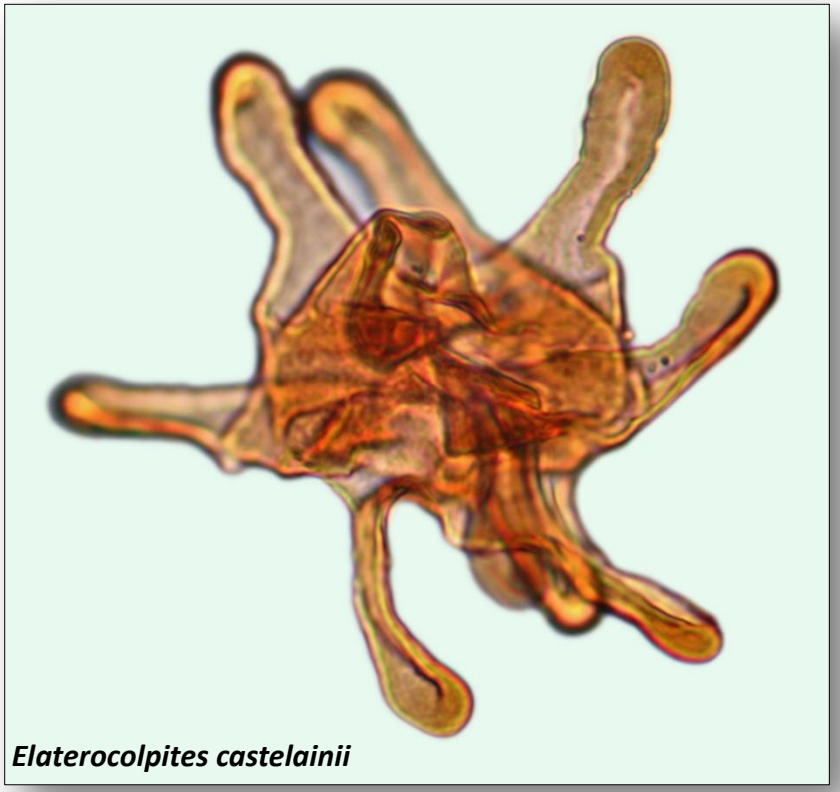
Palynology



Elaterocolpites castelainii

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What is Palynology?

- The branch of science concerned with the study of fossil and living palynomorphs
- The term **Palynology** was coined by Hyde and Williams (1944)

What are Palynomorphs?

- **Palynomorphs** include microscopic plant and animal structures composed of sporopollenin, chitin, or related compounds that are highly resistant to most forms of decay other than oxidation
- **Palynomorphs** are abundant in most sediments and sedimentary rocks, and are resistant to the routine pollen-extraction procedures including strong acids, bases, acetolysis, and density separation
- Most palynomorphs are between **5–500 µm** in size

Common palynomorph categories:

- Acritarchs
- Chitinozoans
- Scolecodonts
- Microscopic Algae and Algal Parts
- Cryptospores
- Embryophyte Spores
- Pollen
- Dinoflagellates
- Chitinous Fungal Spores and Other Fungal Bodies
- Microforaminiferal Inner Tests
- Megaspores

1. Acritarchs

Stratigraphic range: Proterozoic–present

- The name **Acritarchs** means ***"of uncertain origin"*** and was coined by Evitt (1963)

- Acritarchs include any small *organic-walled* microfossil which cannot be assigned to a natural group

- They are believed to have algal affinities, probably the cysts of planktonic eukaryotic algae

- **Size range: <10 µm to >1000 µm** (mostly between **15–80 µm**)

- They show variable sculptures (ornamentation); some are spiny, others are smooth

- They are mostly marine, but also found in brackish- and fresh-water settings

- They are valuable Proterozoic and Paleozoic biostratigraphic and paleoenvironmental tools

***Micrhystridium* spp.**

Acanthomorph,
from the latin acantha = thorn

Polygonomorph,
poly = many,
gonia= angle

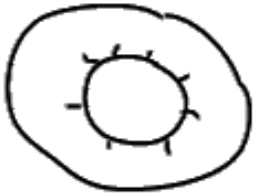
Netromorph, netron
= spindle

Diacromorph,
di = two, akron = summit

Prismatomorph,
prisma = prism

Oomorph, oon = egg

Herkomorph, herkos
= wall or fence



Pteromorph,
pteros = wing

Sphaeromorph,
sphaira = ball

Data from: http://www.ucl.ac.uk/GeolSci/micropal/acritarch.html

Basic morphologic groups of Acritarchs

Priscotheca complanata

Age: Lower Ordovician
Size: 40 µm excluding processes
Form: Diacromorphic

Leiofusa bernesgae

Age: Silurian
Size: 10 µm excluding processes
Form: Netromorphic

Veryhachium lairdi

Age: Silurian
Size: 12 µm excluding processes
Form: Polygonomorphic

Data from: http://www.ucl.ac.uk/GeolSci/micropal/acritarch.html

2. Chitinozoans

Stratigraphic range: late Cambrian–latest Devonian

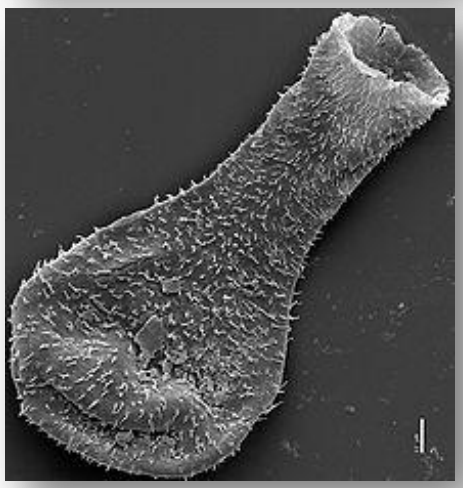
- Chitinozoans are large **(50–2000 µm)** flask-shaped, pseudochitinous palynomorphs that appear dark, almost opaque when viewed using a light microscope

