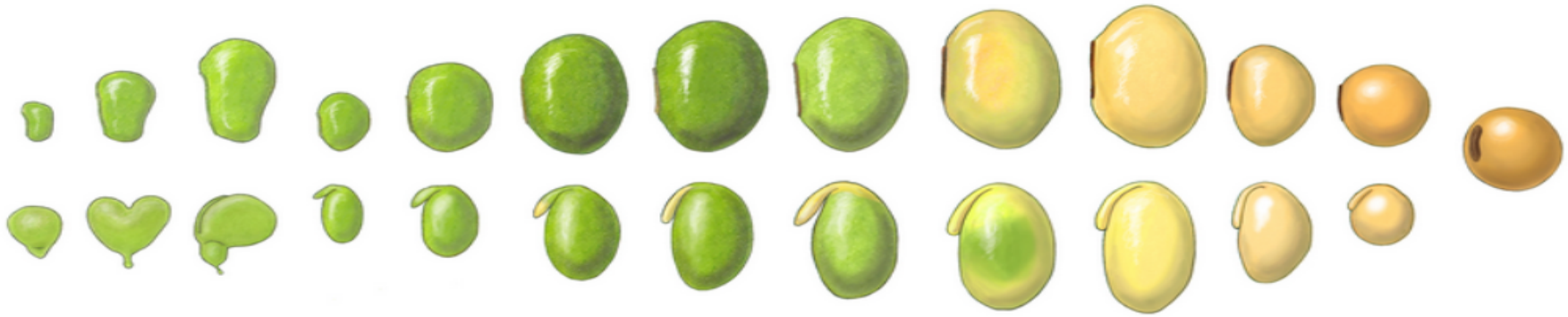


How To Make A Seed

EMBRYONIC DEVELOPMENT AND THE LIFE CYCLE OF ANGIOSPERMS

NORA COOPER | JAZMIN SAMANO | DOMINIC SAADI

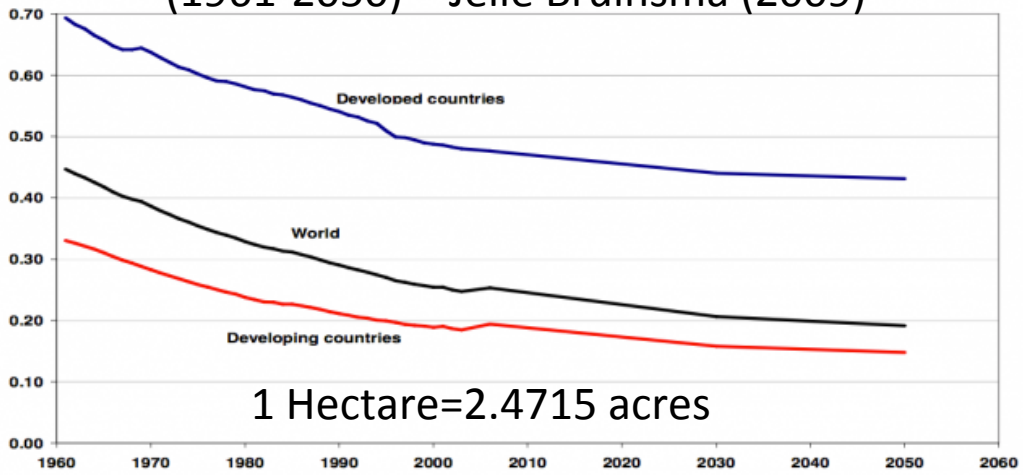
Why Study Seeds?

- Within the next fifty years we will need to produce more food than in all of human history and we must do it with fewer inputs on less arable land
- If we understand which genes do what in seed development, we can manipulate them to engineer more efficient crops
- Most importantly, fifteen crops compose our food source and of these fifteen over half are seed bearing.

How imperative are these studies?

- Currently the world population is a little under 7.2 billion.
- By 2050, the population is estimated to be at 10 billion people.
- An increasing population combined with a daily loss of arable land accounts to an estimated 0.46 acres per person in 2050.

Arable land per capita (ha in use per person) (1961-2050) – Jelle Bruinsma (2009)



