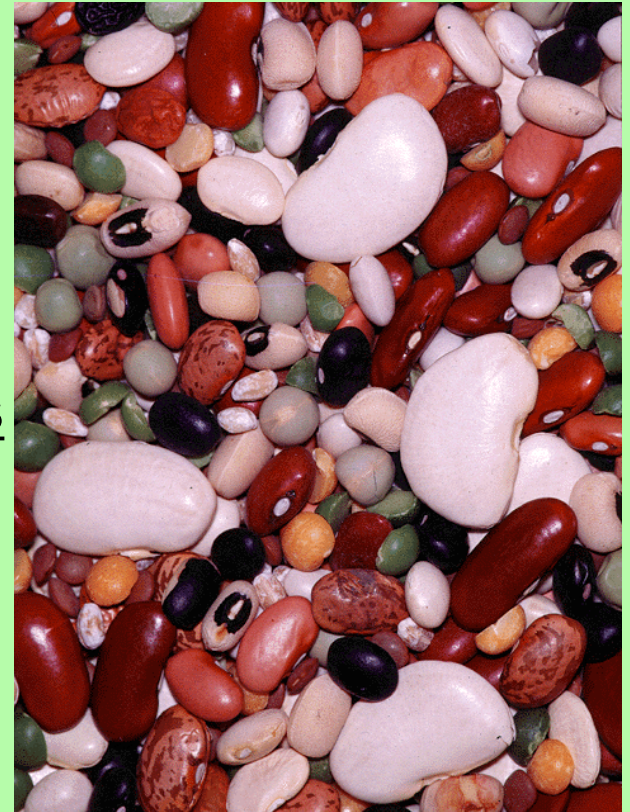


## ***Plant Diversity Lab Two:***

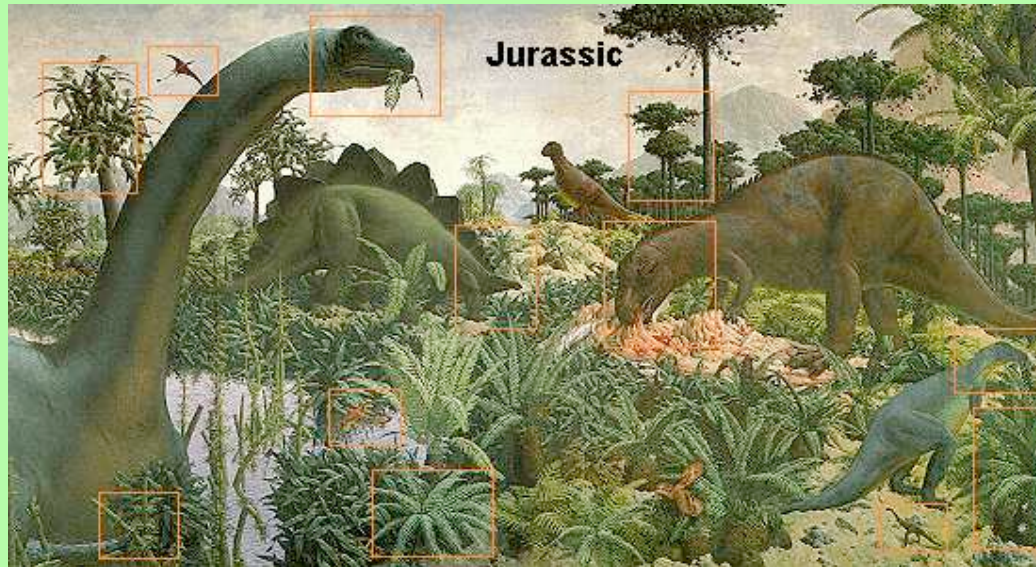
**Higher Plants**: plants that reproduce by seeds

Botanists classify the seed plants into two distinct groups.....

Cone bearing plants - the gymnosperms  
Flowering plants - the angiosperms

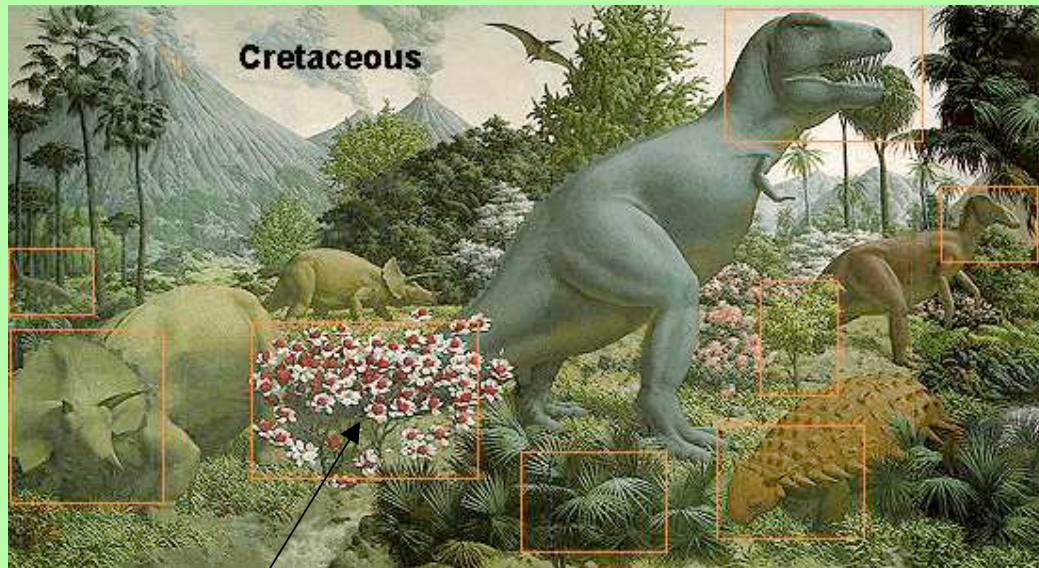


Gymnosperms preceded the angiosperms and ruled the planet during the days of the dinosaurs



All plants in this diorama are gymnosperm (cone bearing) plants

When the angiosperms evolved, they displaced the gymnosperms from the earth's landscape and now comprise most of the plants we have today

