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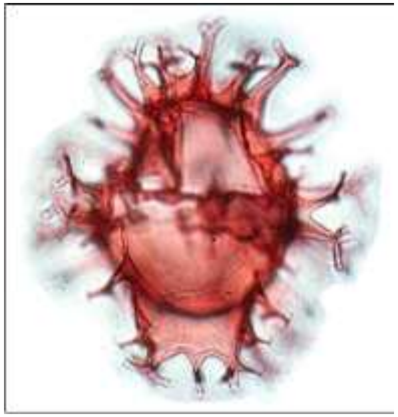
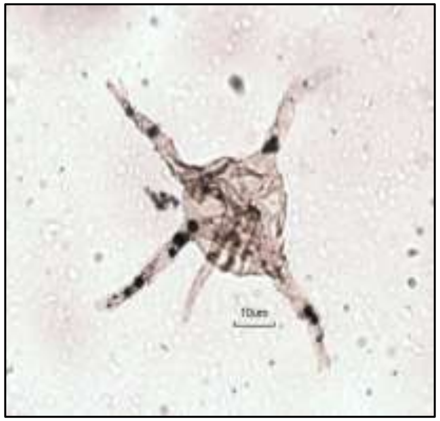
ORGANIC WALLED MICROFOSSILS

- They are called as organic-walled because their shells are made up of organic matter like chitin, sporopollenin, etc.
- They are non-mineralized forms and thus are extremely resistant to chemical as well as microbial attack and to some extent to the effects of temperature and pressure after burial.

- Dinoflagellates
- Acritarchs
- Spores and Pollens





Red Tides

Red tide is a common name for a phenomenon known as an algal bloom (large concentrations of aquatic microorganisms) when it is caused by a few species of dinoflagellates and the bloom takes on a red or brown color. Red tides are events in which estuarine, marine, or fresh water algae accumulate rapidly in the water column, resulting in coloration of the surface water. It is usually found in coastal areas.

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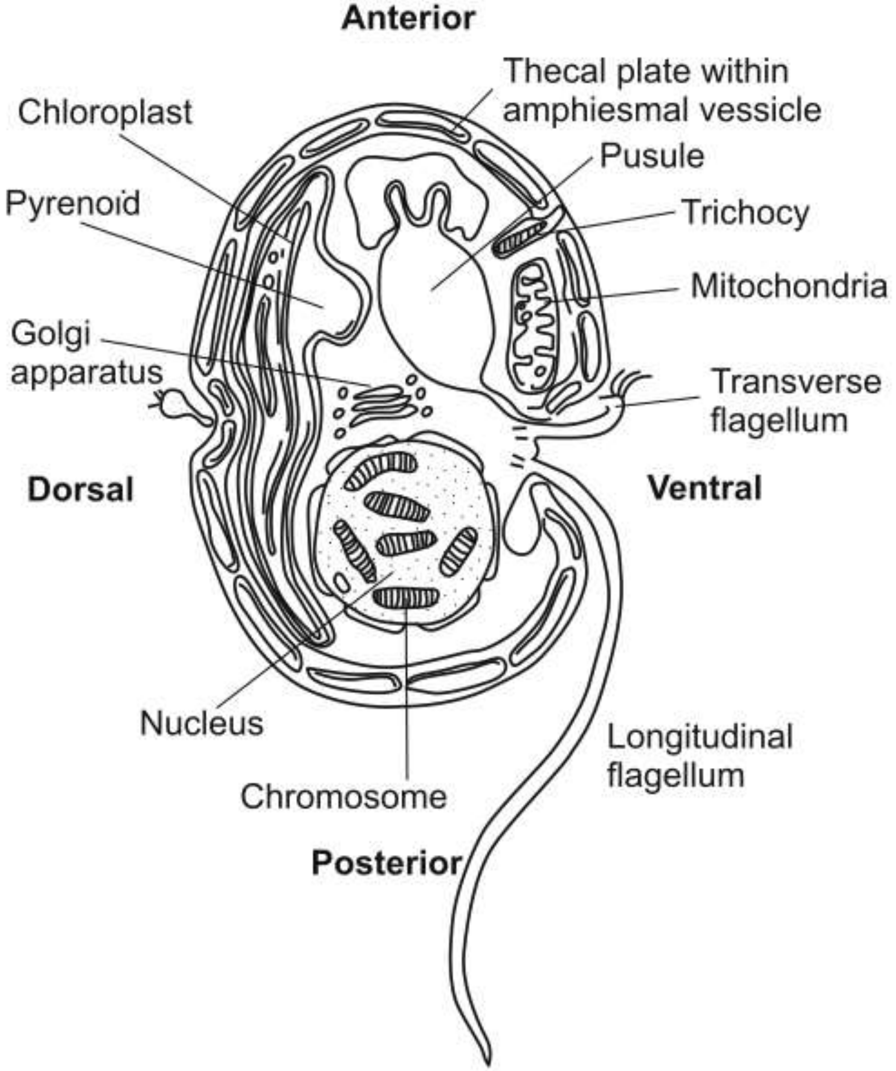
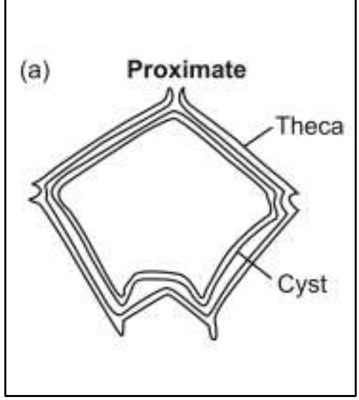
Dinoflagellates (meaning whirling whips) are second only to the diatoms as primary producers in the world’s oceans. They are single-celled organisms generally between 20 and 150µm in maximum diameter, with both plant and animal characteristics. Most dinoflagellates are distinguished by a dinokaryon, a special form of eukaryote nucleus. Their carotenoidpigments dinoxanthin and peridinin give to these organisms flame-like colours and produce ‘red tides’ when populations bloom.
Many living dinoflagellates are also bioluminescent.

