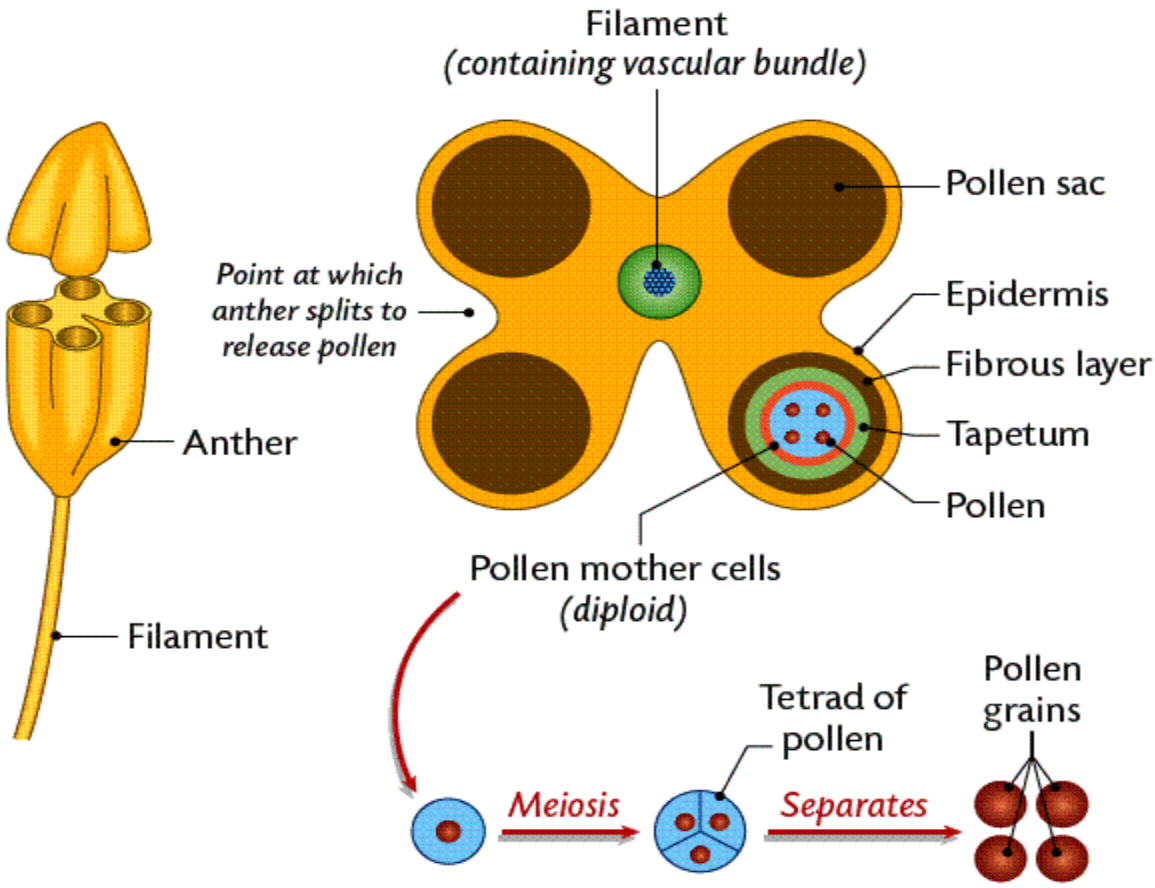
Formation of Sex Cells

The sex cells of the flowering plant are called **gametes.** There are both male and female gametes thus the flower undergoes **sexual reproduction.**