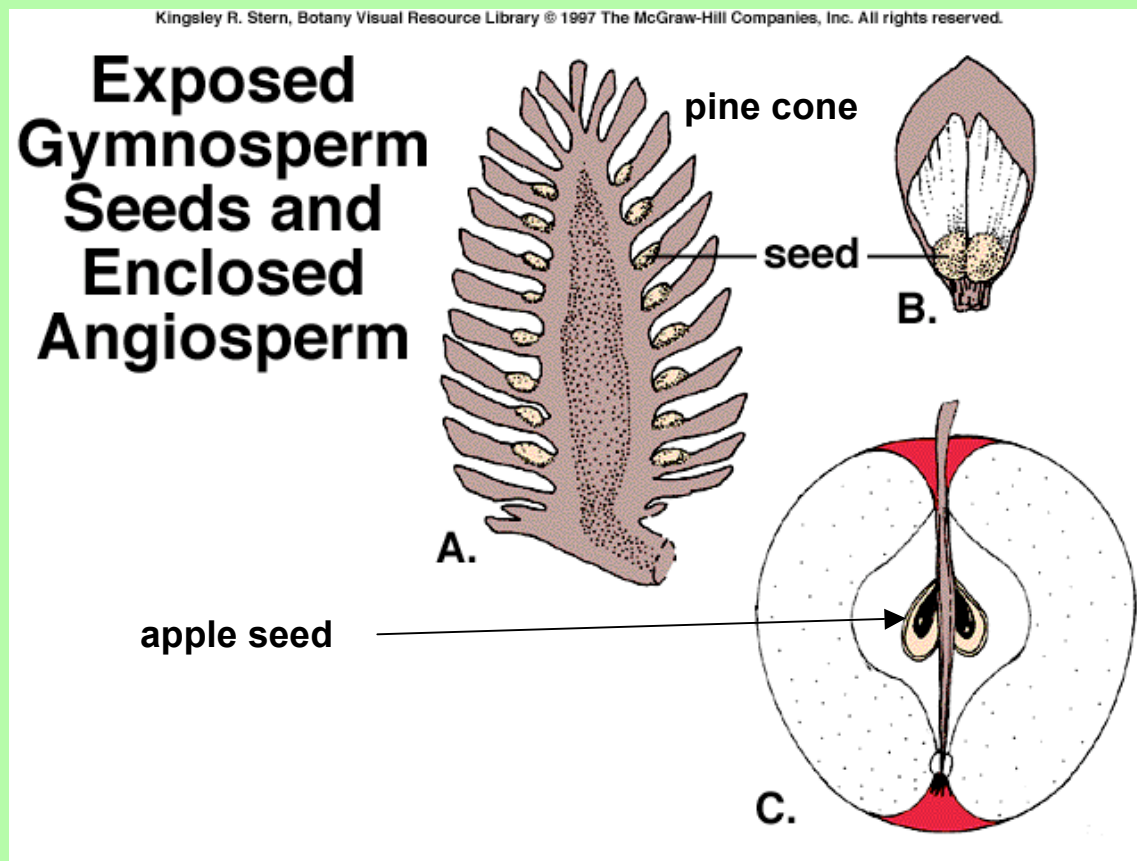


Flowering plant growing amongst the gymnosperm plants

*During the cretaceous (the last days of the dinosaurs), flowering plants started to become prevalent in the landscape.*

The botanical names **GYMNOSPERM** and **ANGIOSPERM** can be deciphered from the Latin as Gymno = Naked Sperm = Seed.....Gymnosperms bear their seeds on cone scales so that when the cone opens, the seed is laying flat and "naked" or exposed on the cone scale.....

Angio = enclosed Sperm = seed.....Angiosperms bear their seeds inside the female flower after the flower has been fertilized. The chamber of the female flower is termed the ovary. When the seed matures, it is enclosed in layers of tissue of the expanded female ovary.



## **Plant Group Three - The Gymnosperms, the first seed plants.**

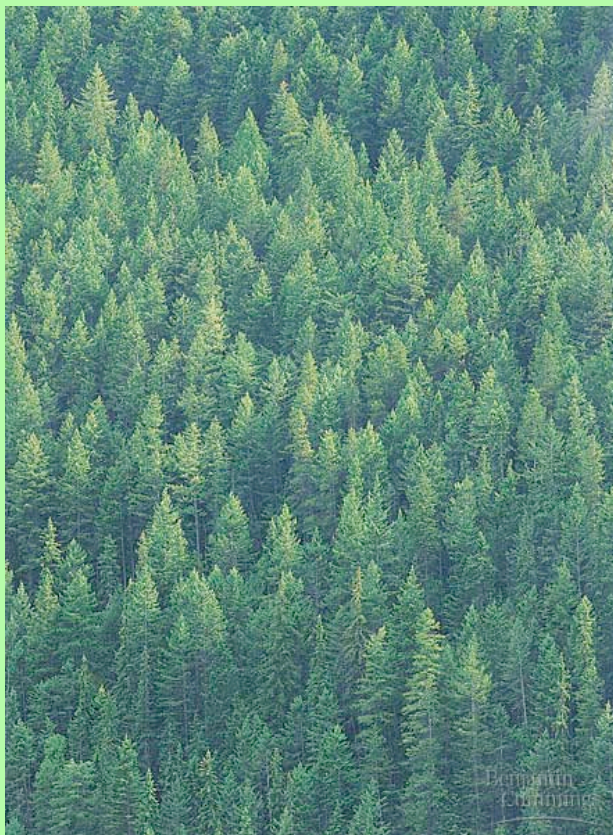
*Some major groups of gymnosperms:*

**The Conifers:**.....the "evergreen" trees, shrubs. Pines, junipers, spruces, yews, redwoods, firs, etc.

**The Cycads:**.....these are tropical plants that resemble low growing palm trees. The common name of one of the cycads is "Sago Palm".

**Ginkgo.**.....a deciduous tree that is the last species of a now extinct group

**Examples of conifers:**



Douglas Fir



Sequoia



Fraser Fir

## Examples of Cycads:



all tropical plants.....most resemble ferns



## The Ginkgo tree:



**Common as an ornamental tree but native only to Southern China**



The evolution of the seed was the outcome of the sporophyte plant retaining the female spore on the cone. This spore then "germinates" inside the cone and grows into a microscopic female gametophyte plant that produces the plant egg. The egg is fertilized by the male gametophytes' sperm. The sperm of the male gametophyte is delivered to the female gametophyte as a pollen grain.

