Formation of seeds in Gymnosperms

**Gymnosperm**: - (Greek for "naked seed") **is a vascular plant that produces seeds that are not protected by fruit but are hidden in a woody cone.** **Like pine trees.**

They do not have flowers, but most retain their leaves year round.

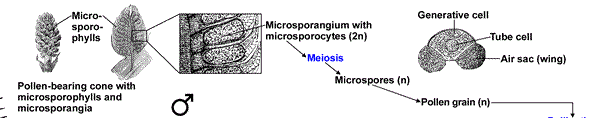
Gymnosperms include over **600** **species**.

Gymnosperm is classified into in **four** divisions namely:

**1-** Coniferophyta **2-** Cycadophyta **3-** Ginkgophytya **4-** Gnetophyta.

**Pine life cycle**

1. **Pollen cones** (**male cones**) with **microsporephylls** and **microsporangia** that contain numerous **microsporocytes,2n** undergoing **meiosis** to produce **haploid pollen grains,** and has **two air sacs** that function as "**wings**". The yellowish pine pollen is produced and dispersed by **wind in spring**.

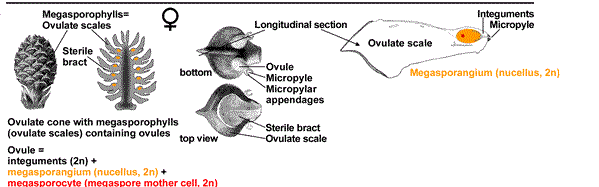


***Fig. (1) Pine pollen cones development***

1. **Ovulate cones** (female cones,seed cones) with megasporophylls that produce **ovules**.

The **pine megasporophylls** are modified leaves called**ovulate scales**.

**Each ovulate scale** forms **two ovules**. **Each ovule** contains **a single megasporangium (nucellus, 2n) with a single megaspore mother cell (megasporocyte, 2n)**, surrounded by **integument tissue** (later becomes the **seed coat** of the seed) produced of the sporophyte. **Pollen grains** can enter through a small opening in the integument, called **micropyle**.

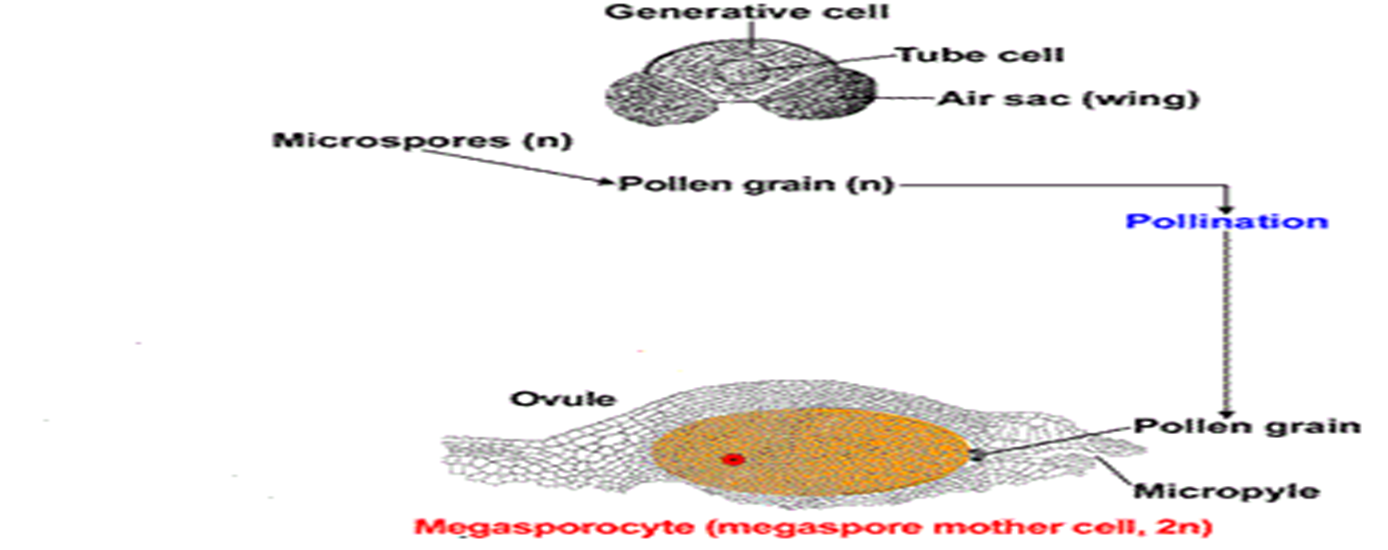


***Fig.(2) Pine ovulate cone and ovulate scale***

* ***Pollination and fertilization***

**Pollination**

Wind-blown pollen grains land on drops of fluid produced by the ovules on the ovulate scales. As the **pollination drop** of an ovule evaporates, several pollen grains are brought through the **micropyle** into contact with the **megasporangium (nucellus, 2n)**, where they germinate. A **germinating pine pollen grain (mature microgametophyte, n)** contains four haploid nuclei, one of which will later fertilize the egg.