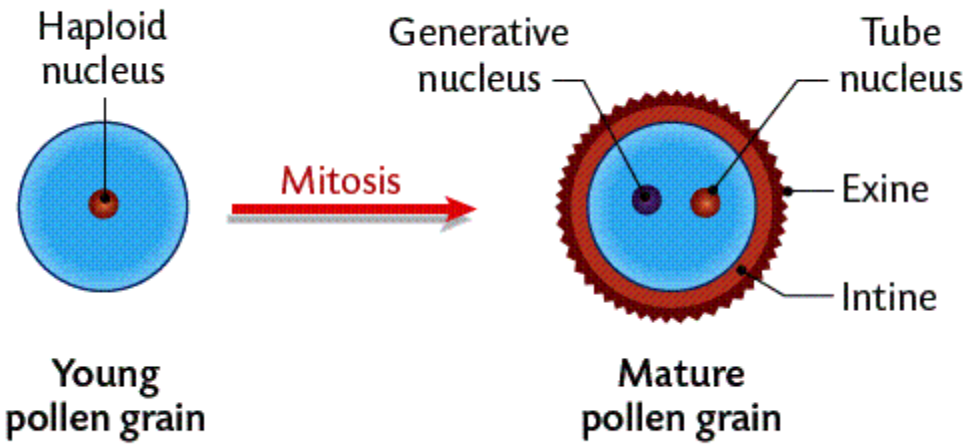
Male Gametes



Development of a pollen grain within the pollen sac of an anther:

A cross section of the developing anther displays four chambers. These chambers are called pollen sacs. Each pollen sac is filled with cells containing large nuclei. As the anther grows, each of these cells goes through two meiotic divisions, forming a tetrad. These cells are called microspores. Each one of these microspores eventually becomes a pollen grain.

Each pollen sac is enclosed by a protective **epidermis** and a **fibrous layer**. Inside the fibrous layer is the **tapetum**. This is a food store and will provide energy for future cell divisions.

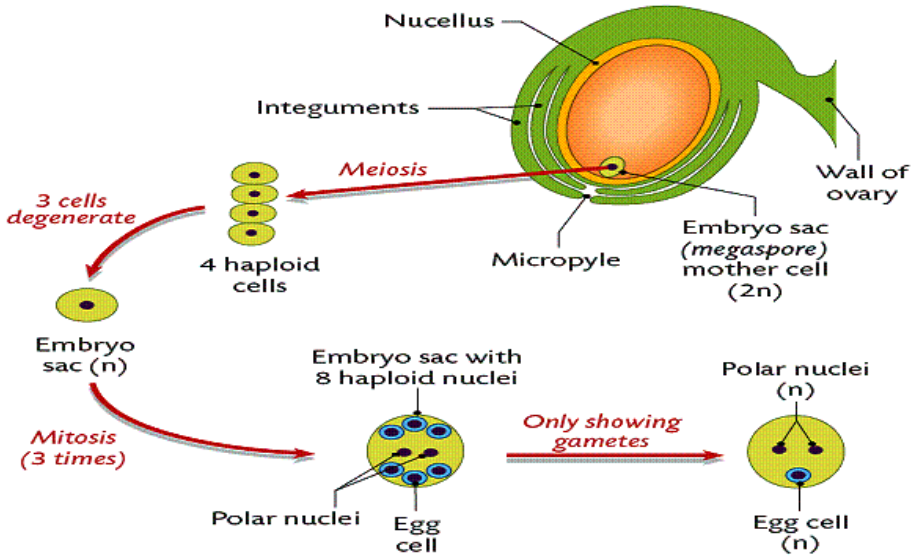


Each pollen grain is surrounded by a tough protective wall called an **exine**. This is a tough covering that allows the pollen grain to survive harsh conditions for long periods of time. The **intine** is another thin protective coating.

