

Sporogenesis & Gametogenesis

Formation of male and female gametes with haploid chromosome number for fertilization is known as gametogenesis. Gamete formation takes place separately in male (anther) and female (ovule) part of the flower. It involves two steps i.e., sporogenesis followed by gametogenesis in both male and female reproductive parts.

Sporogenesis:

It is the formation of spore in reproductive part i.e., spores of male (microsporogenesis) and of female (megaspores).

Gametogenesis:

It is the formation of gamete in reproductive part i.e., gamete of male (microgametogenesis) and of female (megagametogenesis).

Formation of male gamete

It has two steps microsporogenesis and microgametogenesis. Androecium (stamen) is the male part of the flower with anther and filament as its parts. Anther is a four chambered structure placed on a filament. Each chamber is known as pollen sac (microsporangia).

Microsporogenesis:

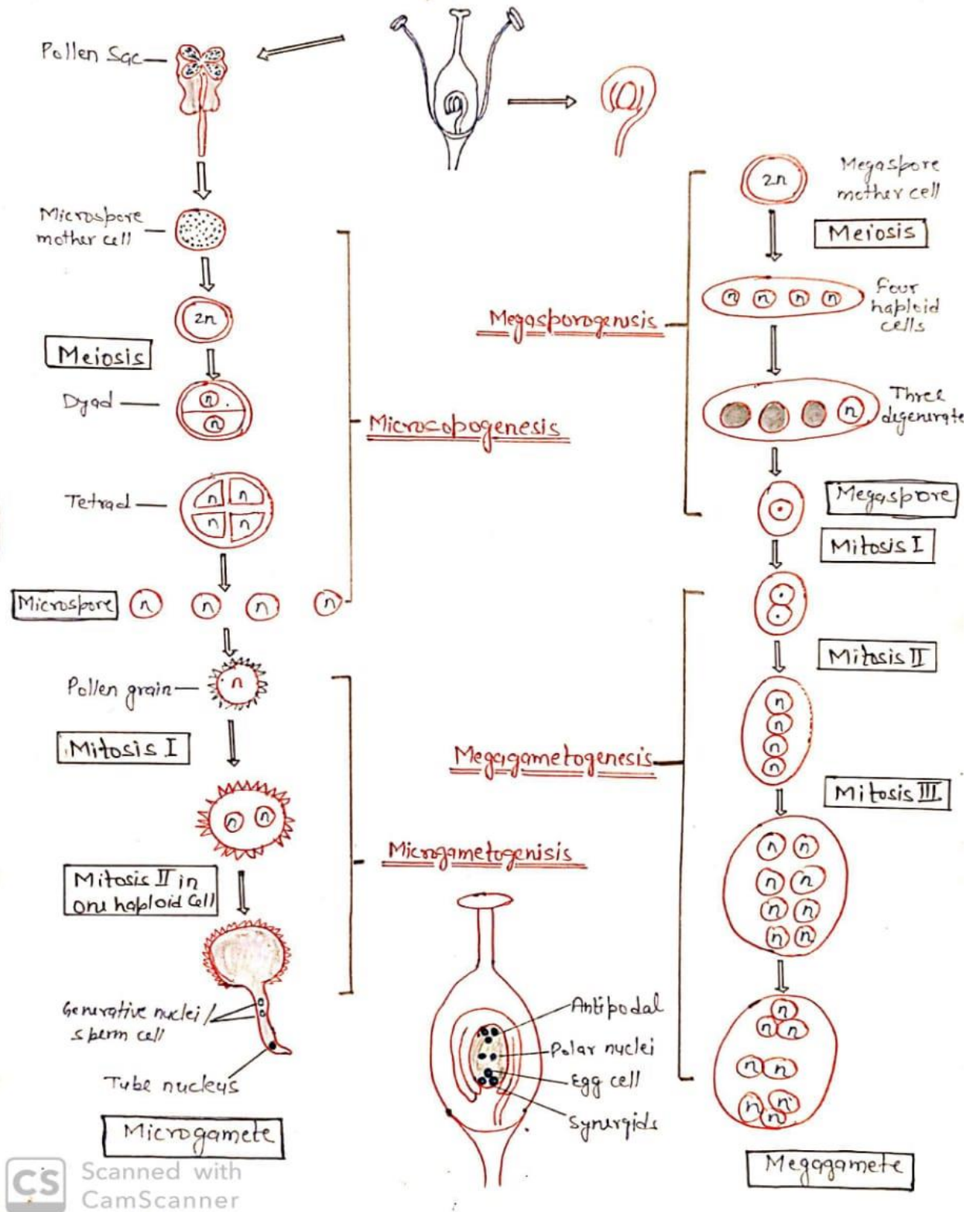
In the pollen sac, pollen grains are formed. Inner most layer of pollen sac is known as Tapetum that provides nutrients for development of pollen mother cells (2n) in each pollen sac. The diploid pollen mother cell undergoes meiosis (reduction) cell division, first to form dyad and then four haploid cells (tetrad). Each one is known as **microspore**.