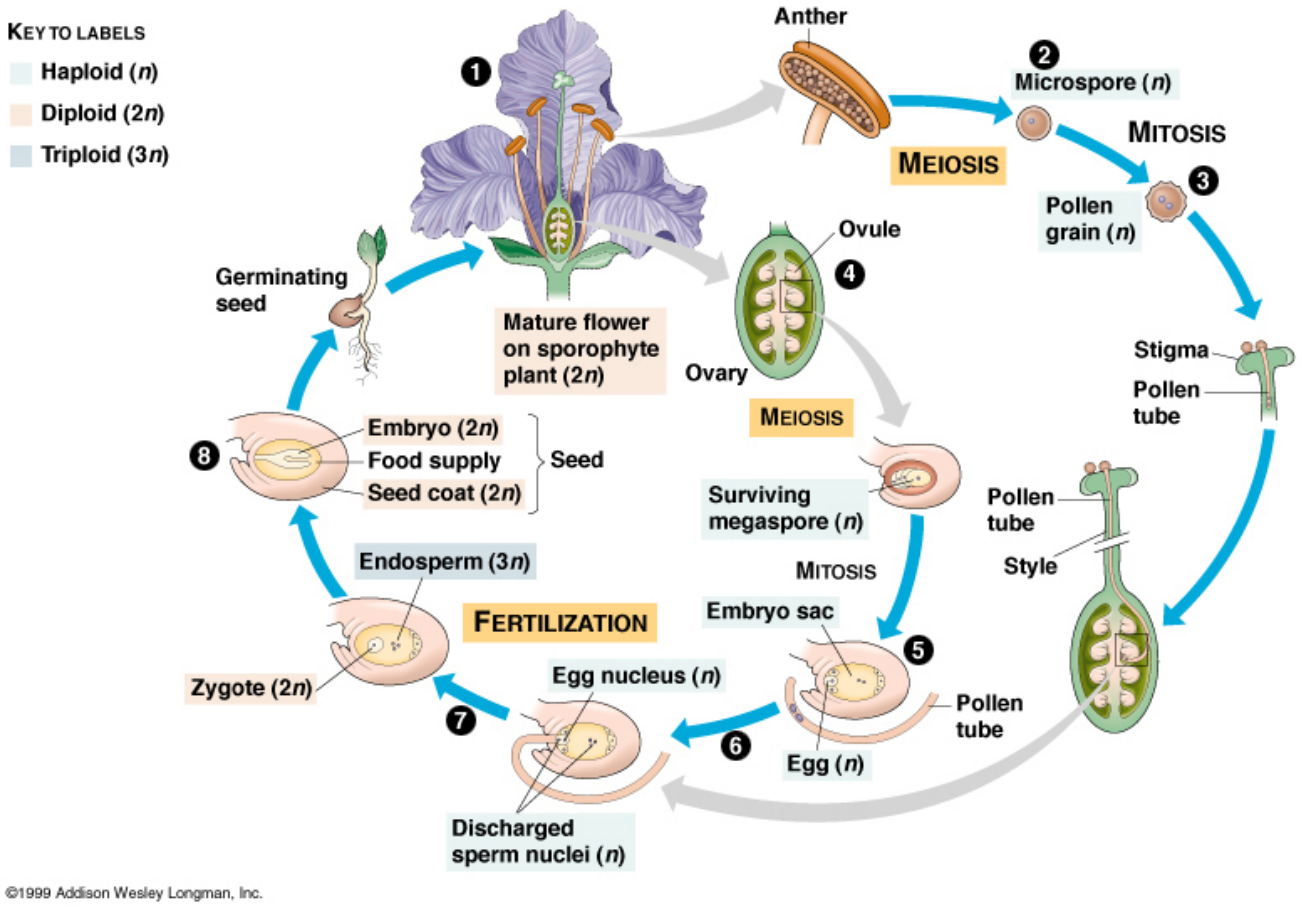
http://www.ourworldindata.org/data/food-agriculture/land-use-in-agriculture/

Why Study Arabidopsis Thaliana?

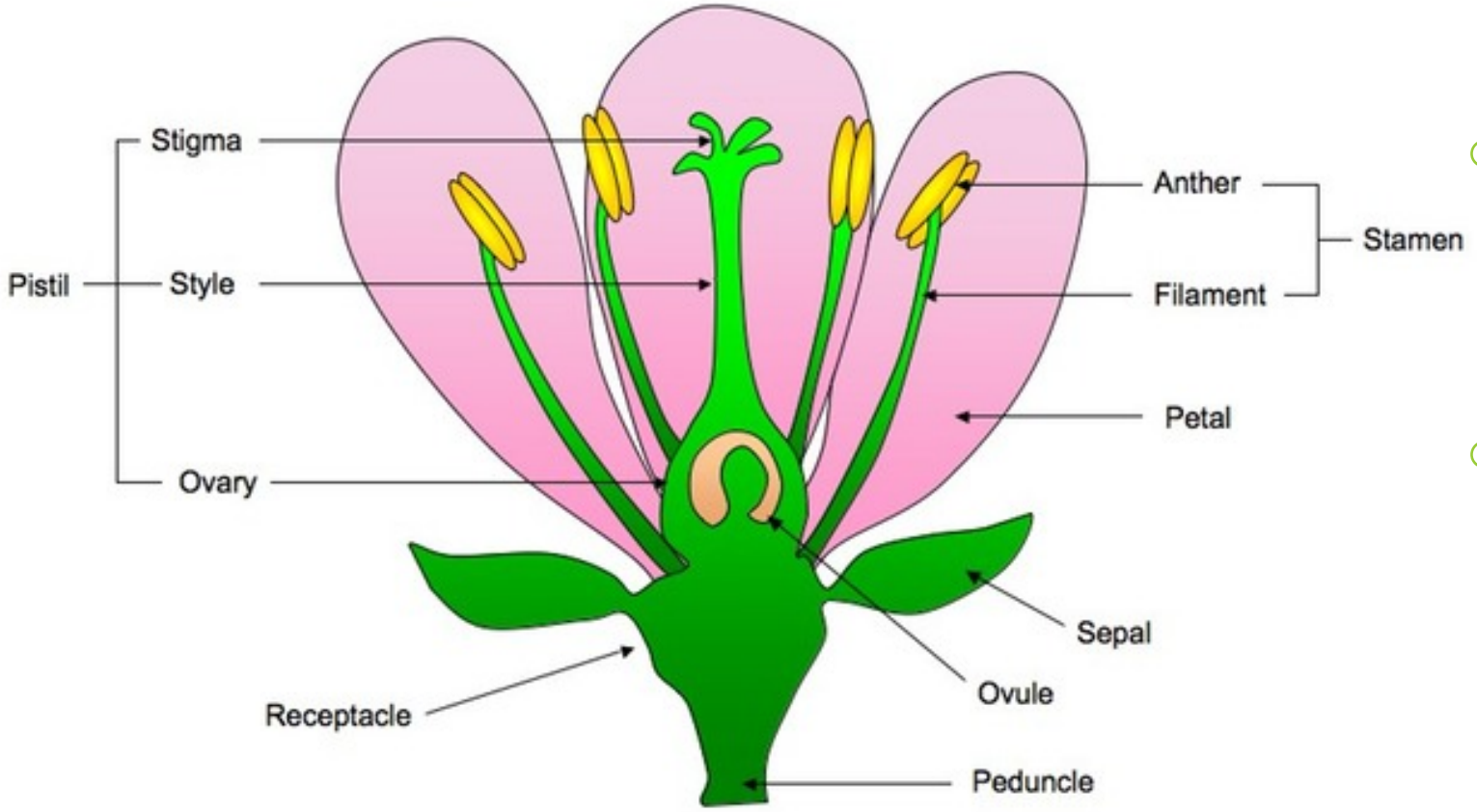
- "The flowering plant Arabidopsis thaliana is an important model system for identifying genes and determining their functions."- *Analysis of the genome sequence of the flowering plant Arabidopsis thaliana*
- Short generation time of about 8 weeks from seed to seed
- Small size (20-25cm)
- Large number of offspring
- Relatively small nuclear genome (~25,000 genes; 135 Mbp)