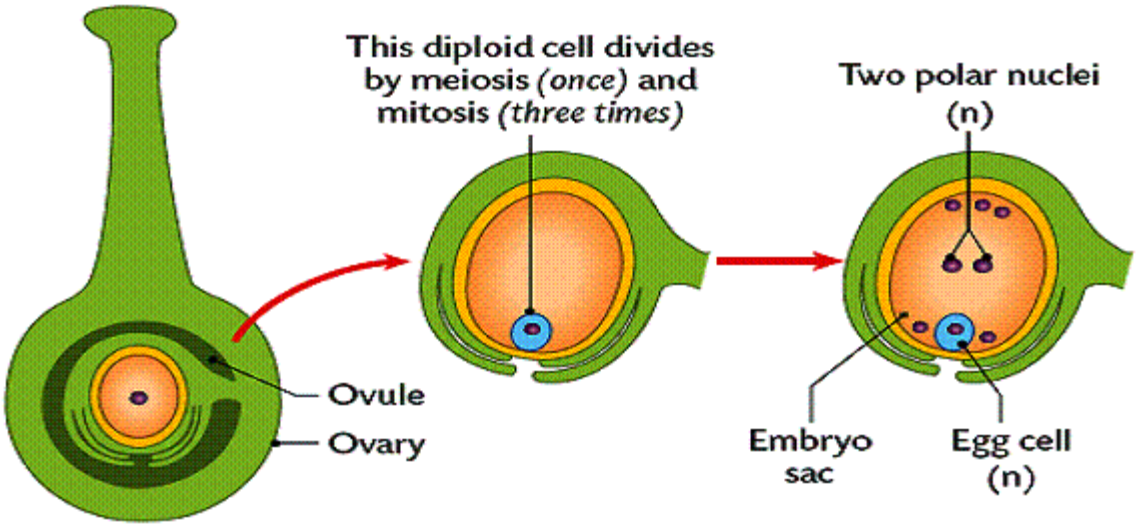
First, each nucleus divides by mitosis to become two nuclei. One is the tube nucleus. The other is a generative nucleus. The wall of the cell thickens to protect the developing pollen grain. As the anther ripens, the wall between the paired pollen sacs disappears. The pollen sacs burst open and the mature pollen grains are ready for dispersal.

Female Gametes

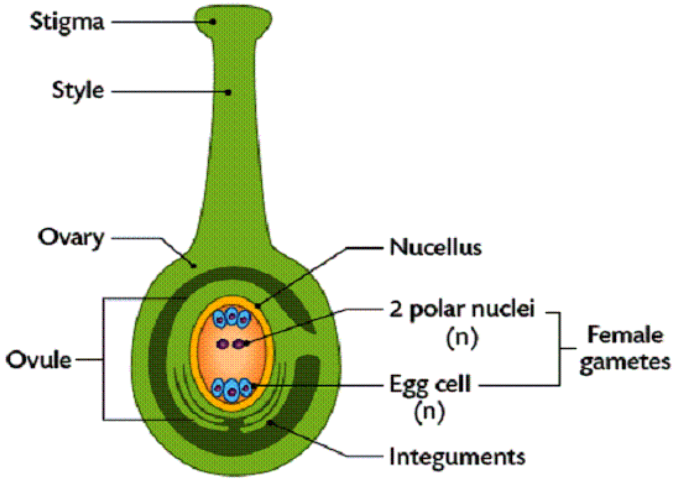
Development of the Embryo Sac:



Each ovary contains one or more ovules. The integuments are the 2 walls of the ovule. There is a small opening in the walls called a micropyle. This is where the pollen tube will enter. The nucellus is cells that provide nutrition for the growth of the ovule. The embryo sac, also known as the megaspore, divides by meiosis to form 4 haploid cells.Three of these cells degenerate and one remains. Only one megaspore survives in each ovule. This becomes the embryo sac. The haploid nucleus of the surviving megaspore undergoes three mitotic divisions. Eight haploid nuclei are now present. Within the swollen ‘megaspore cell’ six haploid cells and two ‘polar nuclei’ are formed. The entire structure is called the embryo sac. One of the cells near to the micropyle end of the ovule is the haploid female gamete (egg cell).



The carpel with a mature embryo sac will appear as shown below:



Structure of stamen, anther, pollen sac and pollen grain:

(a) Structure of Stamen:

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

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.