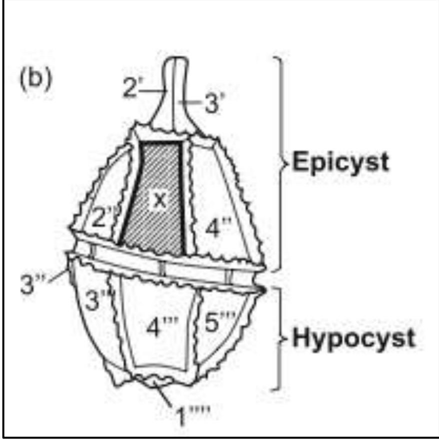
Both heterotrophic and autotrophic modes of nutrition occur, although the latter predominate. Dinoflagellates have formed an important part of oceanic phytoplankton since at least mid-Mesozoic times. Although motile cells are abundant and wide ranging, it is the resistant resting cyst which leaves a fossil record. Dinoflagellate cysts have proved to be valuable tools in biostratigraphy and are also important in palaeoecology, palaeoclimatology and evolutionary palaeontology.

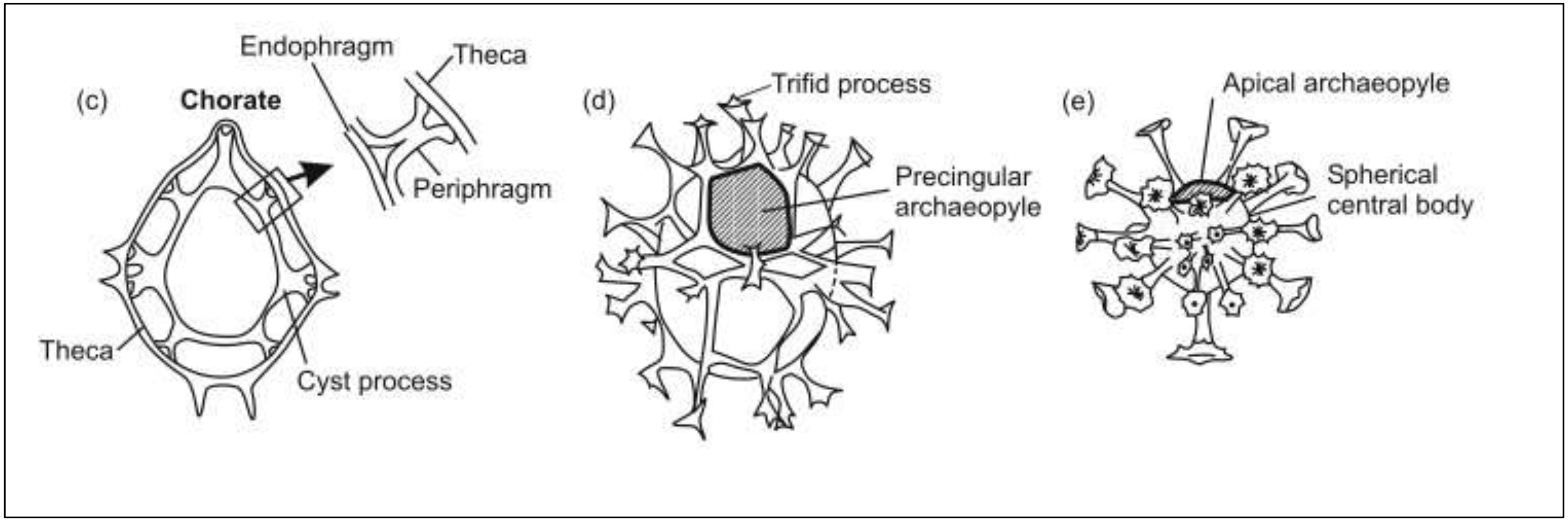


Cyst stage

Only about 10–20% of living species are known to encyst following sexual reproduction, yet almost all fossil dinoflagellates are preserved as cysts. Three basic kinds of cyst are recognized, termed proximate, proximochorate and chorate, depending upon the relative length of any ornament, although intergradations between these exist. Proximate cysts resemble the theca in both size and shape and presumably formed in close contact with the thecal wall. The tabulation, cingulum and sulcus are all reflected in the surface sculpture of proximate cysts. Proximochorate cysts are an intermediate type between proximate and chorate cysts. They have processesthat are between 10 and 30% of the overall diameter and an elaborate ornament. The tips of the processes were in contact with the thecal wall and in some species were plate centred and can be numbered in a similar fashion to proximate cysts. The tips of the processes may be joined by thin, filamentous trabeculae giving the impression of an additional layer. Choratecysts usually exhibit no traces of a reflected cingulum or sulcus.