The Life Cycle of Flowering Plants

- Before anything else, we need to understand how healthy seeds develop so that we can assess which step of the process is interrupted
- Anatomy of Flowers
- Gametogenesis
- Double Fertilization
- Embryogenesis
- Anatomy of a Seed



Anatomy of a Flower

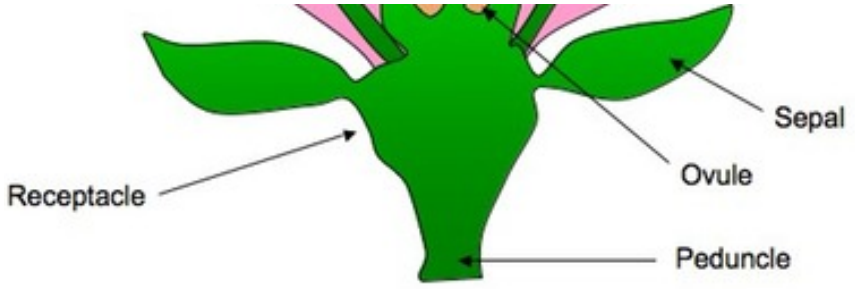


- A Flower is the reproductive structure of a flowering plant and it is often known as a bloom or a blossom.
- A Flower consists of four whorls: the calyx, the corolla, the androecium, and the gynoecium.

Flower Anatomy Breakdown: Part 1

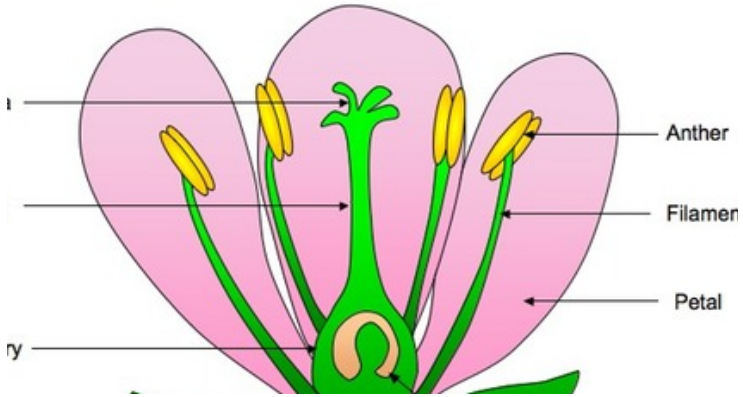
THE CALYX

- The outermost whorl which consists of the green sepals.
- Typically functions as protection for the flower in the bud and protection for the petals in the bloom.



THE COROLLA

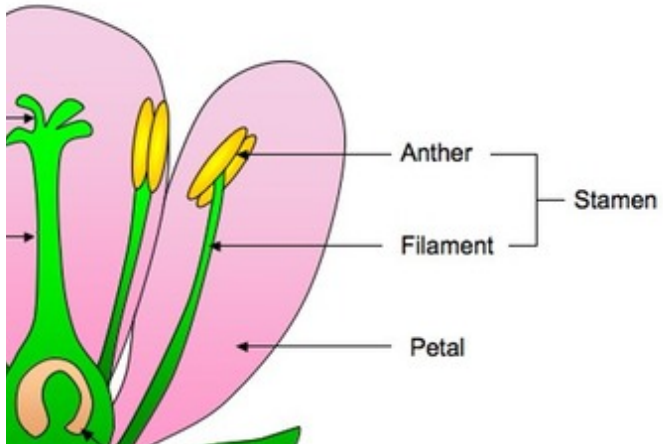
- The next whorl in a flower which consists of units called petals. Petals are modified leaves that surround the reproductive parts of the flower.
- They are often brightly colored or unusually shaped to attract pollinators.



Flower Anatomy Breakdown: Part 2

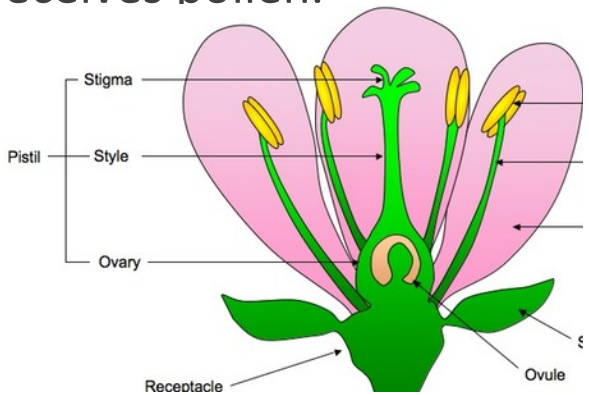
THE ANDROECIUM

- The following whorl consisting of the stamen also known as the male part of the flower.
- The stamen consists of two parts: a stalk called the filament, and an anther “top” where pollen is produced.