Hence, in gymnosperms, there two kinds of cones:

**(i) female cones**, which contain the female gametophyte plants and will produce the seed

**(ii) male cones**, which produce the pollen grain....the pollen grain **IS** the male gametophyte plant and will produce sperm cells as it germinates

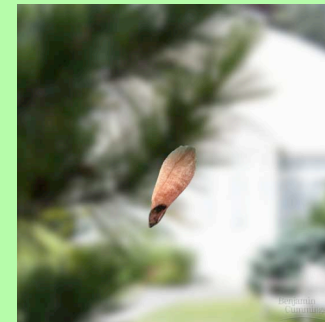


**first year female cones....before pollination**

**ephemeral, papery male pollen bearing cones**

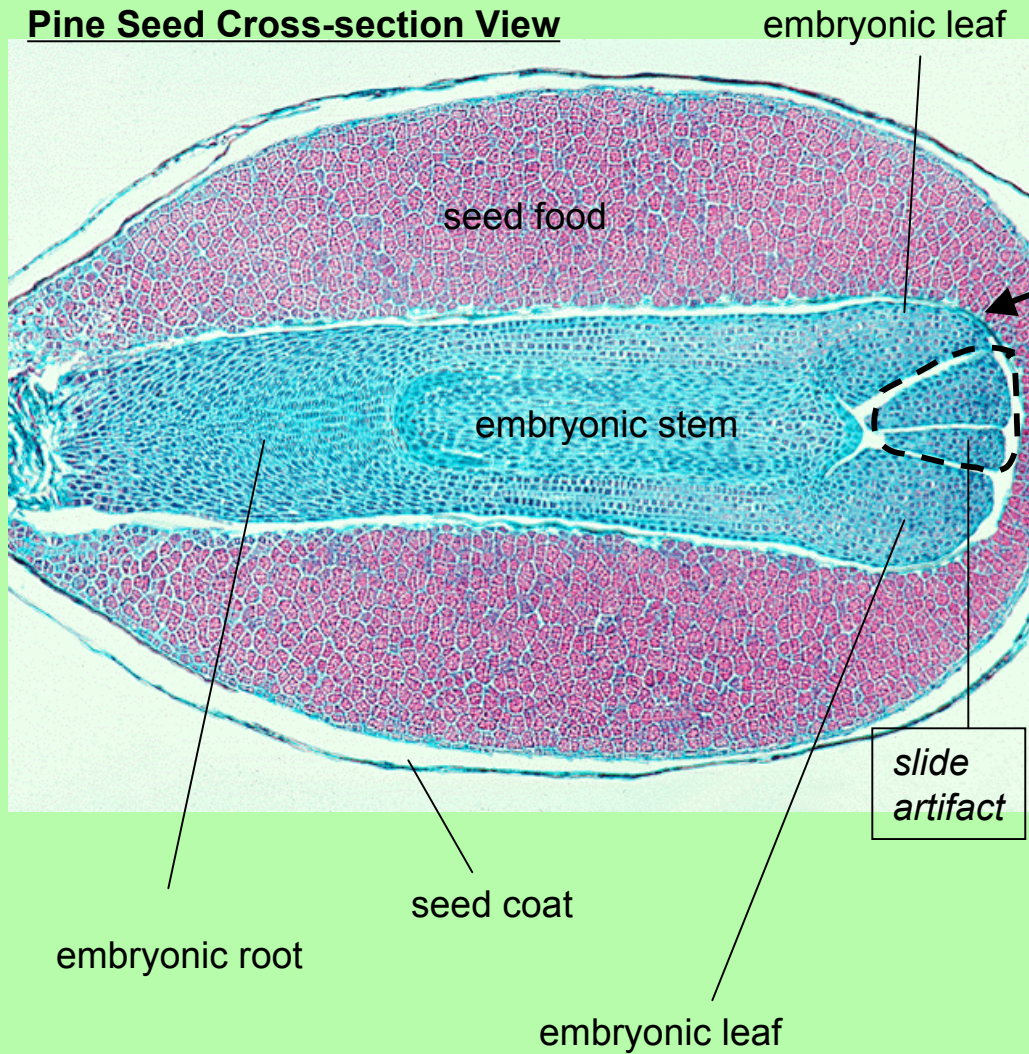


**mature female cones shedding seeds**



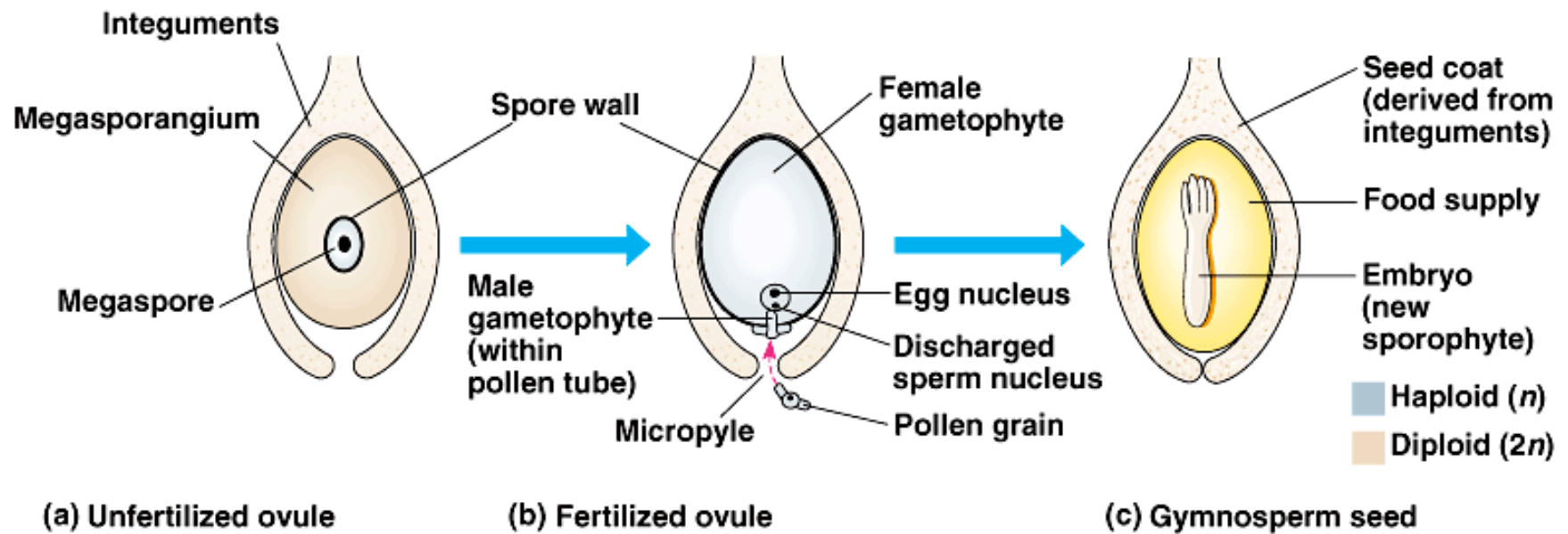
The fusion of the gymnosperm egg and sperm within the female cone produces a zygote which subsequently develops into the seed containing a sporophyte "fetus" (plant embryo) complete with pre-formed leaves, root, stem, and shoot.