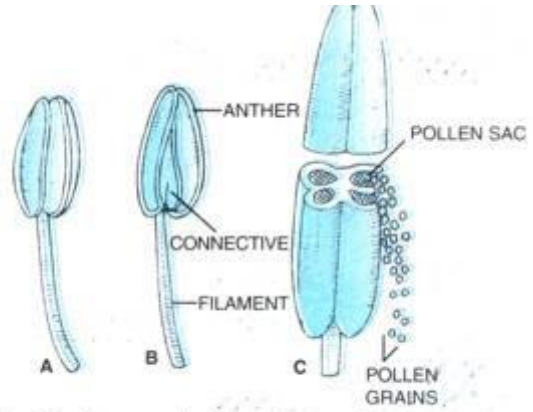


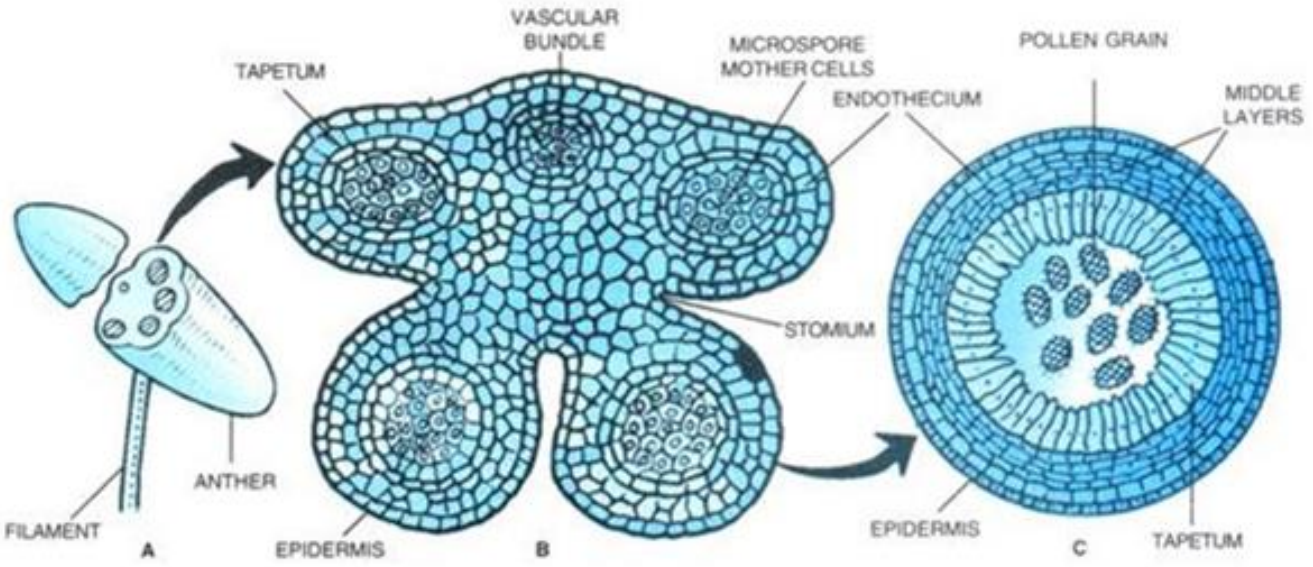
Fig. 2.3. Stamen. A. Ventral view; B. Dorsal view; C. Three dimensional cut section of Anther (Enlarged).