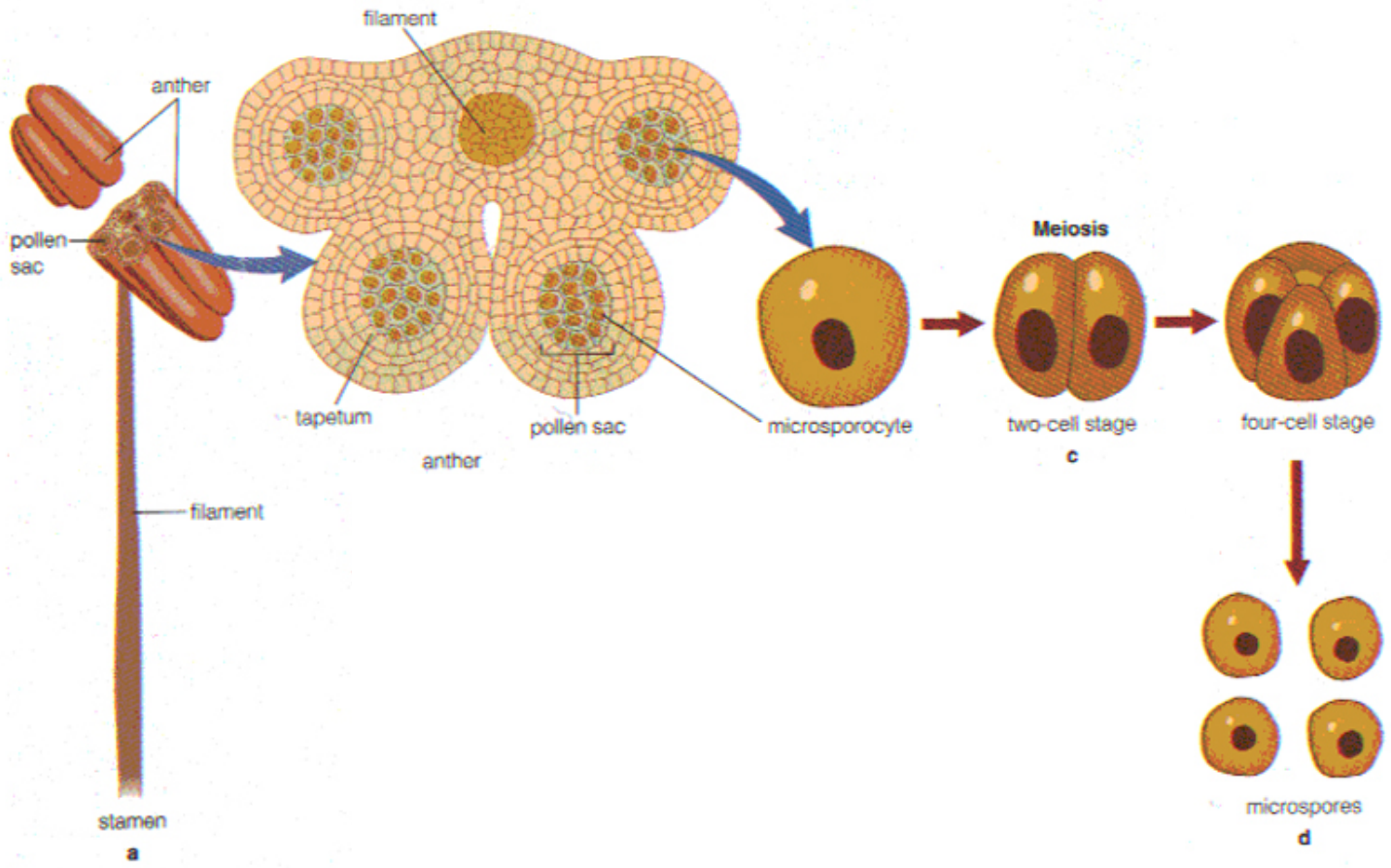


THE GYNOECIUM

- The inner most whorl of a flower which is also known as the female reproductive part of the flower. The gynoecium consists of:
- one or more units called carpels which form a hollow structure called an ovary.
- And the stigma, the sticky tip of the carpel which receives pollen.

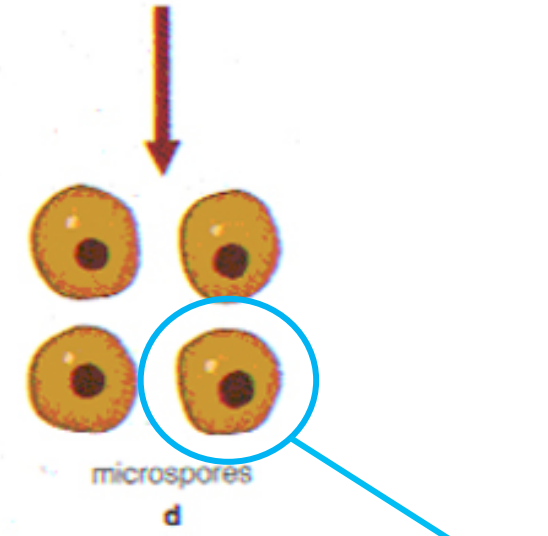


Pollen Development: Microgametophyte

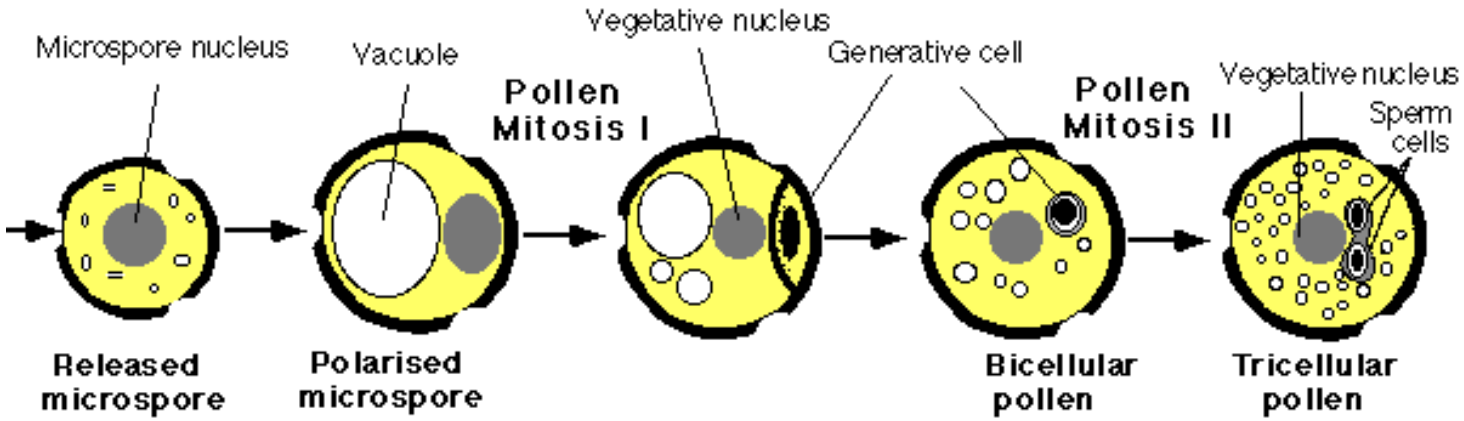


- Microsporogenesis is the first of two distinct processes
- Ends in the formation of microspores (single-celled pollen grains)