**Pine Seed Cross-section View**



Dissected pine seed showing seed embryo

Benjamin Cummings



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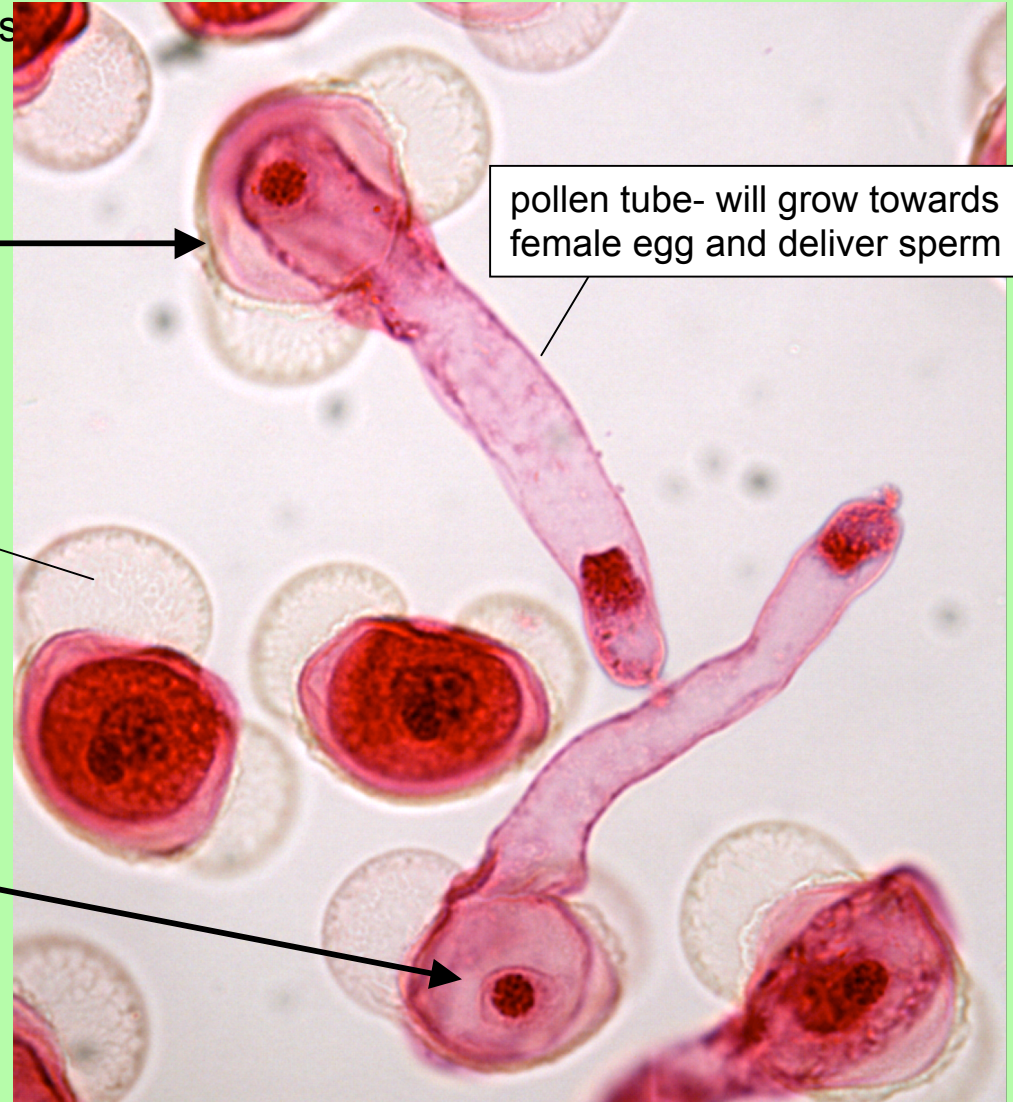
**A diagrammatic image of how a pine seed is formed on a female pine cone scale**

The pollen grain is a microscopic structure that is composed of several cells and has wings or air bladders to give it buoyancy in the wind.....the female cones are pollinated each spring by the wind borne pollen grains

This is pollen grain is germinated and is technically now referred to as the male "gametophyte plant"

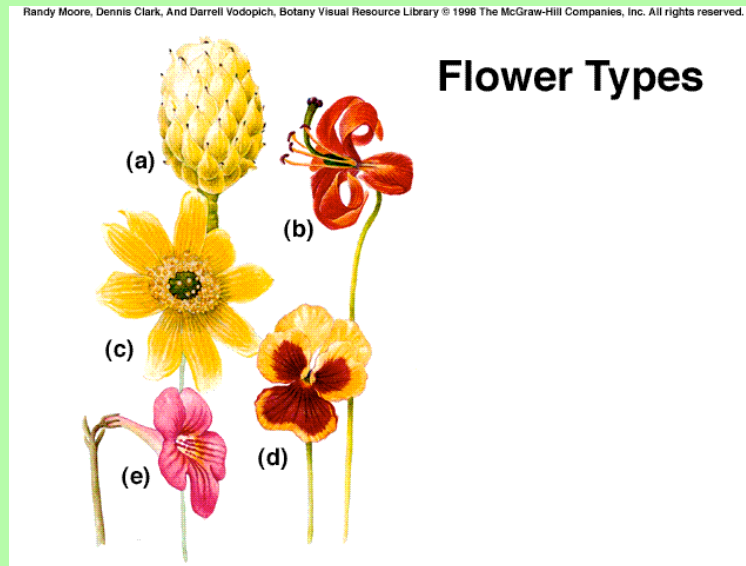
each pollen grain has a pair of wings to allow it to float through the air and into the open female cone

This cell (red stained) is destined to divide and produce two sperm cells, one of which will fertilized the female egg



pollen tube- will grow towards female egg and deliver sperm

## Plant Group Four - The Angiosperms, the flowering plants



Botanists classify the flowering plants between two major groups:

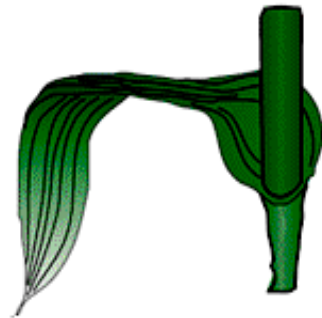
-the DICOTS.....dicotyledonous plants

-the MONOCOTS.....monocotyledonous plants

the COT in di/cot or mono/cot refers to the term cotyledon. A cotyledon is the embryonic leaf of the seed embryo. Seeds of dicotyledonous plants have seed embryos with a pair of cotyledons. Seeds of monocotyledonous plants have seed embryos with a single cotyledon.