(b) Structure of Anther:

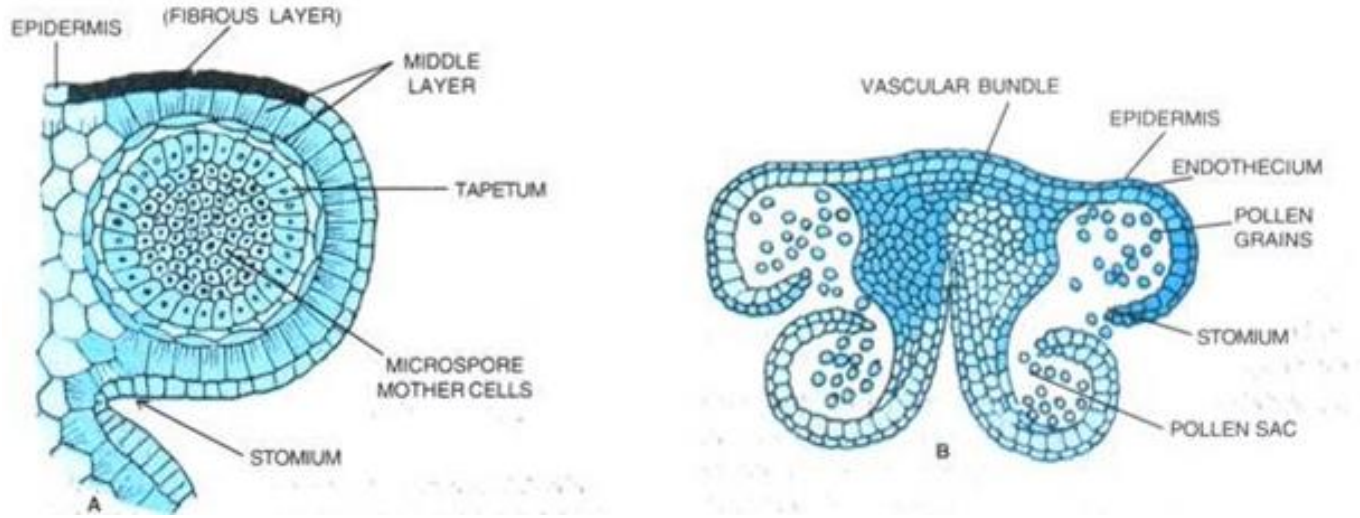
A normal bithecous or dithecous anther is made up of two anther lobes, which are connected by a strip of sterile part called connective. Two anther lobes contain four elongated cavities or pollen sacs (microsporangia) in which pollen grains are produced.

(c) Structure of Microsporangium (Pollen Sac):

Young anther while it is still in flower bud in T.S. reveals the presence of outermost epidermis. The outermost wall layer lying just below the epidermis is called endothecium or fibrous layer, because wall (two radial and inner) develop fibrous thickenings on them except at the junctions of two pollen sacs. Below the endothecium, there are 1-3 middle layers of parenchyma cells.



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



The cells of innermost wall layer are radially elongated and rich in protoplasmic contents. This layer is called tapetum. The tapetum forms the nutritive tissue nourishing the developing microspores. The cells of tapetum may be multinucleate or may have large polyploid nucleus. The tapetal cells provide nourishment to young microspore mother cells either by forming a plasmodium (amoeboid or invasive type) or through diffusion (parietal or secretory type).

The pollen sac wall encloses a number of archesporial cells that further forms microspore mother cells (microsporocytes). In the beginning microspore mother cells are polygonal and

closely packed, but as the anther enlarges, the pollen sac becomes spacious and gets loosely arranged. A few microspore mother cells become non- functional and are finally absorbed by developing microspores.