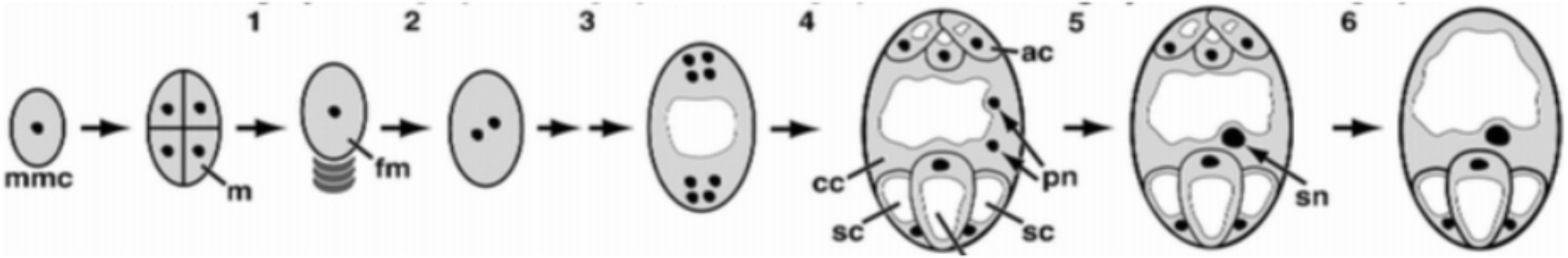
Pollen Development: Microgametogenesis



- Microgametogenesis is the second process
- Ends with the development of a three-celled microgametophyte (pollen grains)



Egg Development: Megagametophyte

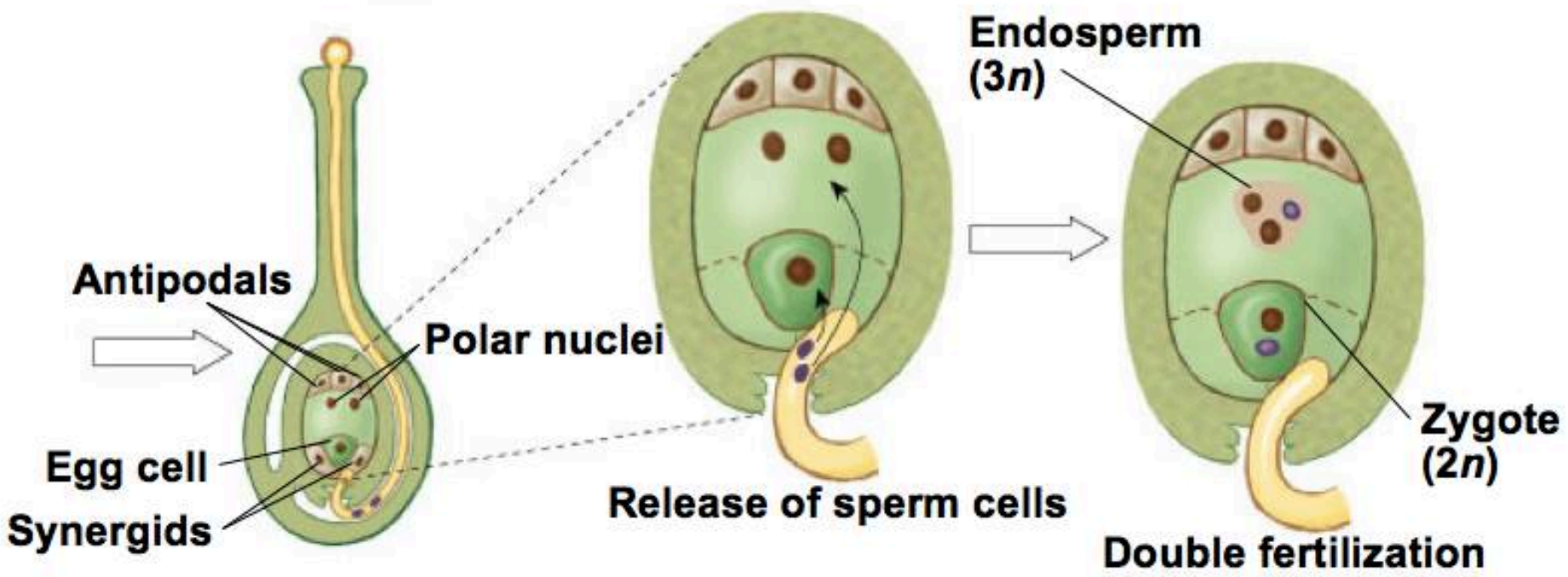


ac: antipodal cell
cc: central cell
ec: egg cell
fm: functional megaspore
m: megaspore
mmc: megaspore mother cell
pn: polar nuclei
sc: synergid cell
sn: secondary nucleus