In more familiar terms, dicots are also referred to as the "broad leaf" plants and monocots are referred to as the "grass-like" plants. Dicot leaves have branched venation patterns in their leaves, while monocot leaves have a parallel venation pattern.

**(c) Venation**



**Parallel**

Monocot leaves  
(grass-like)



**Net**

Dicot leaves  
(broad-leaf plants)

## Some important flowering plant factoids

✓ Flowering plants burst onto the landscape promptly after the cretaceous just as the dinosaurs became extinct.....this corresponding mass extinction was followed by the abrupt displacement of gymnosperm plants by the flowering plants was unlikely a coincidence

✓ The evolution of the flower provided plants a vastly improved means of reproduction compared to those plants that reproduced using cones

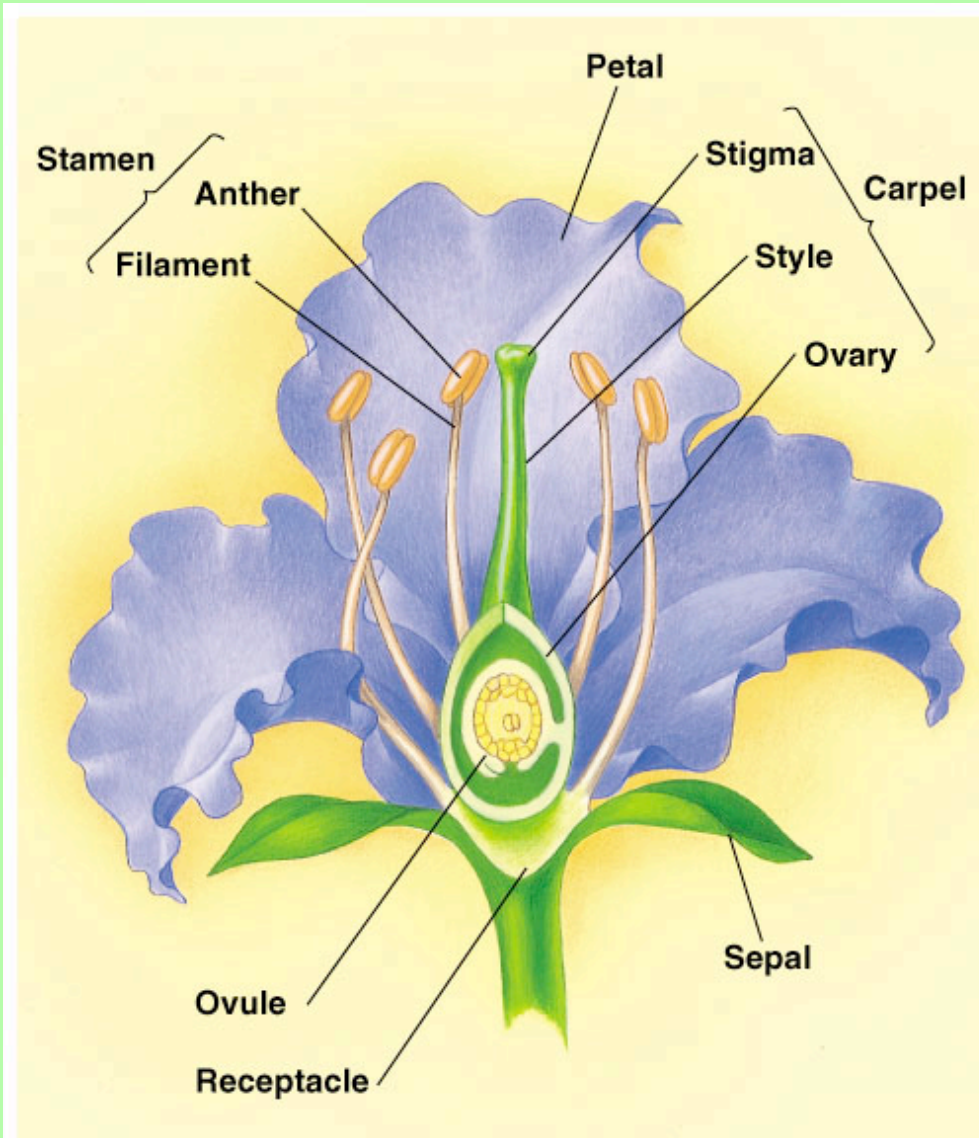
- cone bearing plants are capable of disperse their seeds by using only primitive seed-wings. They are also strictly wind pollinated.

- because flowering plants can develop fruit from their flowers, they can disperse their seeds using a myriad of mechanisms such as wind, water, animal, or self dispersal. Pollination can be carried out by a variety of agents such as insects, birds, mammals, as well as by wind.

✓ Flowers actually evolved from gymnosperm cone-type structures although it is not directly evident from the appearance of modern flowers.



## Flower Anatomy



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Each part of the flower has a function in the reproductive effort of the plant:

the receptacle - stem tip where flower parts are attached

the sepal - protects developing flower inside flower bud

the petals - attract insect/animal pollinators

the stamens - the male part of the flower  
filament - stalk that projects pollen bearing anthers out of the flower so pollinators pick up pollen