Dinoflagellate ecology

Dinoflagellates currently form a major part of the ocean plankton, especially the armoured and autotrophic forms, and they play a prominent role in the food chains of the marine realm. The autotrophic forms thrive in areas of **upwelling currents** that are rich
in nutrients such as **nitrates and phosphates**, whilst they are rarely found alive **below 50m depth** because of their need for light. **Flagella locomotion is employed in bringing them to the surface at night and withdrawing them to greater depths in the day because they must avoid harmful ultraviolet light.**

Of the primary ecological factors one of the most important for controlling cyst assemblages is sea surface temperature. As a whole, the group has a wide temperature tolerance (1–35°C) with an optimum for most species of 18–25°C.

Dale (1976) noted a change of only a few degrees might be sufficient to cause differentiation into biogeographical provinces. One of the most important temperature boundaries controlling the distribution of dinoflagellate cysts in the Northern Hemisphere occurs between the main bodies of cooler and warmer water in the North Atlantic Ocean. This boundary lies between Cape Cod and Nova Scotia (42–43°N) and between the English Channel and southwestern Norway

On a global scale modern dinoflagellates occupy broad latitudinal low-, middle- and high-latitude zones.

Dinoflagellates can tolerate a wide range of salinities and are found in lakes, ponds and rivers.

Distribution of Dinoflagellates

At present, dinoflagellate cysts are most abundant in sediments from coastal to continental slope and rise settings, with 1000–3000 cysts per gram. There is also a tendency for specific diversity to increase with distance from shore and to be greatest in tropical waters, a pattern reflected in many groups of marine plankton. In modern sediments specific assemblages of dinoflagellate cysts are known from estuarine, nearshore, neritic and oceanic environments.

Applications of dinoflagellate cysts

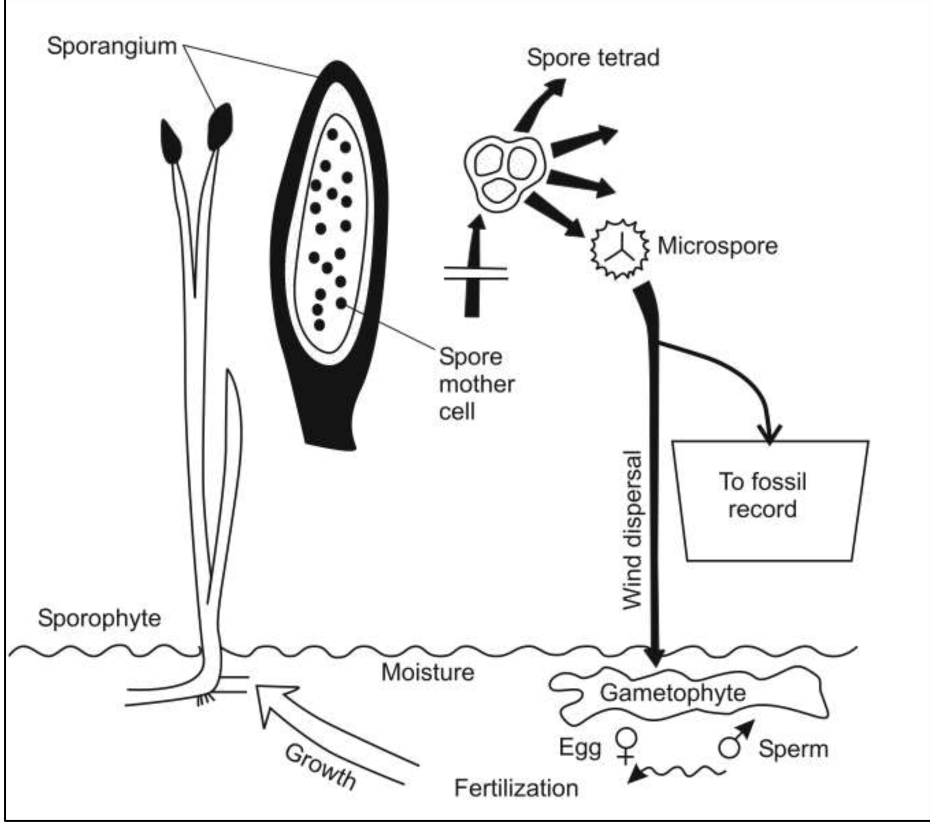
Dinoflagellate cysts are ideal biostratigraphical indices.

Late Triassic dinoflagellate assemblages are known from Alaska, Arctic Canada, Australia, England and Austria. Early Mesozoic assemblages are low in species diversity but by the mid-Jurassic dinoflagellates were an important part of the phytoplankon. Provincialism means different biozonations have been erected for the Arctic, Boreal, Tethyan and Southern Hemisphere realms, corresponding approximately to molluscan faunal provinces (Davies & Norris 1980; Stancliffe & Sarjeant 1988).

Dinoflagellates did not show appreciable levels of increased extinction at the K-T boundary, although the character of assemblages did change.