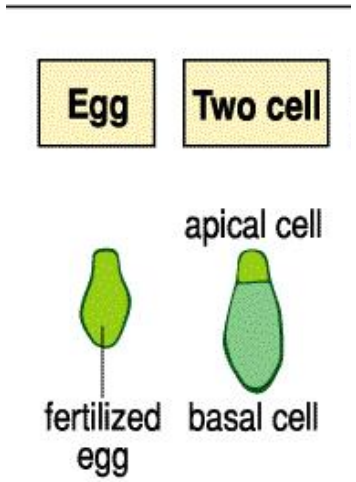
Pollination: Pollen To Stigma

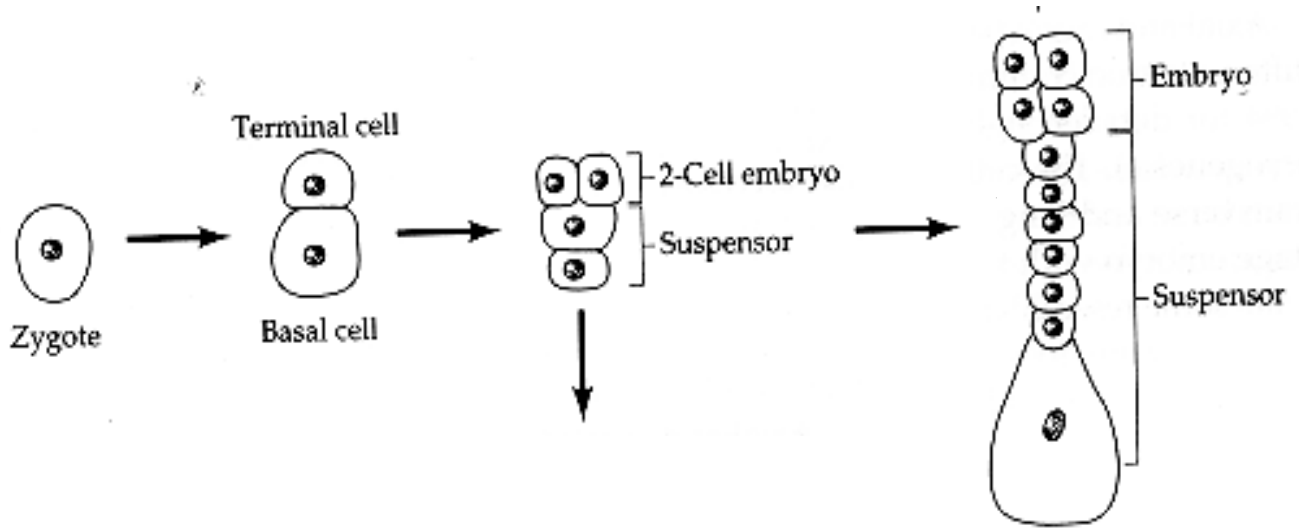
- First, the pollen grain (microgametophyte) has to land on the stigma
- wind and water, but mostly insects and birds