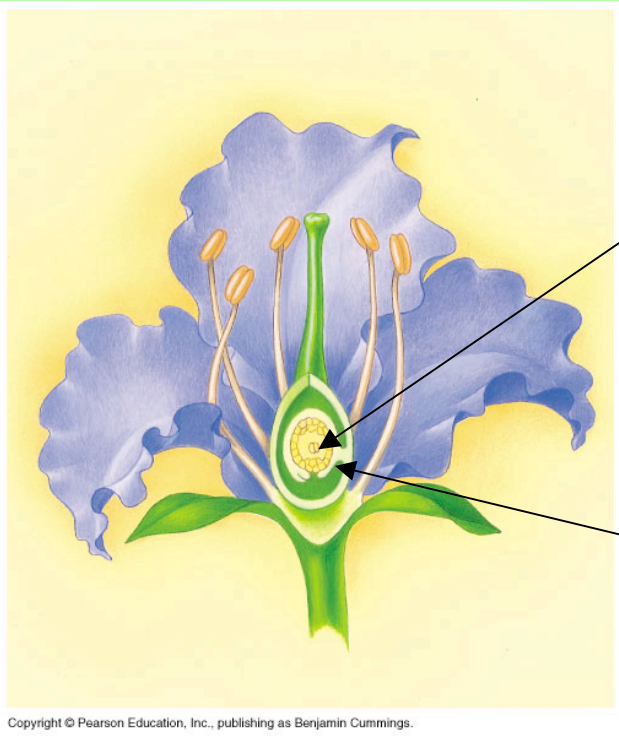
the carpel - the female part of the flower  
stigma - the tip of the carpel that serves to receives pollen  
style - a solid stalk of tissue that separates the ovary from the stigma. Forces pollen to grow tubes the distance from the stigma to the ovary chamber. This selects the fastest growing pollen tube and therefore the most vigorous male genes fertilize the females egg  
ovary - contains the female gametophyte plant that bears the egg

Flowering plants follow the "alternation of generation" method of sexual reproduction. The sporophyte produces spores which germinate and grow into male or female gametophyte plants. But the male and female gametophyte plants have undergone extreme evolutionary reduction so as to be comprised of only the bare essential cells that can produce either egg (female gametophyte) or sperm (male gametophyte).



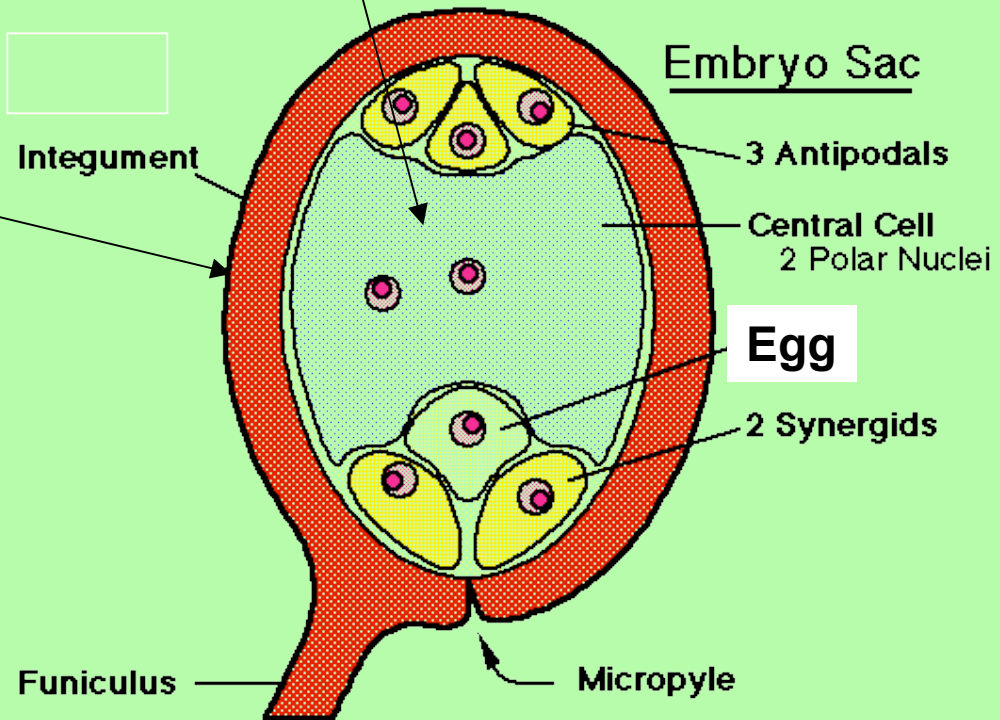
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Where is the female gametophyte plant in the flower?



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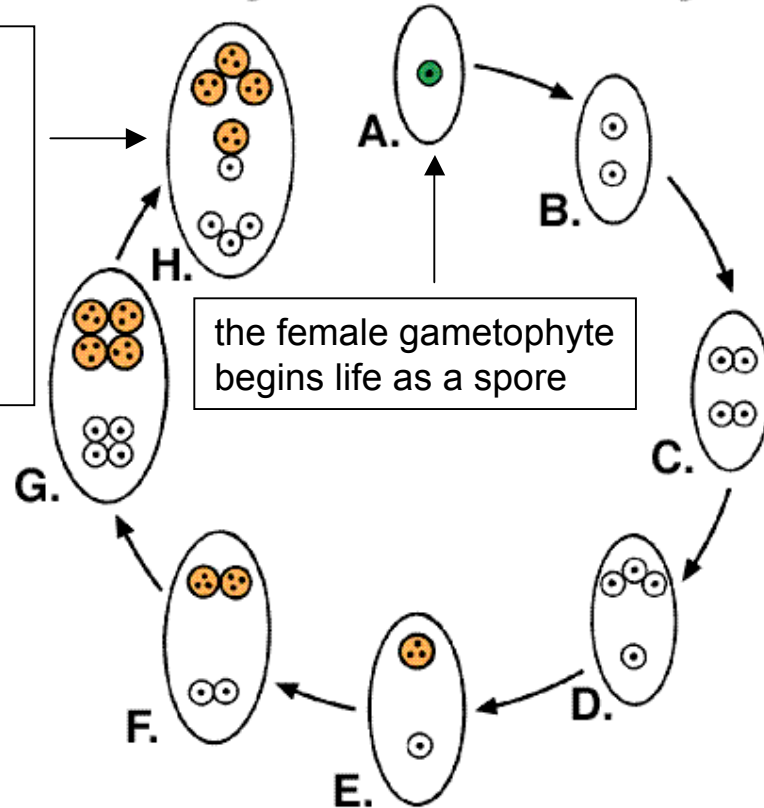
Here it is!....inside the ovary of the female flower.