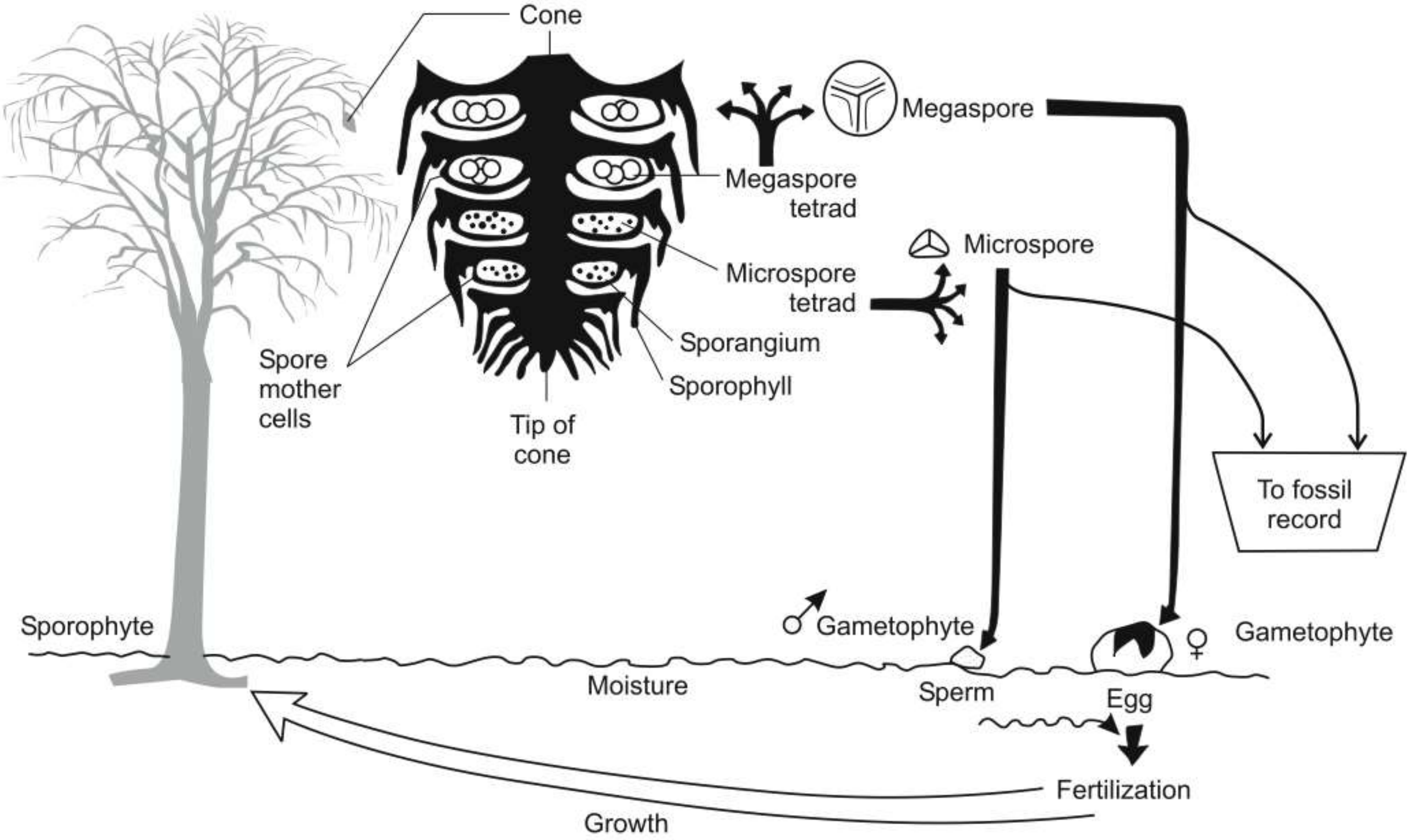
Spores and Pollens

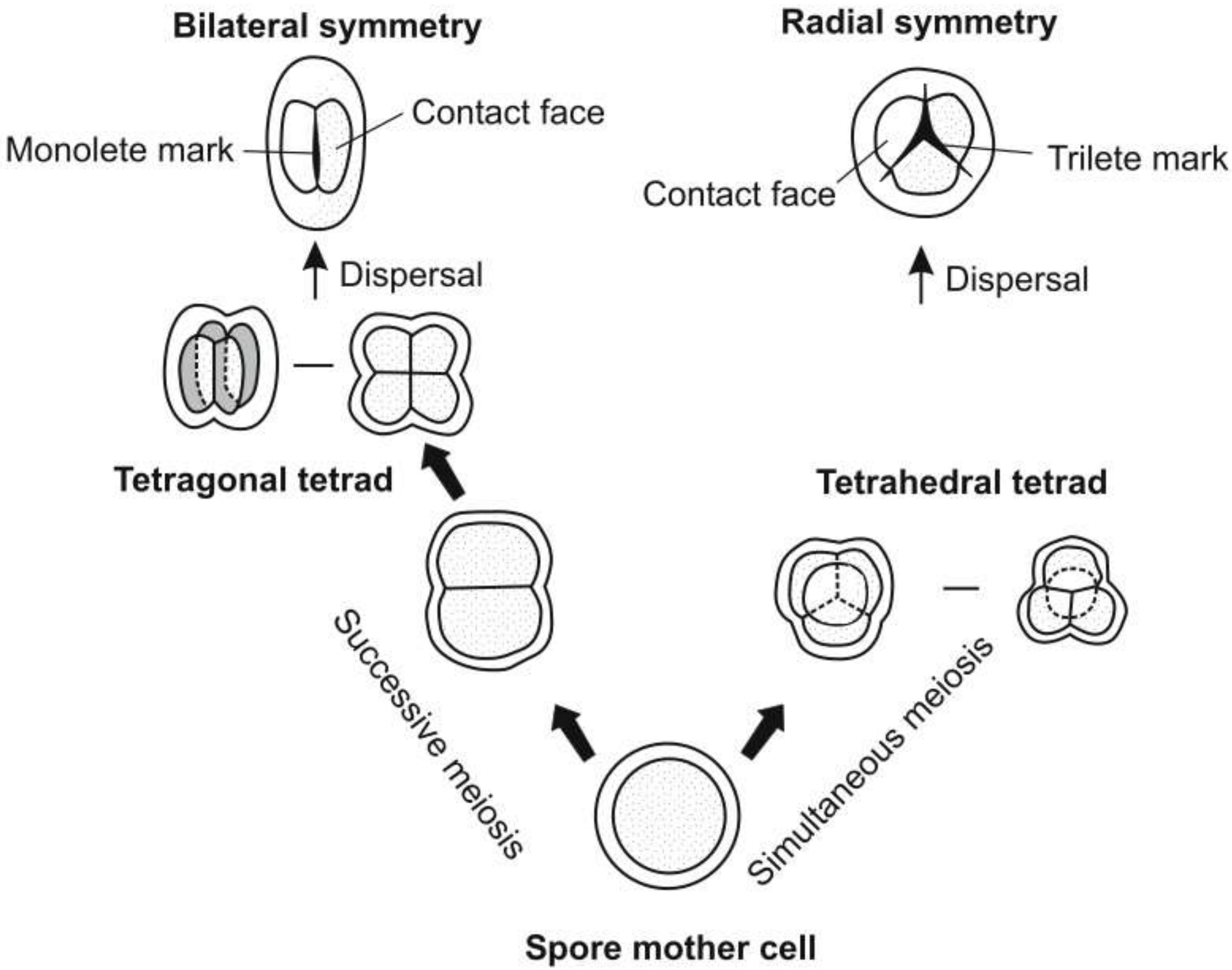
Spore sand pollen are produced during the life cycle of plants – spores by the lowly bryophytes and ferns, and pollen by the 'higher plants', the conifers and angiosperms. Both types of grain possess a wall that is remarkably resistant to microbial attack and to the effects of temperature and pressure after burial. Produced in vast numbers, these microscopic grains can travel widely and rapidly in wind