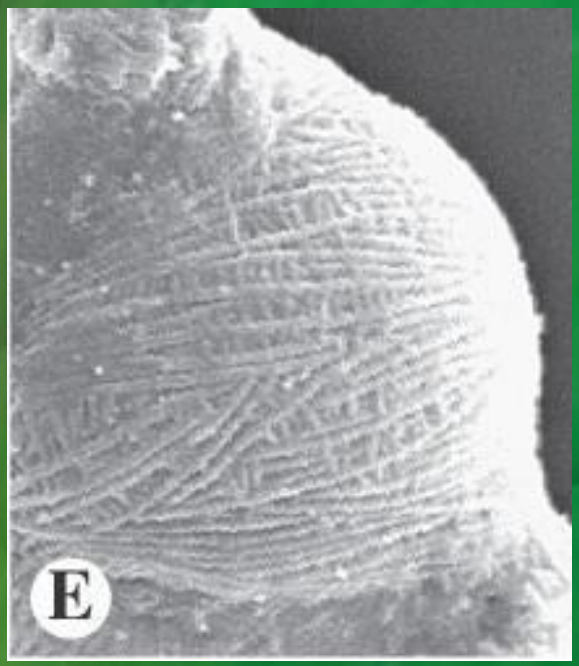
Acanthaceae

Fabaceae

Pollen Sculpturing



Reticulate
(netlike)



Striate
(with stripes)

Pollen Wall Structure

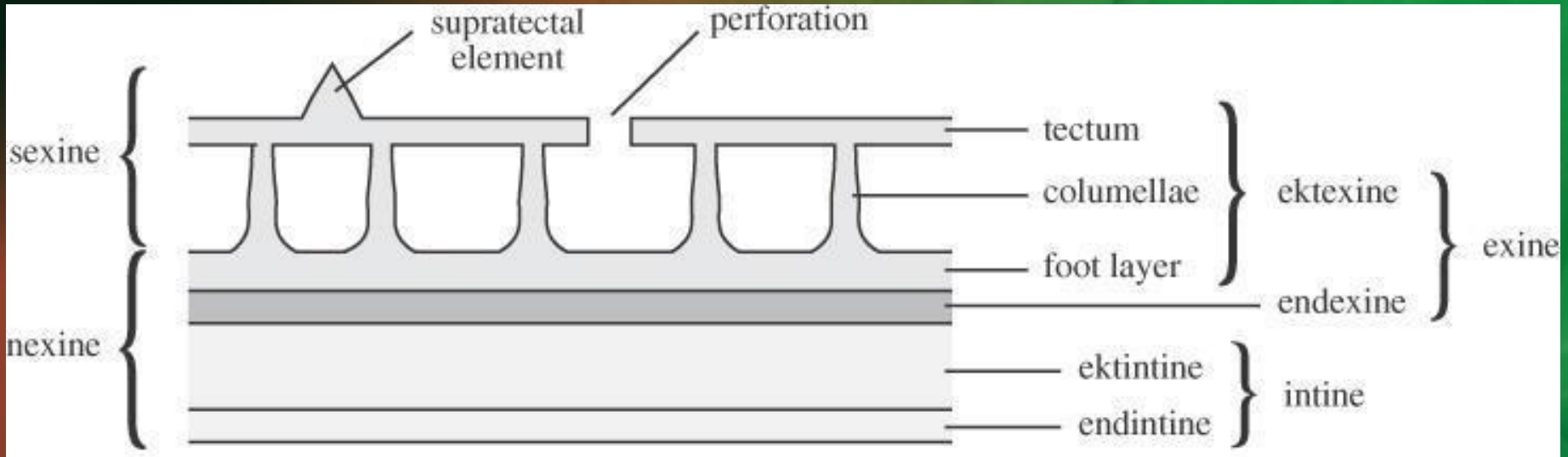
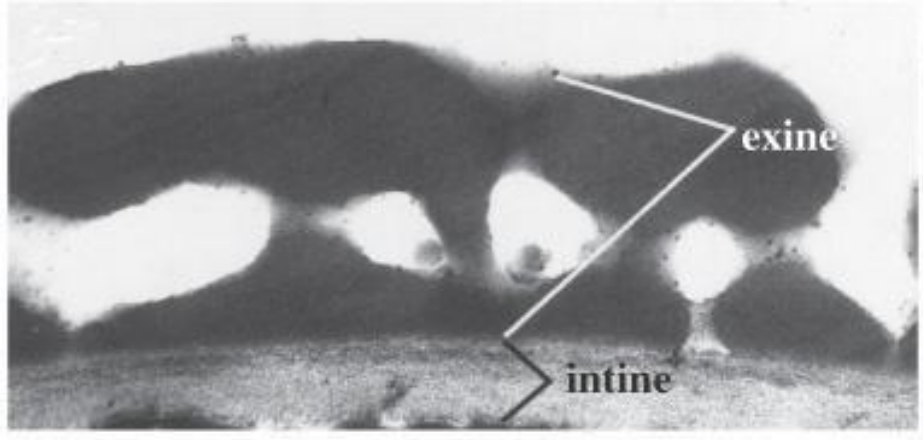


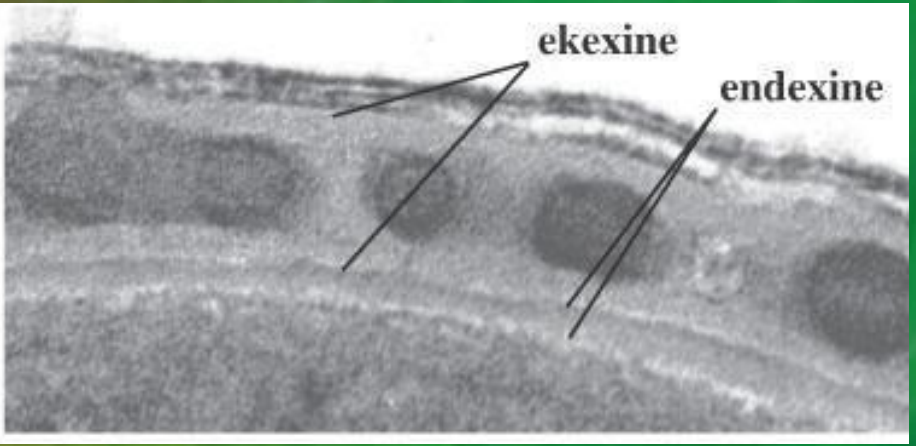
Figure 12.8 Pollen wall structure.

tectate-columellate

(majority of the angiosperms)

Pollen Wall Structure





tectate-columellate

(roof and footlike layer)

Let’s summarize!!!

Palynological Features Used in Plant Systematics

- Pollen Nucleus Number
- Pollen Storage Product
- Pollen Unit
- Pollen Polarity
- Pollen Aperture
- Pollen Size
- Pollen Shape
- Pollen Sculpturing
- Pollen Wall Structure

Thank you