- They are found only in marine rocks and are important Paleozoic stratigraphic markers

- ***They are of uncertain affinity, but theories have been proposed as follows:***

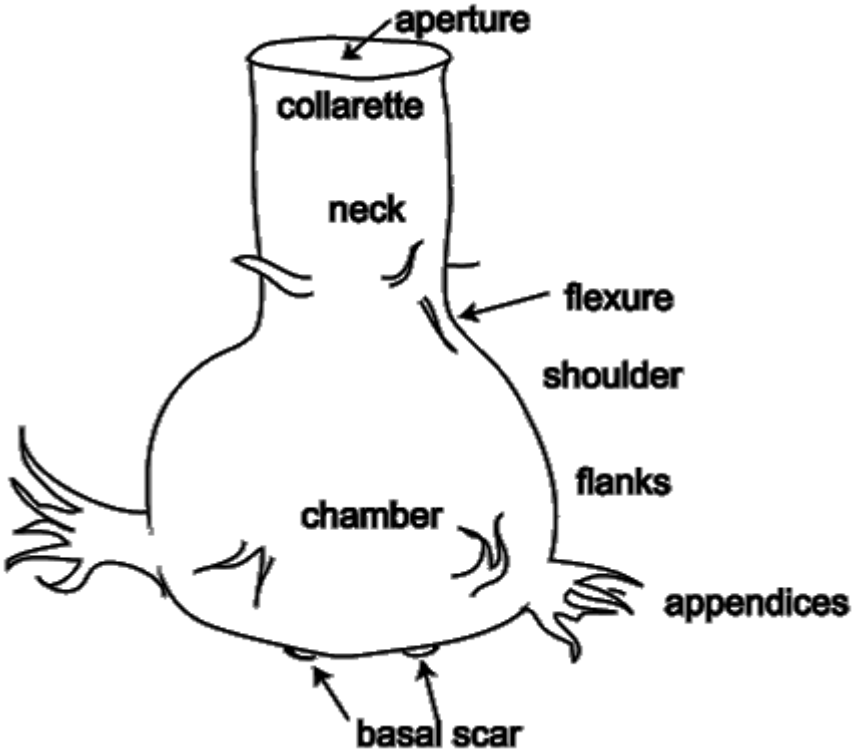
- Kozlowski (1963) suggested they were the eggs of annelid worms which is supported by: **1)** the co-occurrence of chitinozoans with scolecodonts and **2)** their similar trends of abundance

- Jenkins (1970) recognized an affinity between chitinozoa and graptolites based on circumstances like chemical similarity, frequent association, and close agreement in stratigraphic limits

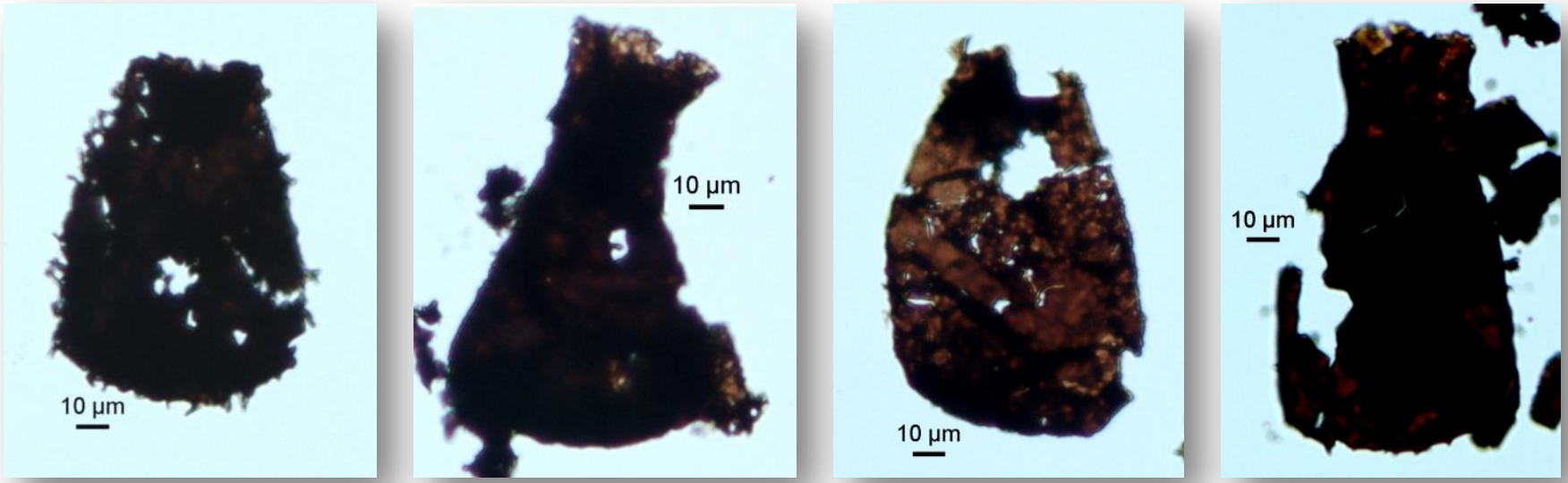


Morphology…

- Chitinozoans are flask-shaped sacs or vesicles
- They have variable surface ornamentation
- The main chamber may have a neck with a marked flexure between the two.
- It is thought that at least some chitinozoans were linked together at the appendages to form colonial chains.