The structure called the embryos sac is actually the female gametophyte plant at this stage of evolution....it consists of 8 cells, only 3 of which function in reproduction (the egg, and the 2 polar cells)

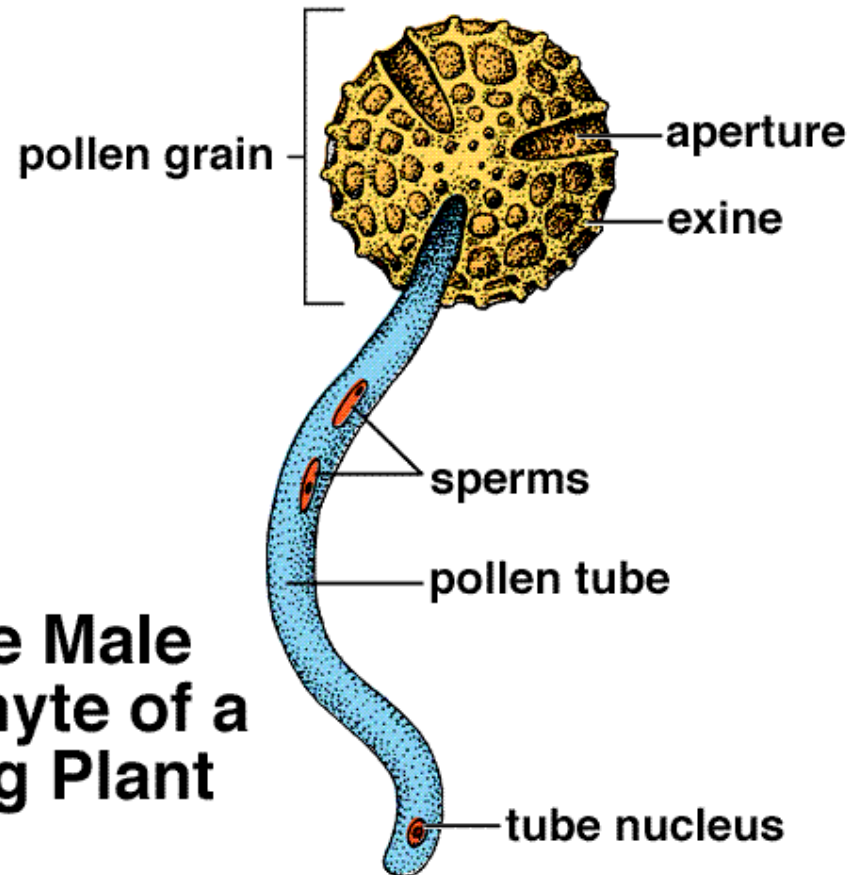
## How the Embryo Sac of a Lily Develops

Early in the development of the flower, a spore germinates inside the ovary and then undergoes several cell divisions, resulting in the 8-celled embryo sac, a.k.a. the female gametophyte plant



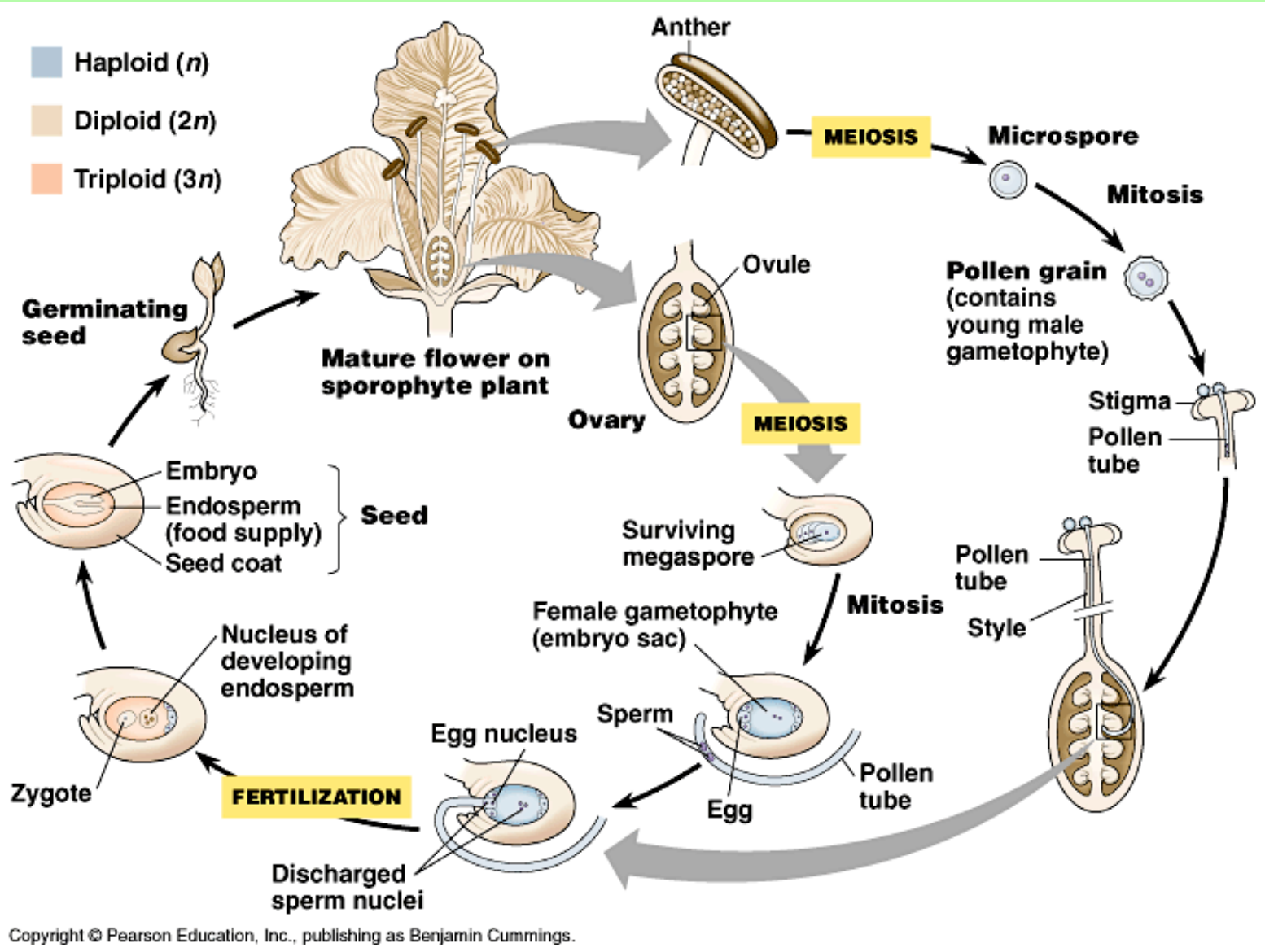
**The male gametophyte is simply a germinating pollen grain!**

Kingsley R. Stern, Botany Visual Resource Library © 1997 The McGraw-Hill Companies, Inc. All rights reserved.