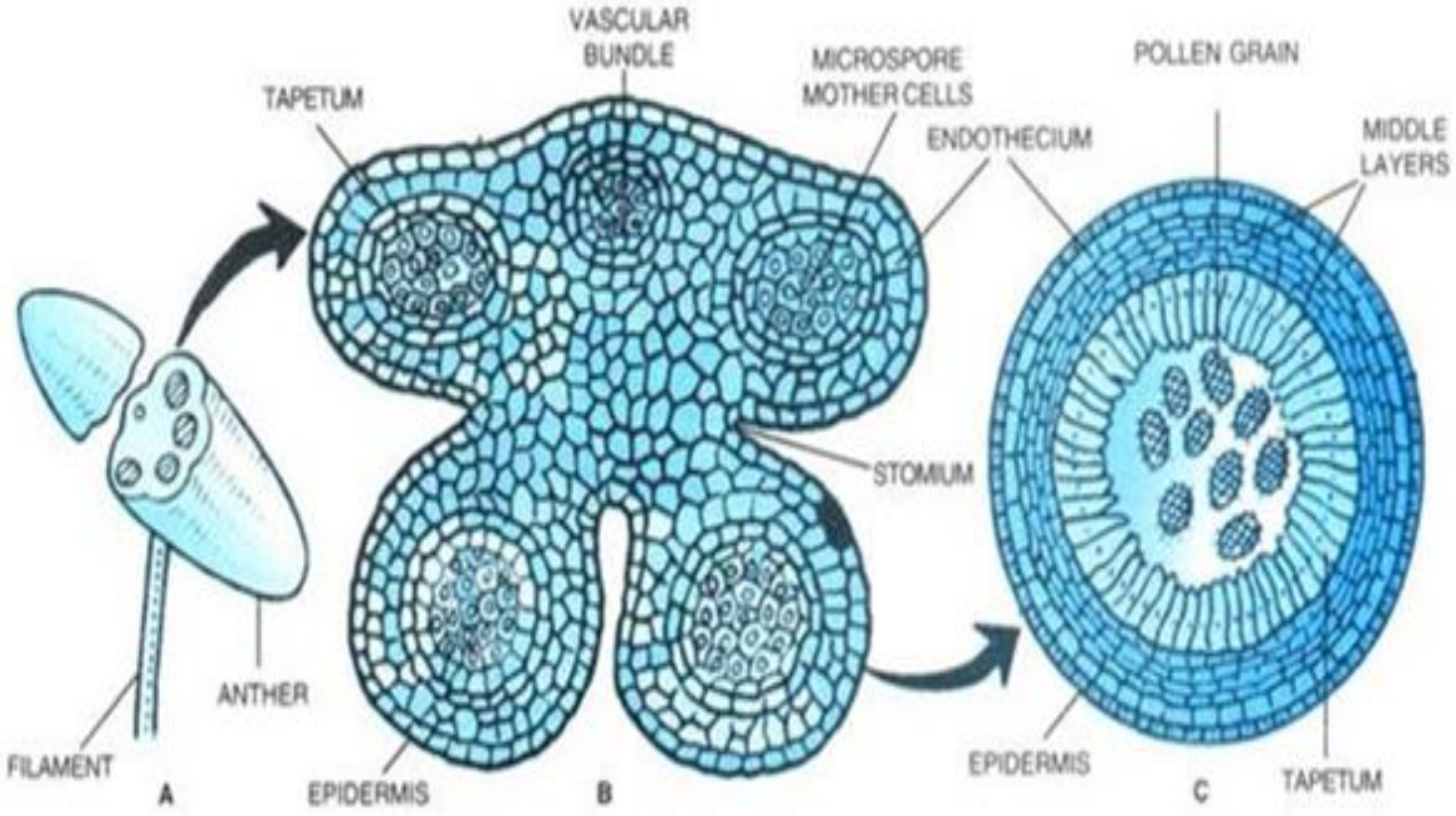
During microsporogenesis the nucleus of each microspore mother cell undergoes meiosis and gives rise to four haploid nuclei (microspore tetrad). These four nuclei are arranged in a tetrahedral manner forming tetrahedral tetrad. The four microspores separate from each other, and each develops a characteristic shape or form which differs in different species of plants.