From: http://www.ucl.ac.uk/GeolSci/micropal/acritarch.html



Examples of some chitinozoans from the Utica and Haynesville shale-gas source rocks, USA (Elgmati et al., 2011)

3. Dinoflagellates

Stratigraphic range: Late Triassic–present

- Dinoflagellates are unicellular aquatic protists (mostly marine, but also found in brackish- and fresh-water settings)

- Their name is derived from the Greek dinos "whirling" and Latin flagellum "whip"

- They are motile and can be heterotrophic, parasitic, or photosynthetic (autotrophic)

- Their most abundant fossil assemblages are from neritic to upper bathyal environments

- They are useful biostratigraphic and paleoenvironmental tools

Oligosphaeridium perforatum

(http://www.nhm.ac.uk/research-curation/research/projects/duxbury/database/detail.dsml?SpeciesID=62&search=Show+specimen+details)

Oligosphaeridium perforatum
(movie through the image stack)

Oligosphaeridium perforatum
(extended focus animation)

(http://www.nhm.ac.uk/research-curation/research/projects/duxbury/database/detail.dsml?SpeciesID=62&search=Show+specimen+details)

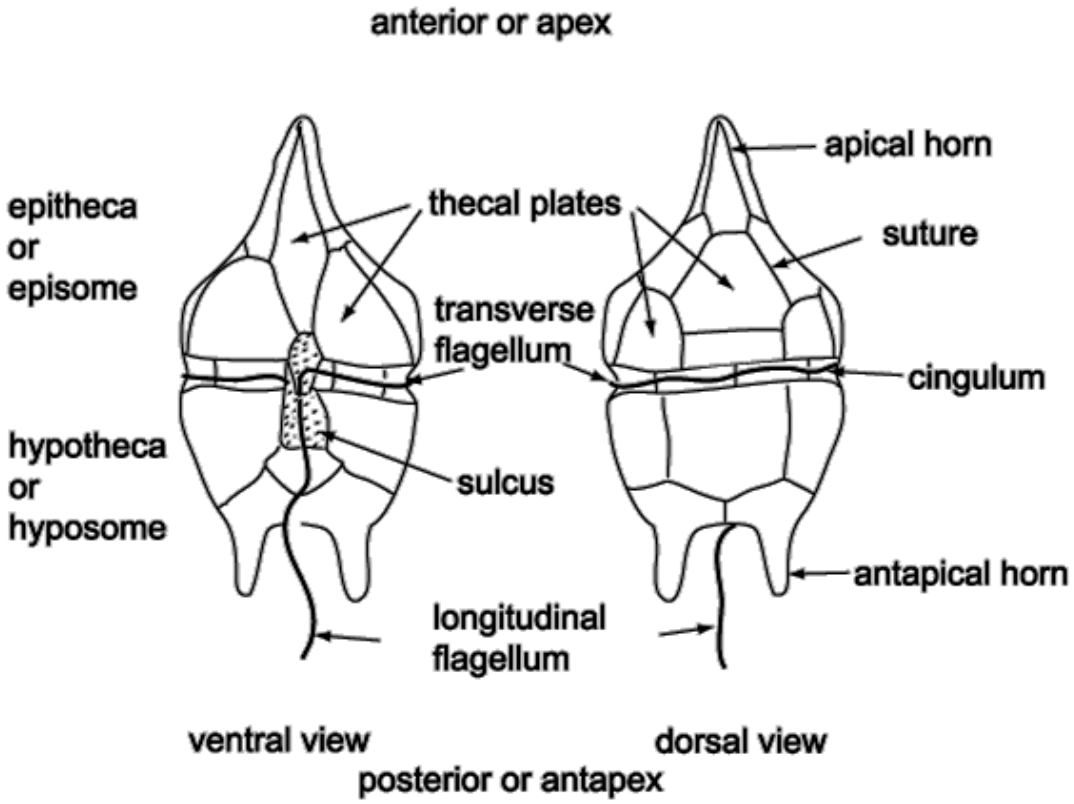
Morphology…

- Dinoflagellates generally have two flagella:

- ***Transverse flagellum*** (mostly contained in a groove-like structure around the equator of the organism called the **cingulum**. It provides forward motion and spin to the dinoflagellate)

- ***Longitudinal flagellum*** (trailing behind providing little propulsive force, mainly acting as a rudder)

- Dinoflagellates may be ***armored***, with a rigid outer cell covering **(theca)**, or ***unarmored***