**A Mature Male  
Gametophyte of a  
Flowering Plant**

# The complete diagrammatic life-cycle of a flowering plant.



**Fruit:** A key advantage flowering plants have over non flowering plants is the ability to form fruit from the female flower tissue after pollination has occurred

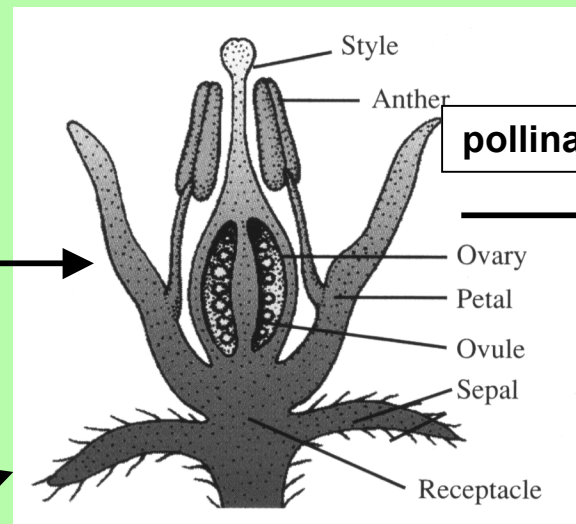
The botanical definition of fruit is any structure that develops from carpel tissue that aids in the dissemination of the seeds within.....**ALL fruits were once flowers!**

By this definition, avocados, tomatoes, green beans, jalapeño peppers are fruits.....so are acorns, dandelion plumes, and cockle burs!

## How fruits are formed



a tomato blossom



Tomato skin is same as ovary skin

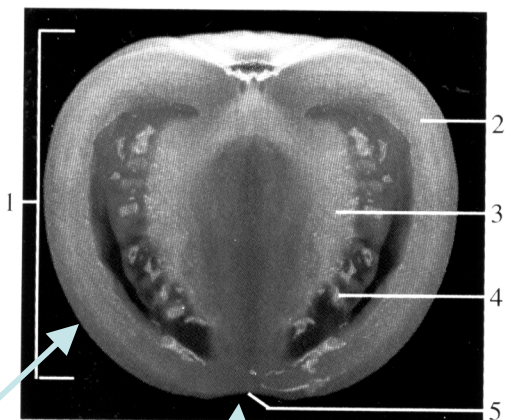
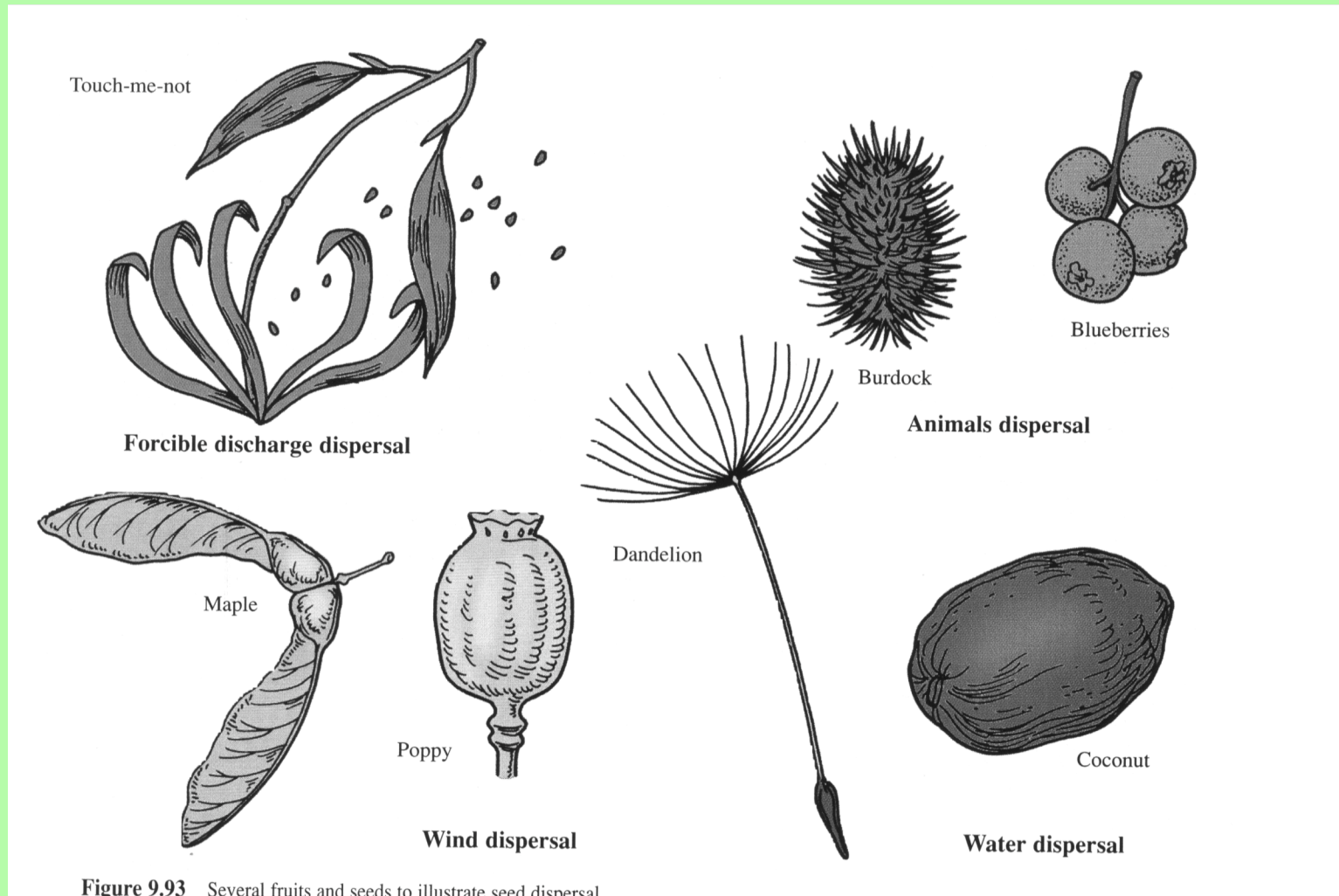


Figure 9.87 A longitudinal section of a tomato fruit (a berry).

- 1. Mature ovary
- 2. Ovary wall
- 3. Placenta
- 4. Seed
- 5. Remnant of stigma

position of former tip of female flower (stigma)

# Examples of fruits and the associated seed dispersal mechanism





*Rose hips.....fruit of the wild rose*



**The End**