Pollination: Double Fertilization

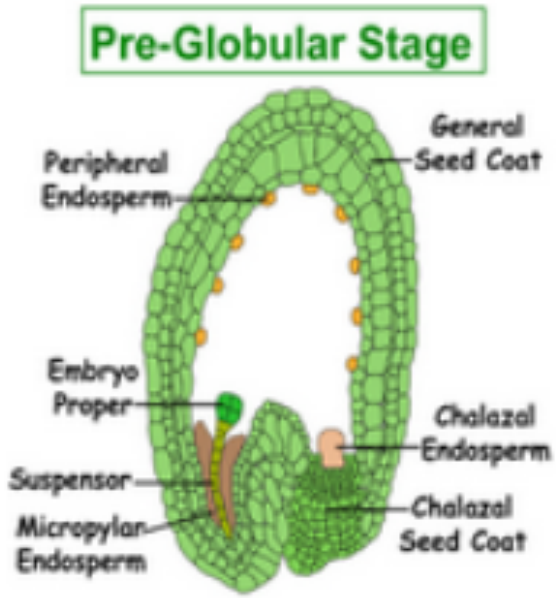


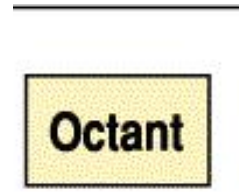
Embryogenesis: The Egg Cell

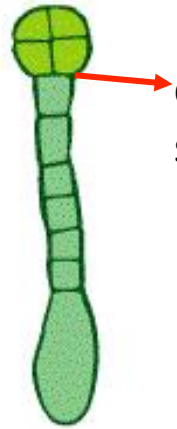




Embryogenesis: 8-Celled Embryo

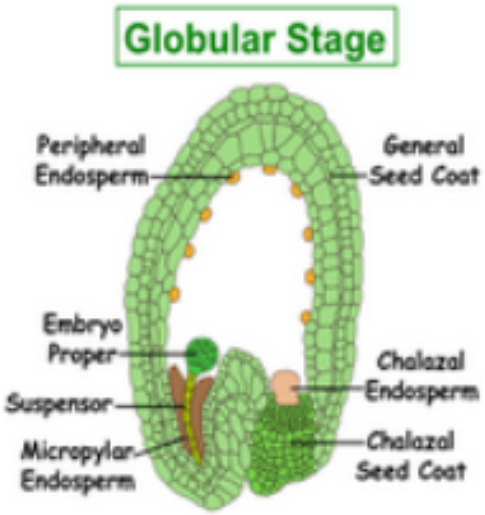




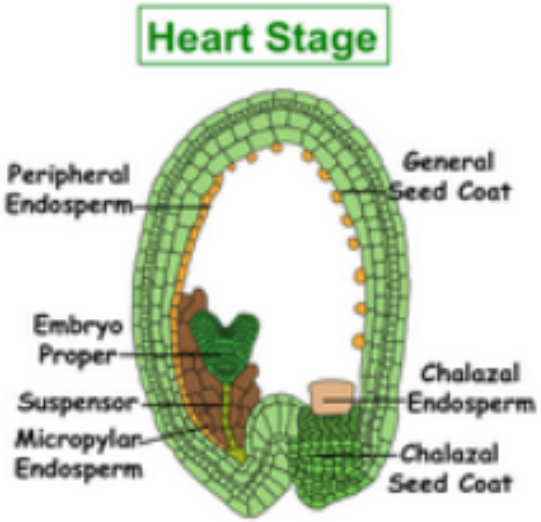


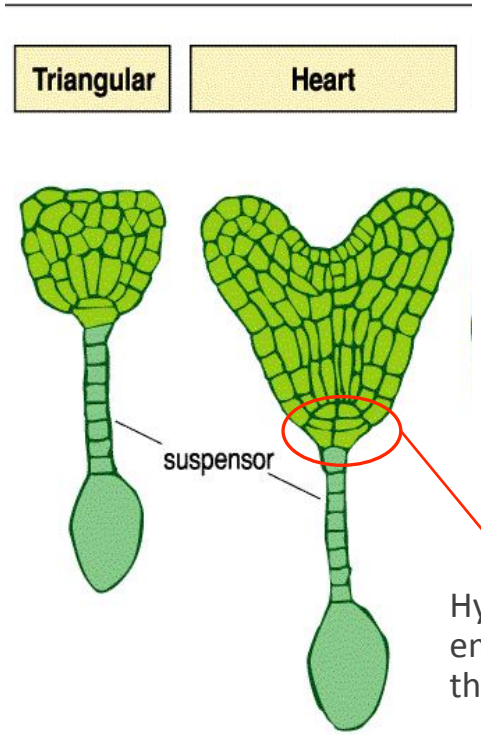
Plasmodesmata connects EP to suspensor

Embryogenesis: Globular Stage



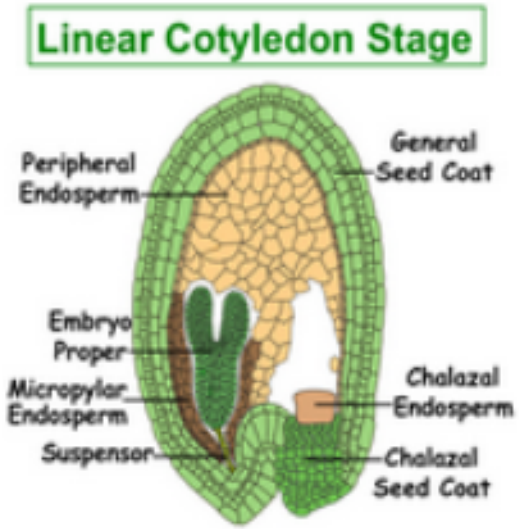
Embryogenesis: Transition to Heart Stage

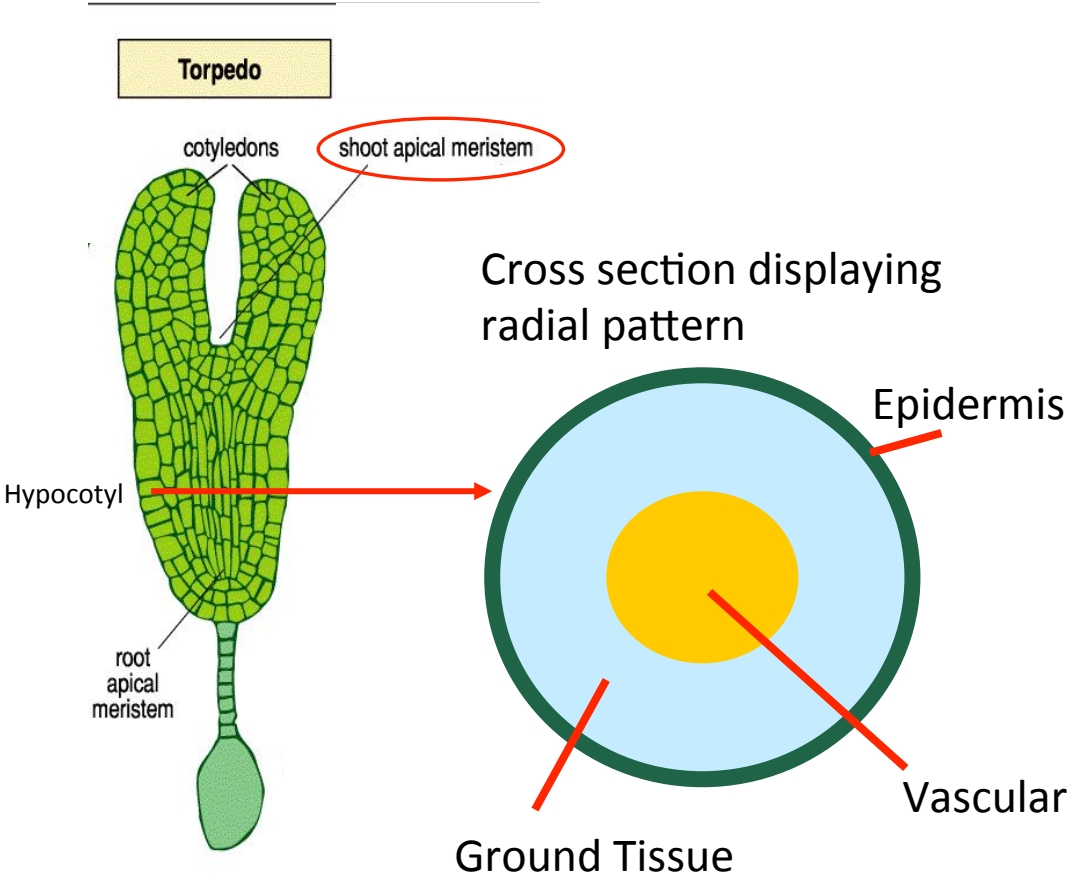




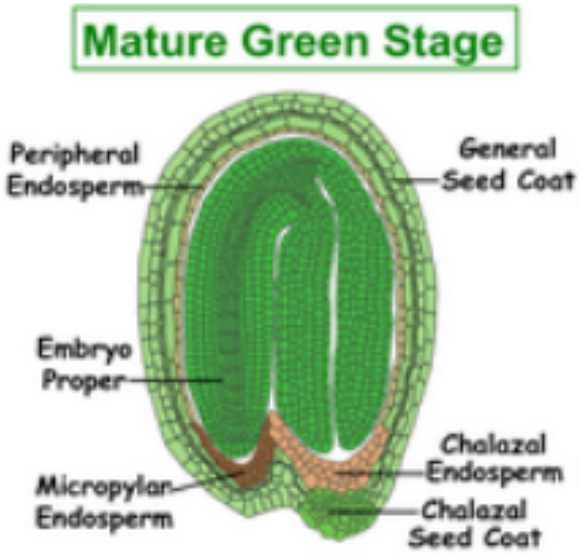
Hypophysis and lower embryonic cells give rise to the root meristem