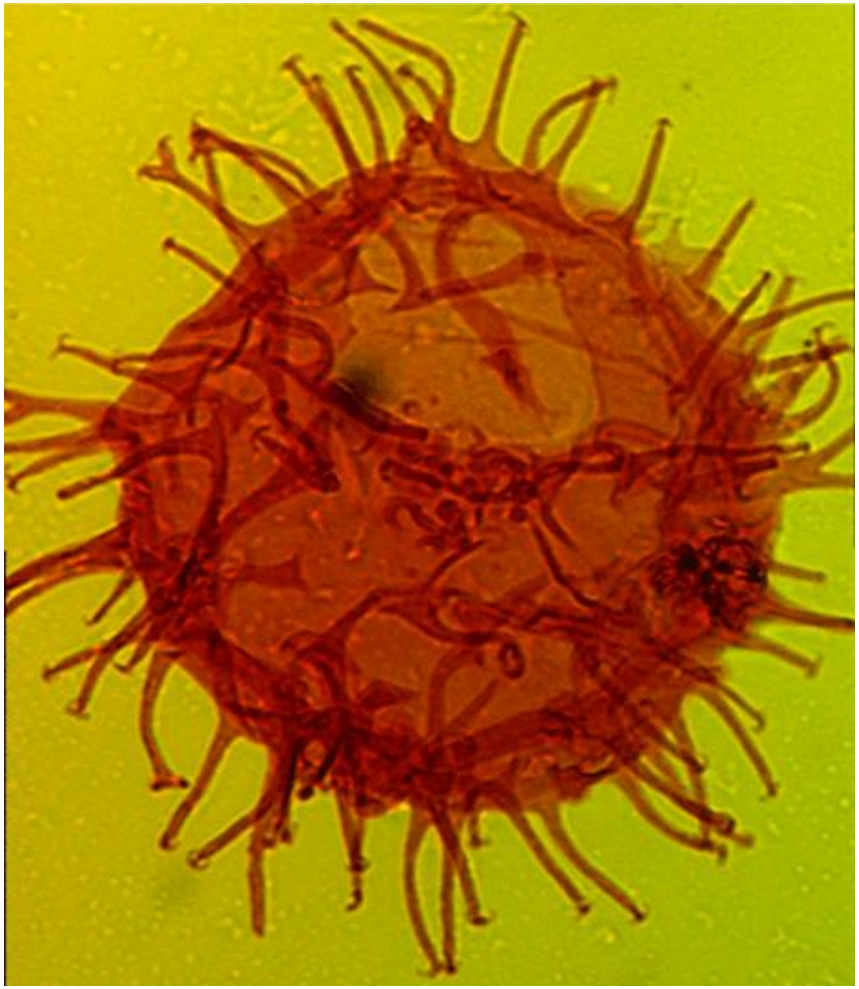


Common morphological features of a dinoflagellate cyst

(http://www.ucl.ac.uk/GeolSci/micropal/dinoflagellate.html)

Red tide caused by a bloom of the dinoflagellate *Lingulodinium polyedrum* along the coast of La Jolla, San Diego County, USA

(http://www.cdph.ca.gov/HealthInfo/environhealth/water/Pages/Redtide.aspx)



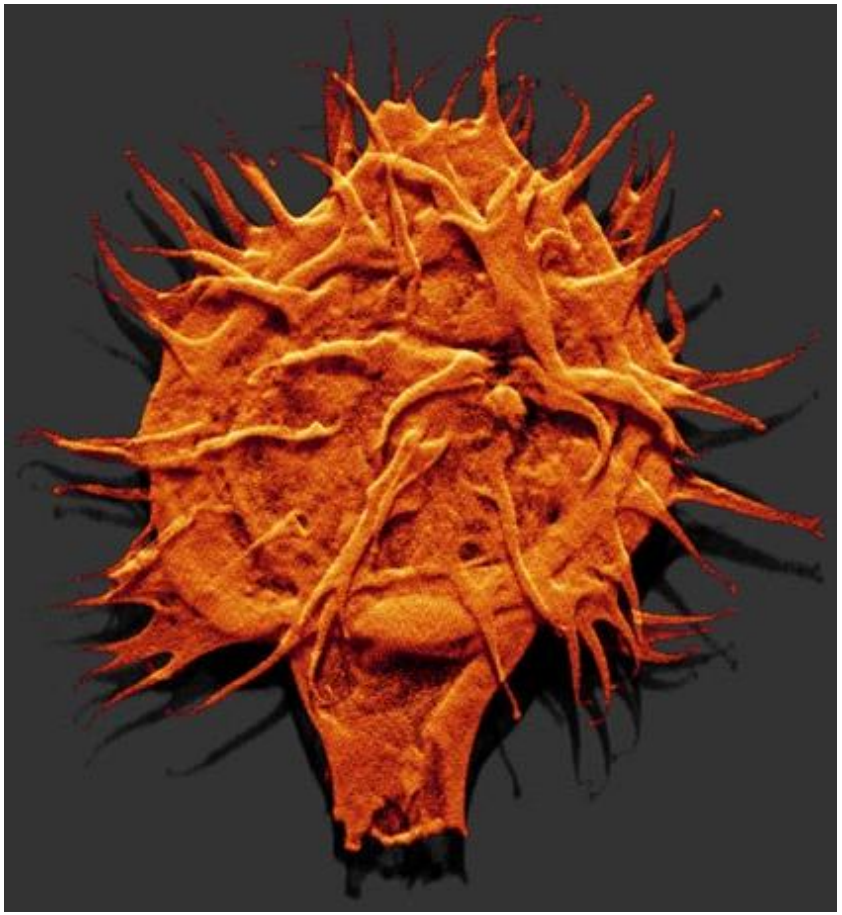
Apectodinium homomorphum

Thanetian (Palaeocene)–Bartonian (Eocene)