or water, eventually settling on the bottom of ponds, lakes, rivers and oceans. Such features make them valuable to biostratigraphy, particularly when correlating continental and nearshore marine deposits of Silurian or younger age. Where the ecology of the parent plant is known, spores and pollen can be used for palaeoecological and palaeoenvironmental studies.



Reconstructed life cycle of a homosporous plant

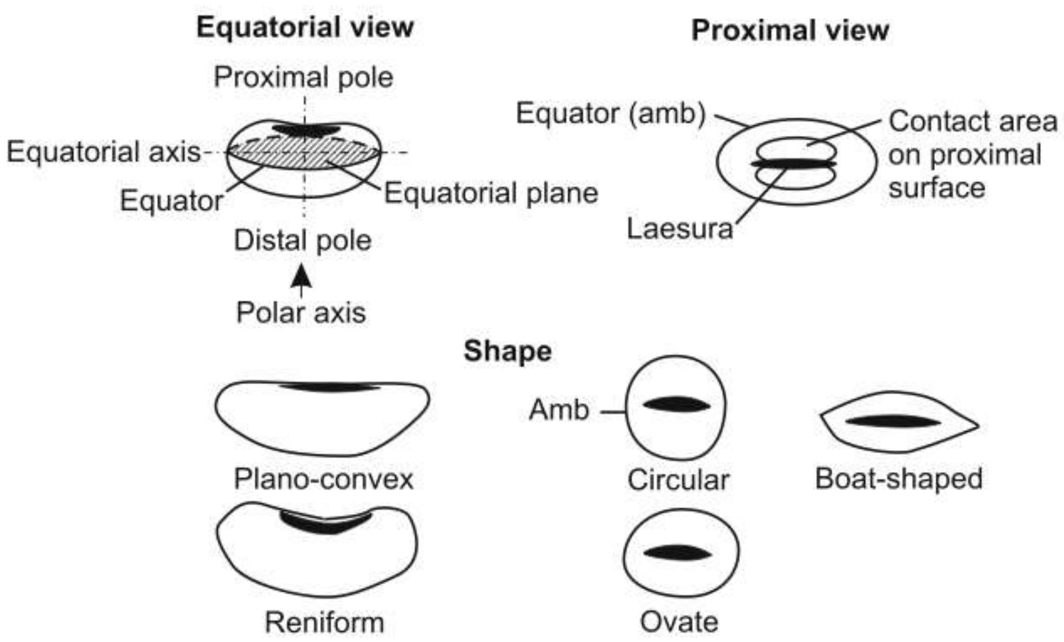
Reconstructed life cycle of a heterosporous plant