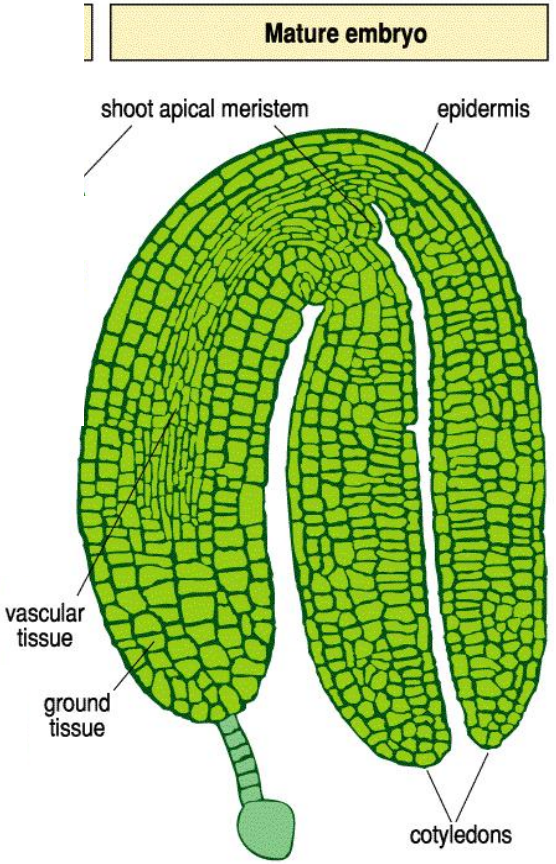
Embryogenesis: Torpedo Stage



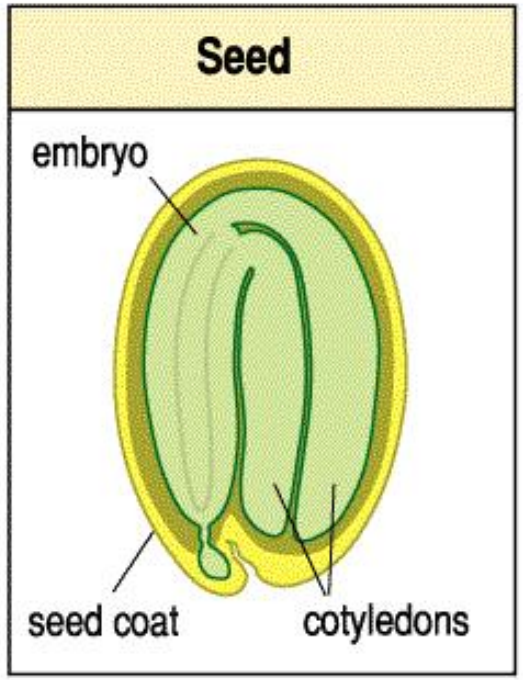


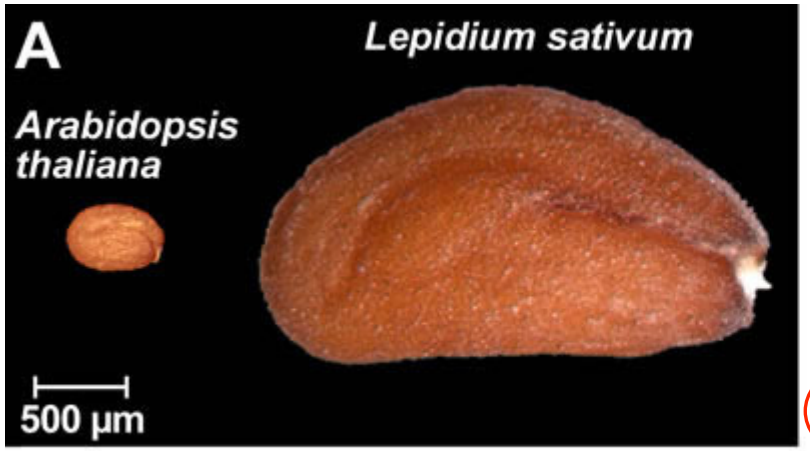
Embryogenesis: Mature Stage

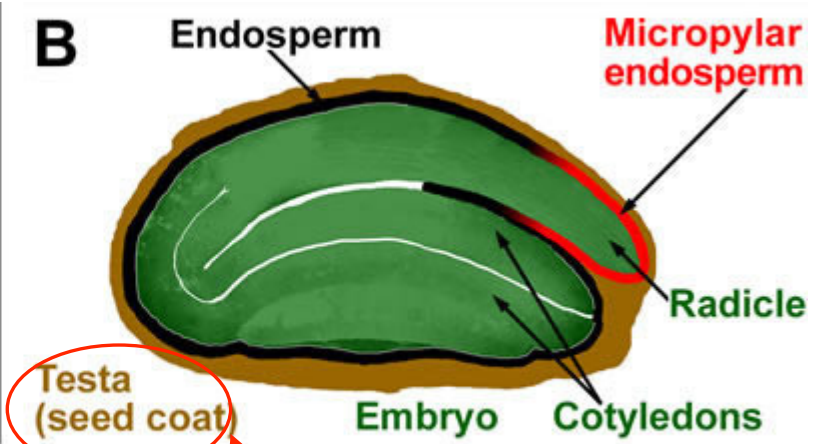




Seed







Müller et al. (2006) - © Plant Cell Physiology, Oxford University Press, http://pcp.oxfordjournals.org

Two integuments make up seed coat, giving it structure and, in Arabidopsis, brown pigment