Lingulodinium machaerophorum

Eocene–Recent

(http://www.ucl.ac.uk/GeolSci/micropal/dinoflagellate.html)



Florentinia abjuncta

(http://www.nhm.ac.uk/research-curation/research/projects/duxbury/database/detail.dsml?SpeciesID=45&search=Show+specimen+details)

4. Embryophyte Spores

Stratigraphic range: Late Ordovician–present

- **Embryophyte Spores** are microscopic unicellular reproductive cells of certain **vascular plants** (those with special conducting tissues called xylem)

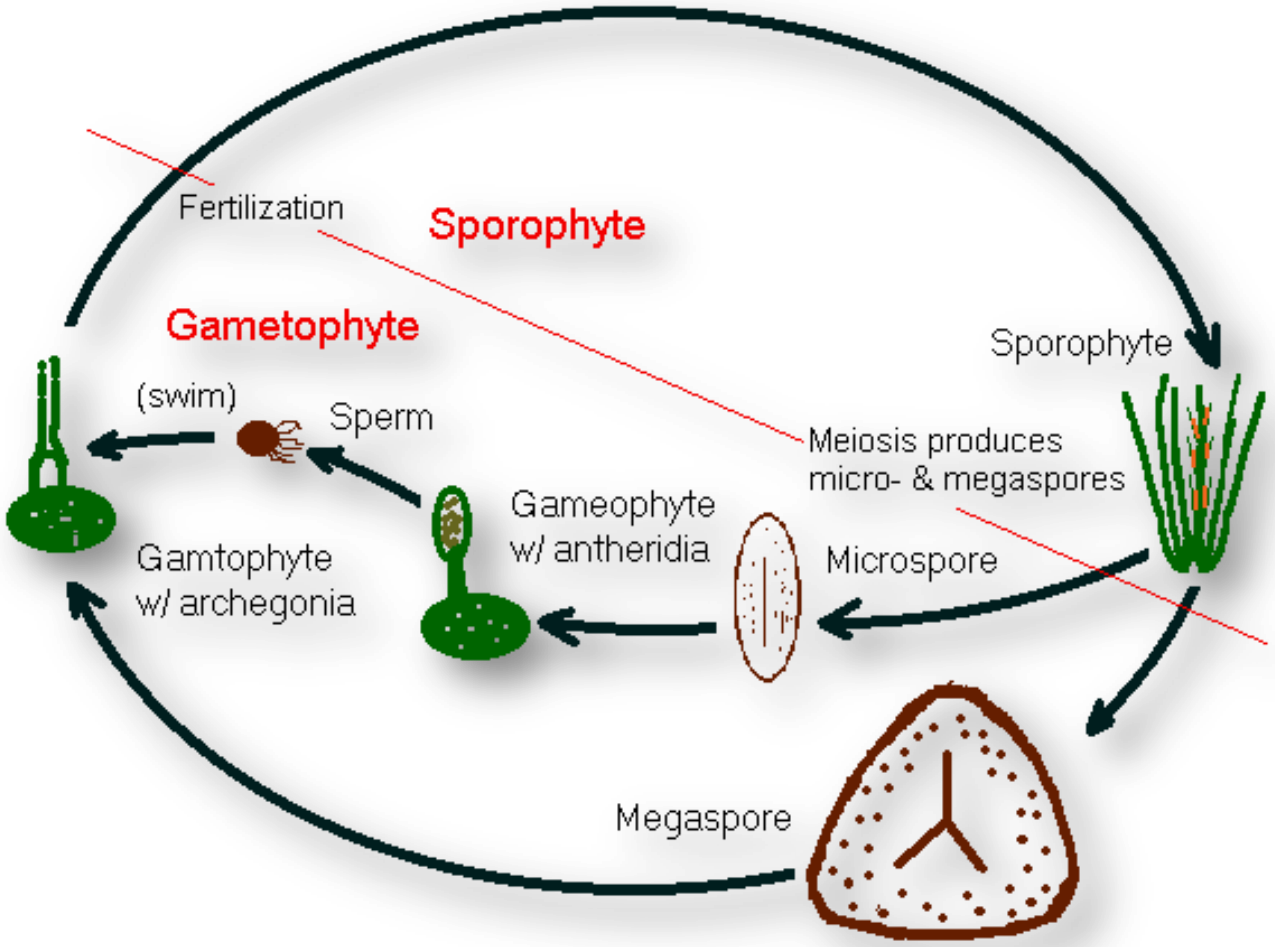
- These spores are extremely resistant and are easily transported by wind and water

- They are useful biostratigraphic tools particularly in fresh-water environments, evaporitic deposits, and where marine and fresh-water facies interdigitate

- They show variable surface sculpture (ornamentation)