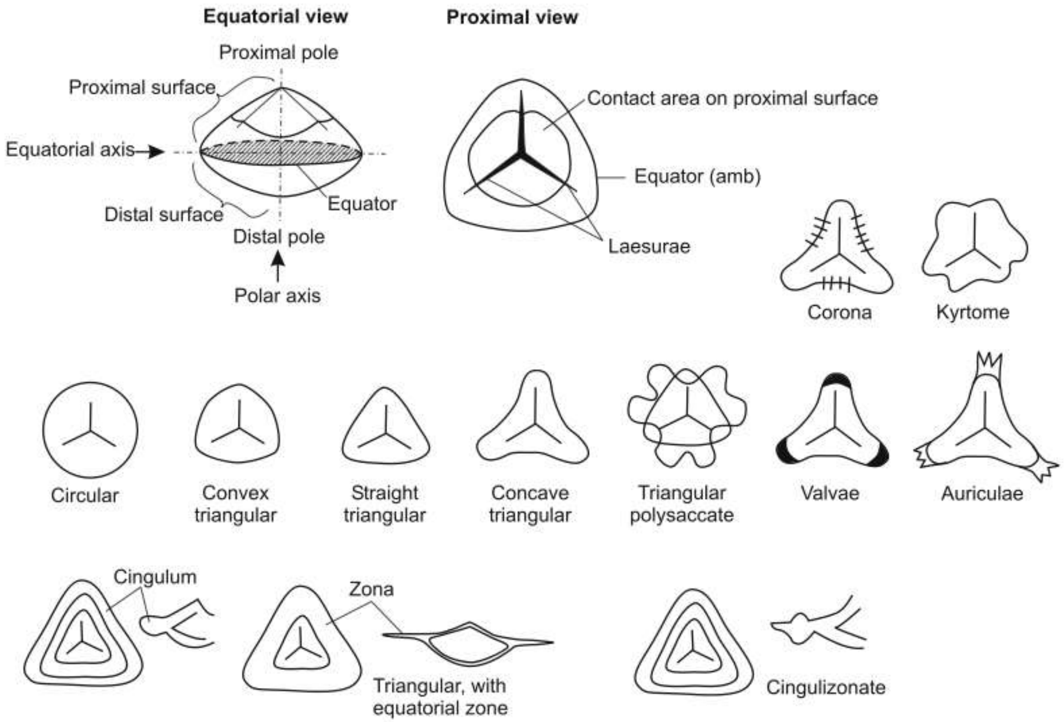




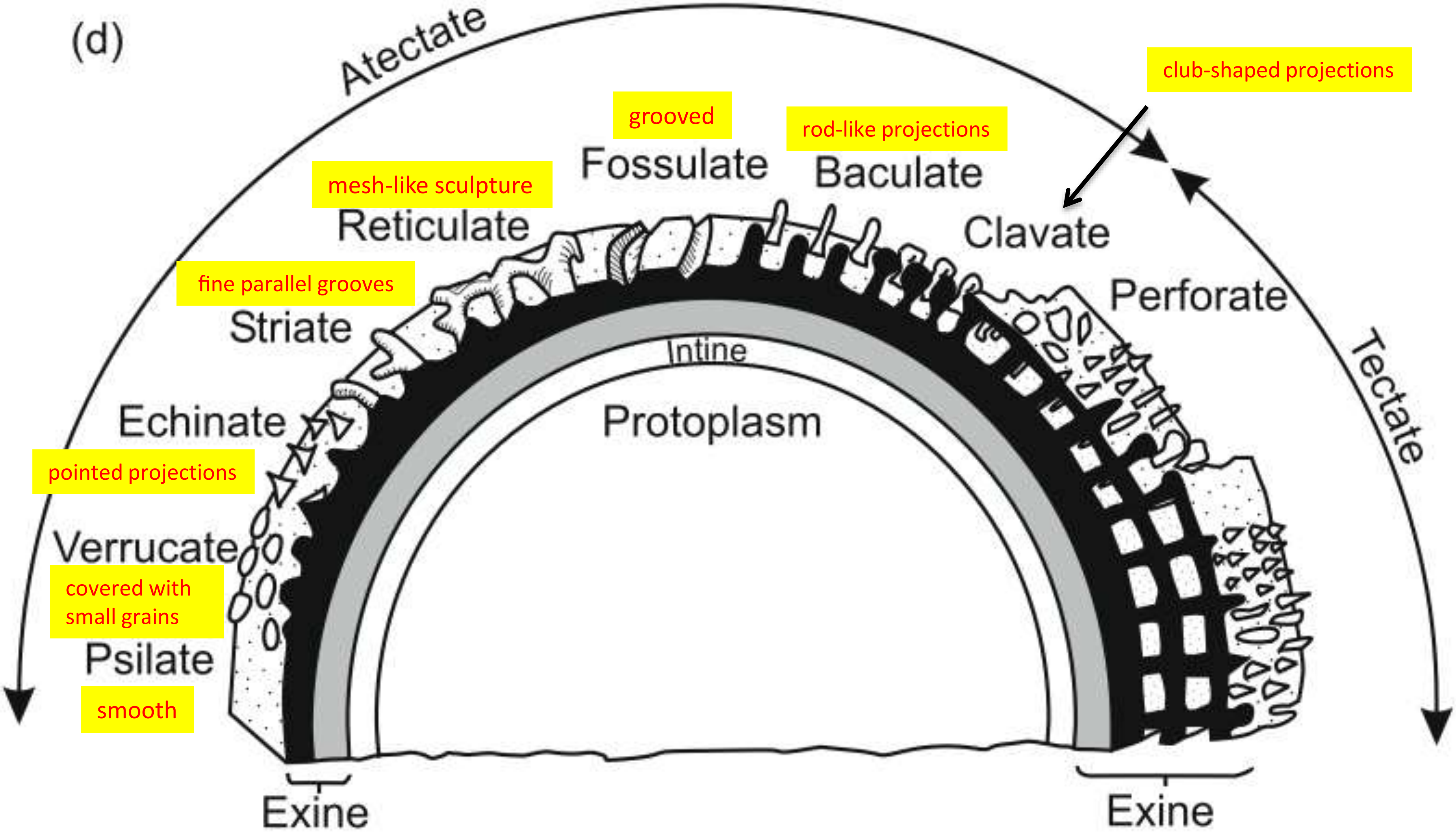
Meiosis and the production of bilaterally or radially symmetrical spores.