****

***Fig (3) pollination processes in pine seed***

**Conifer ovule development and fertilization:**

**1-** **Pollen germination** stimulates **megagametophyte** development within the **megasporangium**.

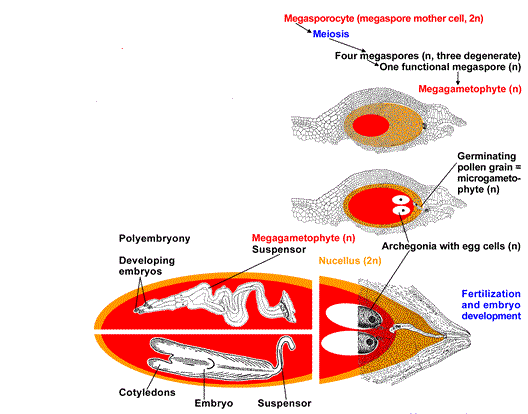
**2-** The single **megaspore mother cell (megasporocyte, 2n)** undergoes **meiosis** and forms **four haploid megaspores (n)**.

**3-** Only **one megaspore survives** (**functional megaspore,n**) and becomes the **megagametophyte (n)**.

**4-**The **megagametophyte matures**, which takes about **one year** in pine, **two to five archegonia** each with **one** **egg (n)** develop within the **megagametophyte** close to the micropyle.

**5-** It takes about a year for the germinating **pine pollen grains** to mature and grow into the **megasporangia** with their **pollen tubes**.

**6-** Fertilization of the **egg** in each **archegonium** is achieved by **one sperm nucleus.** Nourishment of the embryo during its development is achieved by the **megagametophyte**.



***Fig.(4) Fertilization and embryo development***

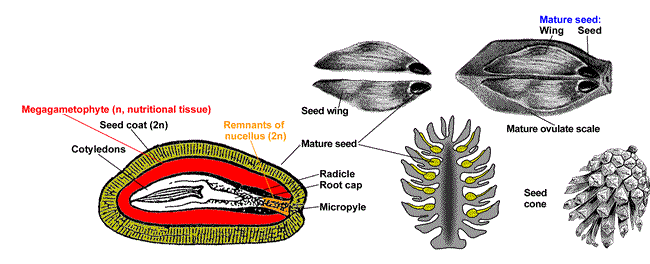
Since often multiple pollen tubes grow and multiple archegonia are fertilized, more than one embryo develops. This initial poly embryony is typical for gymnosperms, but in most cases only one embryo survives and grows.

**Pine seed: the mature pine seed contain an**

**A-** un curved embryo with many cotyledons

**B-** nutritional tissue which is megagametophyte (n) tissue also called primary endosperm

**C-** Seed coat (integument tissue)



***Fig.(5) Mature pine seed***

**Differences between male cones and female cones**

**Male cone:**

1- The male cones produce sperm, which are contained in pollen grains

2- Male cones are normally smaller than female cones

3- Male cones grow in the lower branches

**Female cone:**

1-The female cones produce eggs, which are contained in ovules.

2- Female cones have a sticky resin that “catches” the pollen released by the male cone

3- Female cones grow in the upper branches

**Seed Structure:**

The seed is composed of the following main parts:

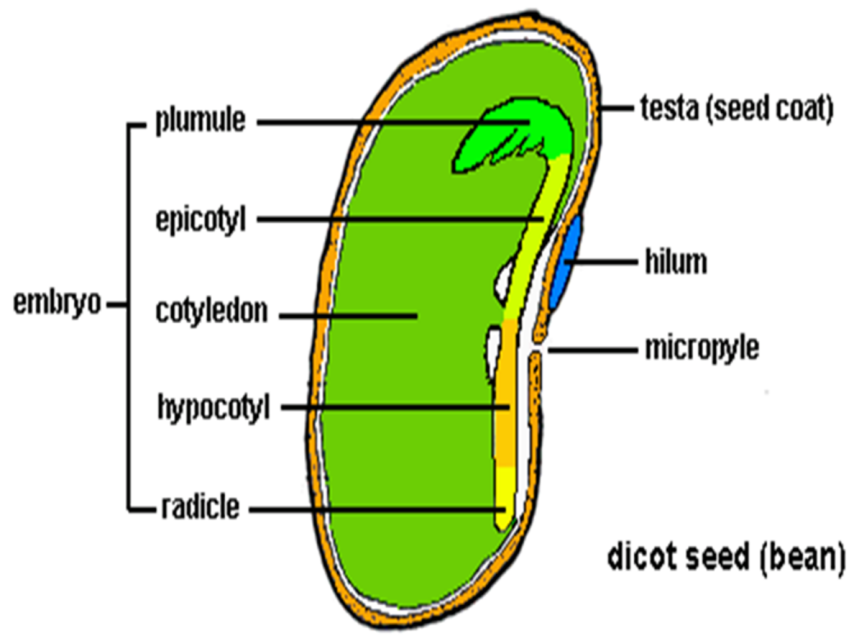
1- **Seed coat** **(Testa)**

2- **Endosperm**: Food stored for the growth of the embryo

3- **Embryo**

**parts of the** **Embryo**

1. Embryonic root (**Radicle**) that grows and gives the root system
2. Embryonic shoot (**Plumule**) which grows to be a shoot
3. **Cotyledon** (mono cotyledon, di cotyledon, multi-cotyledons)
4. **Hypocotyl** associated with radicle cotyledon
5. **Epicotyl** associated with Plumule cotyledon



**Fig.(6) Typical seed structure**