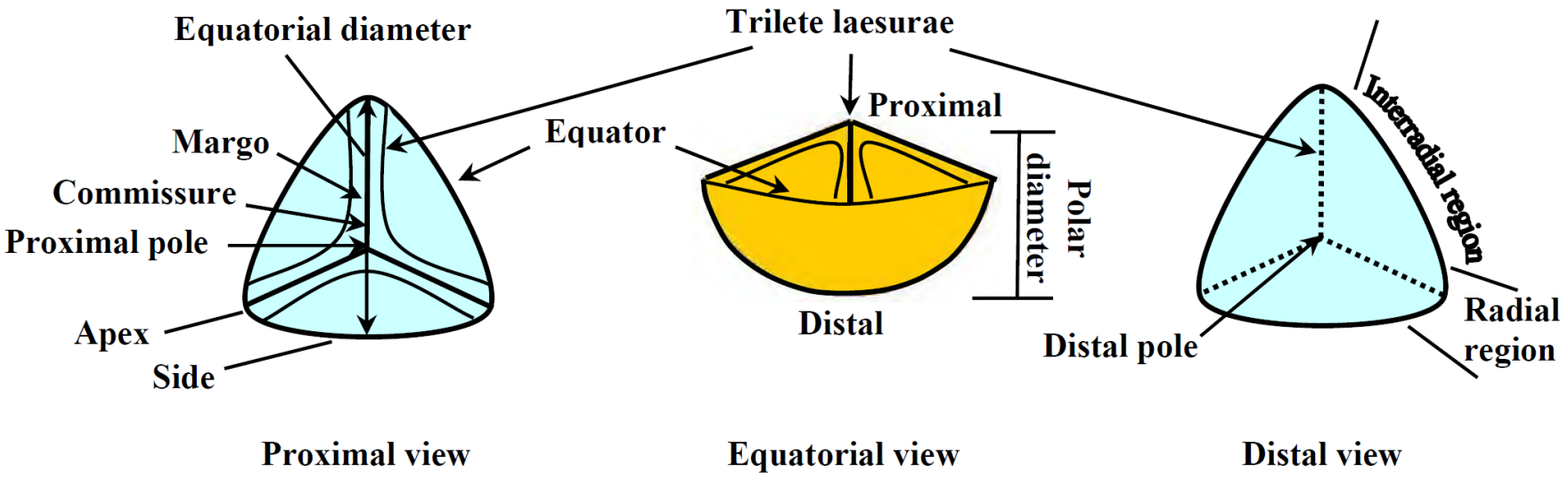
Trilete spore
(***Trilobosporites laevigatus*** El Beialy 1994)

Monolete spore
(From Zobaa et al., 2009)

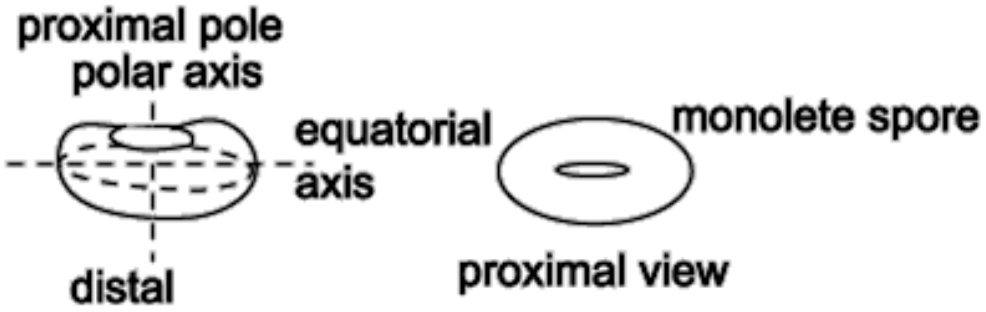


Alternation of generations in some vascular plants

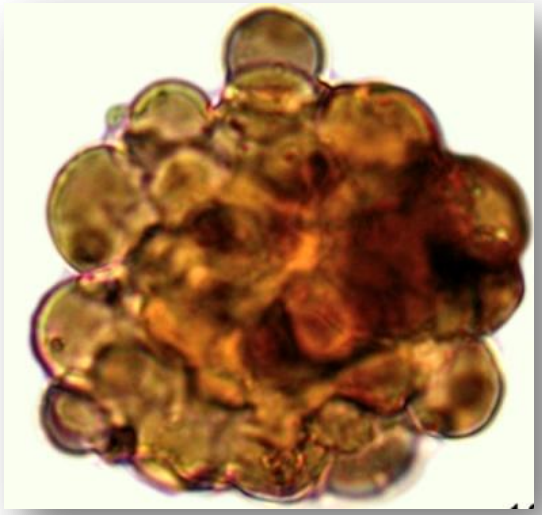
(http://www.geo.arizona.edu/palynology/ppfspor.html)



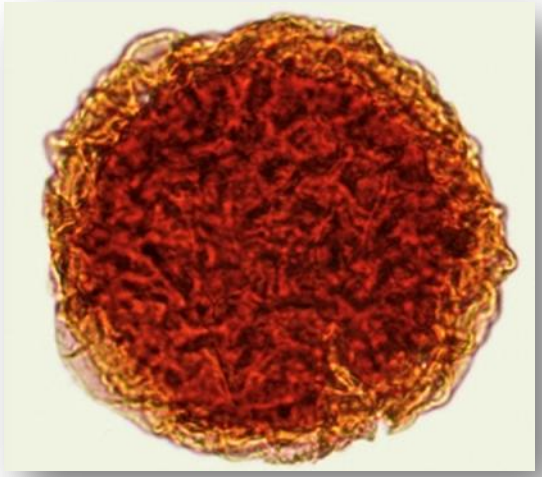
Schematic drawings illustrate the basic morphologic features of a trilete spore (Modified from Singh, 1964)



Basic morphology of a monolete spore
(http://www.ucl.ac.uk/GeolSci/micropal/spore.html)



Leptolepidites psarosus



Crybelosporites pannuceus

Deltoidospora mesozoica

5. Pollen

Stratigraphic range: latest Devonian–present

- **Pollen grains** are the containers of the male gametophyte generation of seed plants (both angiosperms and gymnosperms)