Morphology and terminology of monolete spores.



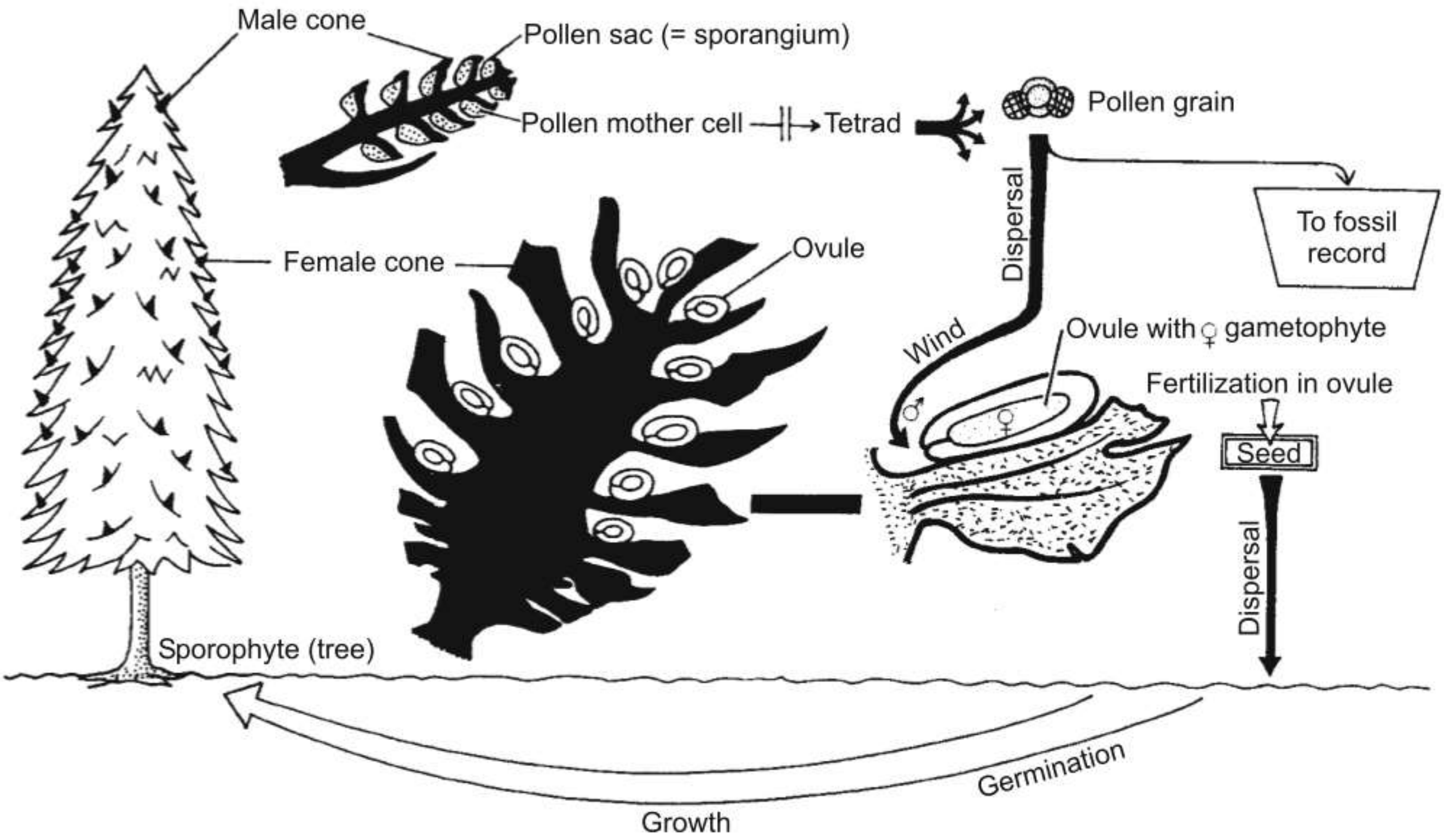


Morphology and terminology of trilete spores.