Microgametogenesis:

Haploid nucleus of the microspore forms two haploid nuclei by mitotic (equational) cell division. Out of two haploid nuclei only one nucleus again divides by mitotic cell division and forms two haploid nuclei. Second nucleus remains as such (no further division). In this way total three haploid nuclei. Each one is known as **microgamete**.

Pollen grain is a double walled structure, with hard outer cover (**exine**) and thin inner layer (**intine**). 3-5 germ pores are present on the exine of the pollen grain. After pollination, pollen grain germinates on the stigma and forms a germ tube which protrudes out from any one germ pore. Through germ tube all the three male gametes enter in the female reproductive part. The gamete present at the tip of the pollen tube is known as **tube nucleus**, whereas the remaining two are known as **generative nuclei** or **sperm cells**. Tube nucleus is responsible for growth and direction of pollen tube whereas generative cells take part in fertilization.

Genetic constitution of each microspore formed in a pollen sac differs from the other because of meiosis cell division that involves crossing over and recombination. But all the three



Sporo and Gamete genesis

microgametes are of same genetic constitution due to mitotic cell division. Study of pollen grain is termed as **Palynology**.

Formation of female gamete

Gynoecium (pistil) is the female part of the flower with stigma, style and ovary as its parts. Ovary contains ovule (megaspore) with embryo sac surrounded by two layers of integuments. In the embryo sac female gametes are formed by megasporogenesis and megagametogenesis in the nucellus.

Megasporogenesis:

A diploid nucellus cell differentiates into sporogenous cell towards micropylar end with nutrients from other nucellus tissues. It works as **Megaspore mother cell**. Megaspore mother cell undergoes meiosis (reduction) cell division to form four haploid cells. Each haploid cell is considered as **Megaspore**. Out of four megaspores, three are degenerated only one remains functional.

Megagametogenesis:

The functional megaspore develops into female gametophyte by three mitotic (equational) cell divisions. By first mitotic cell division two, by second four and by third eight haploid nuclei are formed.

These eight archisporium haploid cells are arranged in three- two- three fashion in the embryo sac, all surrounded by nucellus. Three towards chalaza end are termed as Antipodal, two at the centre as Polar nuclei whereas out of three arranged at the micropylar end, the one present in the middle is termed as egg cell and remaining two as synergids. The nucellus (plural: nucelli) is the central portion of the ovule inside the integuments. It consists of diploid maternal tissue and has the function of a mega sporangium.

All the eight mega gametes have same genetic constitution as they all originated from one spore by mitotic cell division. Haploid cells found by Meiosis are considered as spore. All the four spores formed by one mega mother cell have different genetic constitution. Gametes are found by mitotic cell division in micro or megaspore i.e., of haploid chromosome number. All the gametes formed by one spore have same genetic constitution.

Pollination

Abundant quantity of pollen grains is released by bursting of anther. Female part gynoecium (pistil) consists of stigma, style and ovary. Style connects stigma with ovary, whereas stigma receives pollen for fertilization. Reception of pollen on stigma is known as pollination. Pollen is able to reach on stigma by various means viz., force. of anther bursting, air, insect etc. Stigma becomes receptive for reception of pollen by releasing many enzymes that help in germination of pollen.

Pollen germinates on stigma and forms a pollen tube which comes out through any one germ pore. The pollen tube enters in the stigma and travels through style up to ovule. The tube nucleus present at the tip of the germ tube directs the tube towards ovule. Whereas the generative cell present behind the tube nucleus undergoes mitotic cell division and forms two haploid generative nuclei.

Fertilization

In female embryo sac, eight archisporium cells are present in the ovule inside the ovary. The end of embryo sac towards stigma or opposite to the opening (micropyle) is known as chalazal end (non micropylar end). Three haploid cells arranged at this end are known as Antipodal in the embryo sac. Two haploid cells arranged at the center are known as Polar nuclei (*sl.* nucleus). Three haploid cells are arranged towards micropylar end of the embryo sac. It is known as egg apparatus. The haploid cells of the egg apparatus present on either side are known as synergids, whereas the middle larger one as egg cell.

The pollen tube enters in the embryo sac normally through micropylar end. At the time of penetration in the embryo sac the tube nucleus enters in one of the synergids and gets burst. In chalazogamous plants, the pollen tube enters the ovule through the chalazal end instead of the micropyle opening. During the process of bursting, both the generative haploid cells are released in the embryo sac.

During fertilization, one sperm nucleus combines with the egg cell and forms a zygote ($2n$). It further develops into an embryo. The second sperm cell combines with two polar nuclei ($n+n$) and forms the store of food known as endosperm ($3n$).