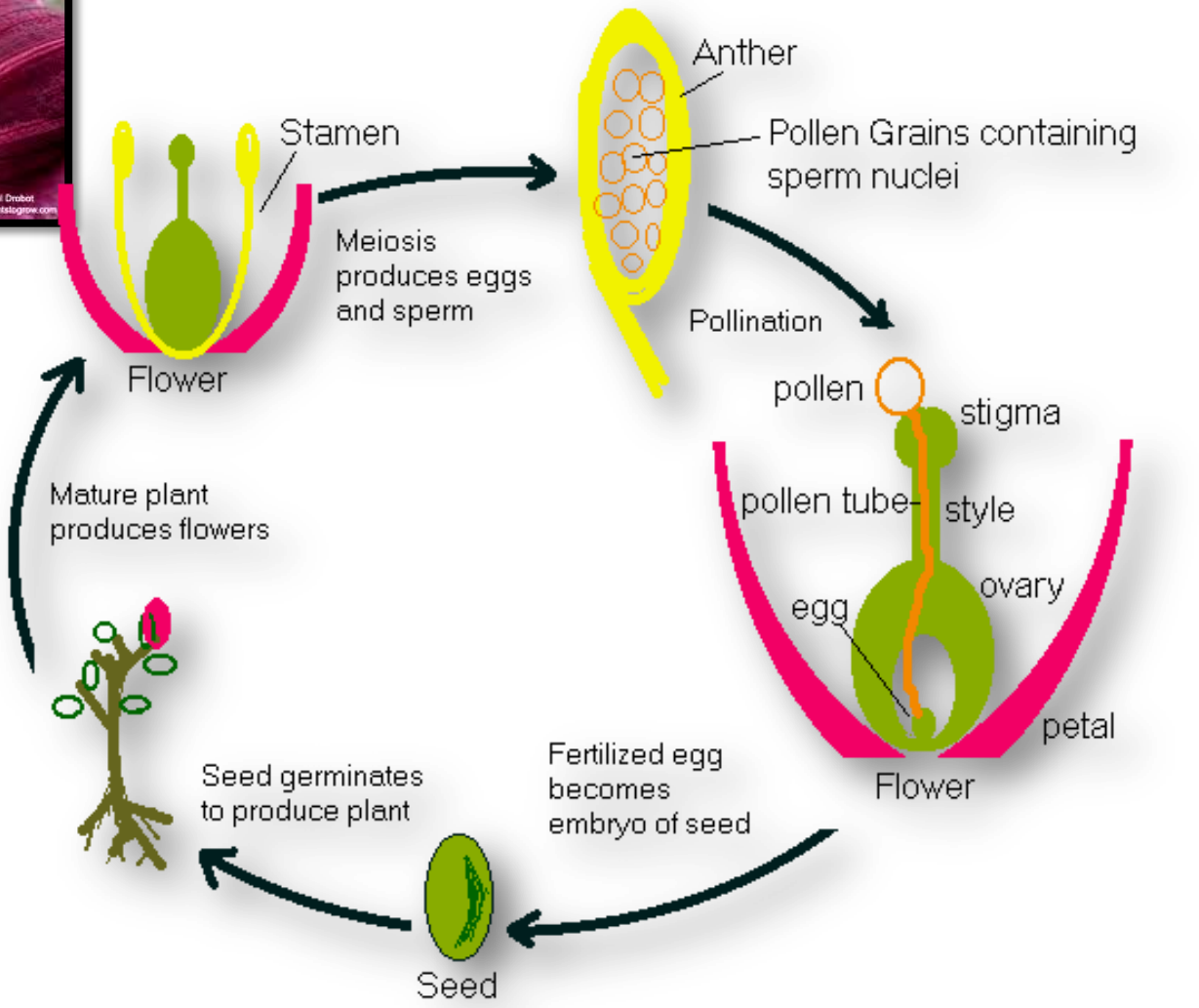
- They are produced in the male organs of the flowers (**anthers**)

- Pollen production is a strategy by which seed plants became free from dependence on standing water for **fertilization**

- **Pollination** occurs by transferring pollen grains from the anthers to the female organs by wind or animals