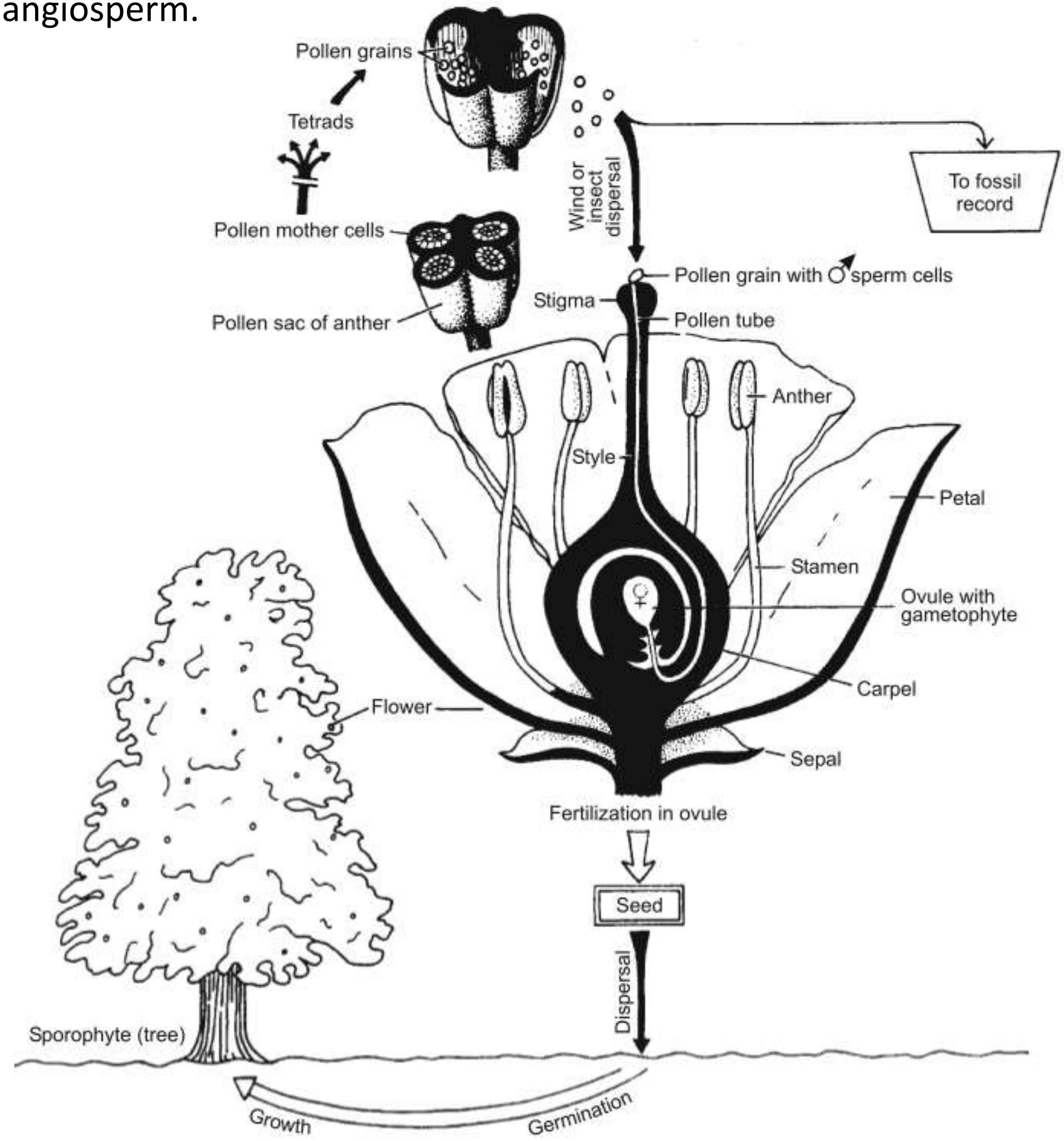


Wall structure and surface ornament of angiosperm pollen.

Simplified life cycle of a coniferous gymnosperm



Simplified life cycle of an angiosperm.



Dispersal and sedimentation

The distance travelled by air-borne pollen and spores depends greatly on their size, weight, sculpture and on atmospheric conditions. They are most frequently found about 350–650m above the land surface during the day, but many sink to the surface at night or are brought down by rainfall. Under favourable conditions pollen grains have been known to drift for at least 1750km, but about 99% tend to settle within 1km of the source. Only a very small proportion ever reaches the oceans by aerial dispersal. Once the pollen grains or spores have settled, they stand a chance of entering the fossil record, either by falling directly into bogs, swamps or lakes, or by being washed into them and into rivers, estuaries and seas. By this stage the pollen record has already been filtered by differential dispersal in the air and may now undergo a similar filtering in water. For example, size sorting across the continental shelf can occur; large miospores, pollen grains and megaspores will tend to settle out in rivers, estuaries, deltas or shallow shelf areas, whereas small miospores and pollen grains may settle out in outer shelf and oceanic conditions. Those which are not buried in reducing sediments will tend to become oxidized and may ultimately be destroyed. Spores and pollen may suffer several cycles of reworking and redeposition, leading to some confusion in the fossil record.