(d) Structure of Microspore (Pollen Grain):

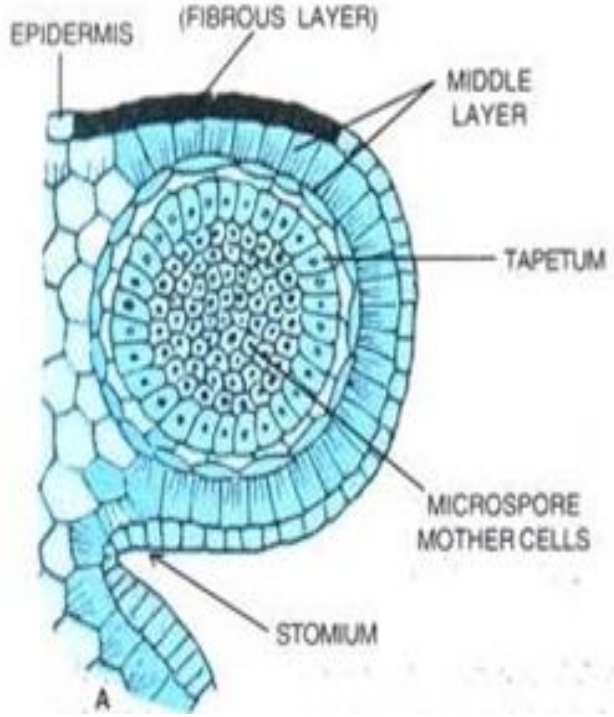
Pollen grains develop from the diploid microspore mother cells in pollen sacs of anthers. Typically, pollen grain is a haploid, unicellular body with a single nucleus. Pollen grains are generally spherical measuring about 25-30 micrometeres in diameter. The outer surface of microspores may have spines, ridges or furrows which may vary in other ways in different species.

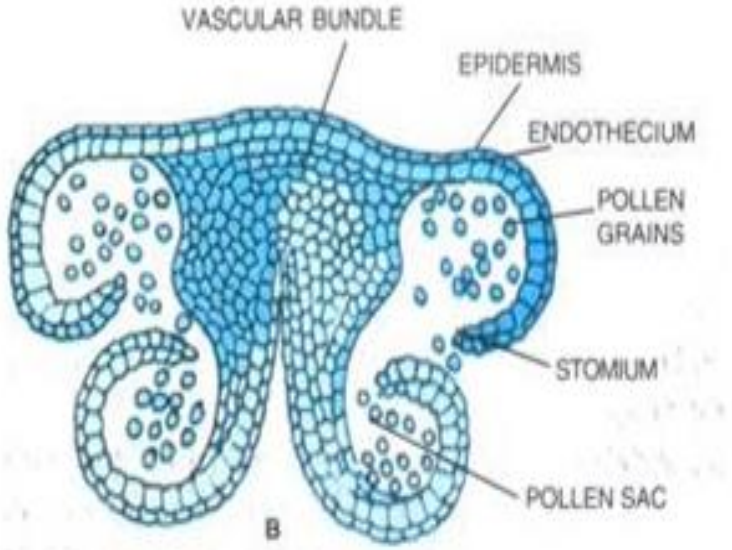
There may be oval, ellipsoidal, triangular, lobed or even crescent-shaped pollen grains. The cytoplasm is surrounded by a two layered wall. The outer layer exine is thick and sculptured or smooth. It is cuticularised and the cutin is of special type called sporopollenin which is resistant to chemical and biological decomposition. In insect pollinated pollen grains, the exine is covered by a yellowish, viscous and sticky substance called pollen kit.

Pollen grains are well preserved as fossils because of the presence of sporopollenin. At certain places the exine remains tirin. The thin areas are known as germ pores, when they are circular in outline and germ furrows when they are elongated. The cytoplasm is rich in starch and unsaturated oils. The branch of study of pollen grains is called palynology.



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


EPIDERMIS
(FIBROUS LAYER)
MIDDLE LAYER
TAPETUM
MICROSPORE MOTHER CELLS
STOMIUM
A


VASCULAR BUNDLE
EPIDERMIS
ENDOTHECIUM
POLLEN GRAINS
STOMIUM
POLLEN SAC
B