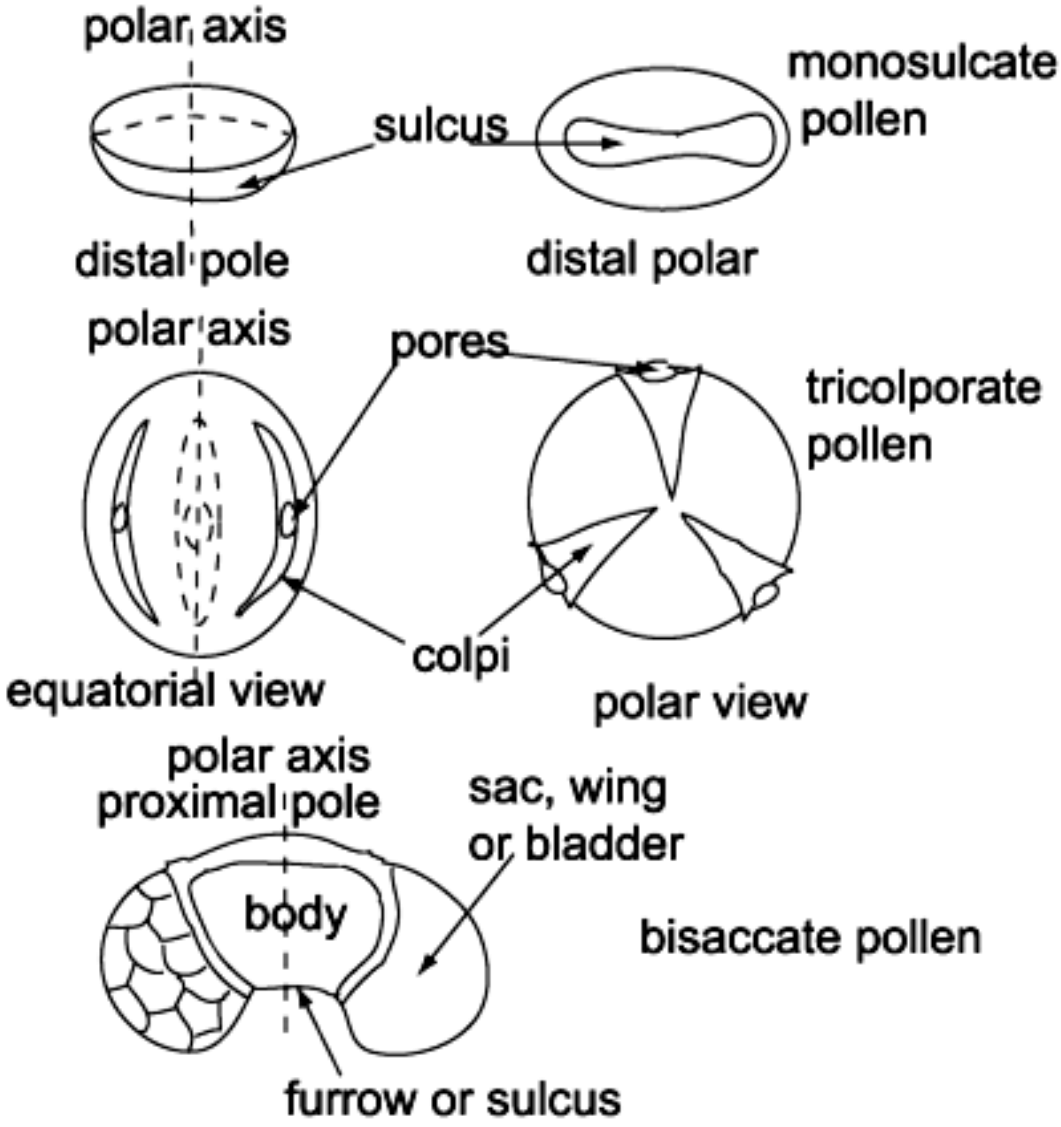
- Pollen are good biostratigraphic and paleoenvironmental tools

Afropollis jardinus



Reproduction in flowering plants

(http://www.geo.arizona.edu/palynology/polkey.html)



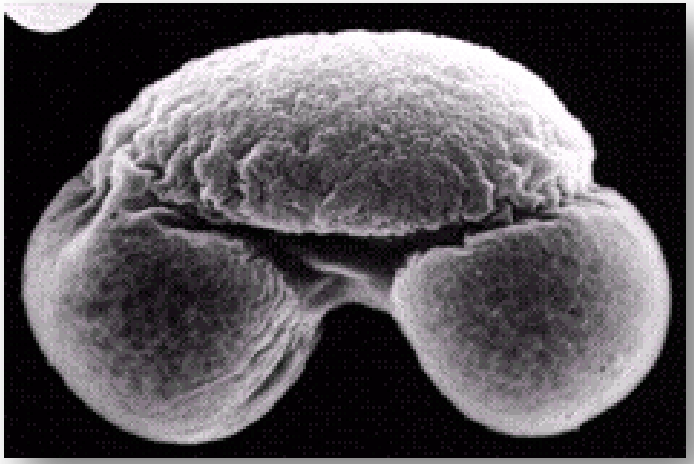
Basic morphology of some pollen types
(http://www.ucl.ac.uk/GeolSci/micropal/spore.html)

Tricolporopollenites kruschii

***Cupuliferoipollenites* sp.**

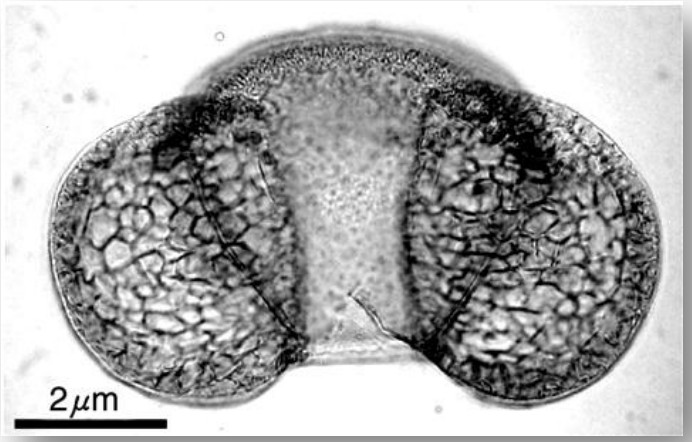
Caryapollenites veripites

(Zobaa et al., 2011)



Pinus echinata

(http://www.geo.arizona.edu/palynology/pid00005.html)



***Pinus* sp.**

(http://jolisfukyu.tokai-sc.jaea.go.jp/fukyu/mirai-en/2007/2_5.html)

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