

Creating the Perfect Seed: Finding the Genes Required To Make a Seed

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Today's Agricultural Crises

- Currently, the world population is close to 7 billion
 - At the current growth rate, the world population will reach **10 billion** people in 2050
 - Coupled with limited land availability, one hectare will have to feed an increasing amount of people.
 - Therefore, we must increase crop yield to satisfy demand

Why study seeds?

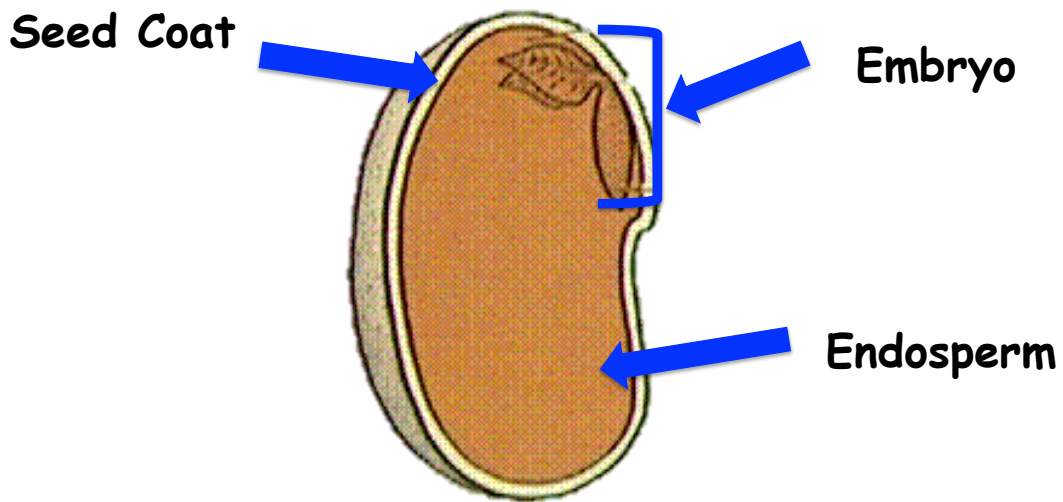
- 90% of all plants are seed-bearing
- Over half of the fourteen most consumed crops are seed-bearing
- By identifying the genes important for seed development, we can improve crop yields
 - Seed size, number, growth rate, etc.

What are seeds?

- Plant's unit of reproduction
- Seeds protect, disperse, and nourish plant embryos that will grow into new plants
- Come in many shapes and sizes.

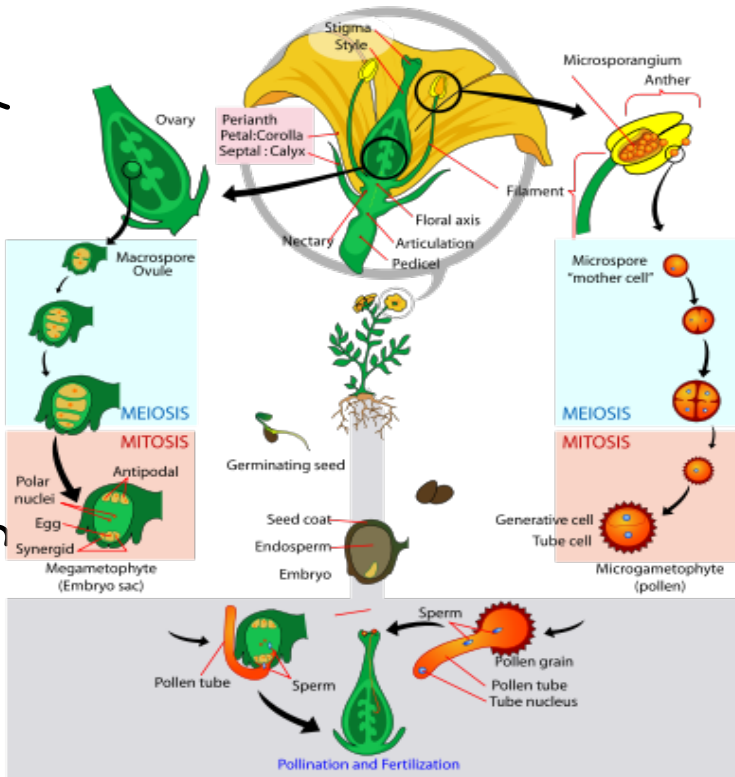


What is a Seed Made of?



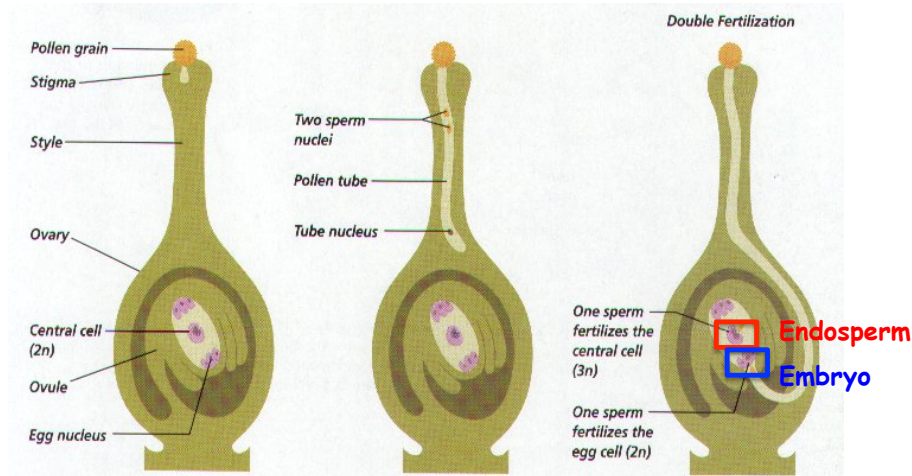
How is a Seed Made?

Flowering Plant Life Cycle

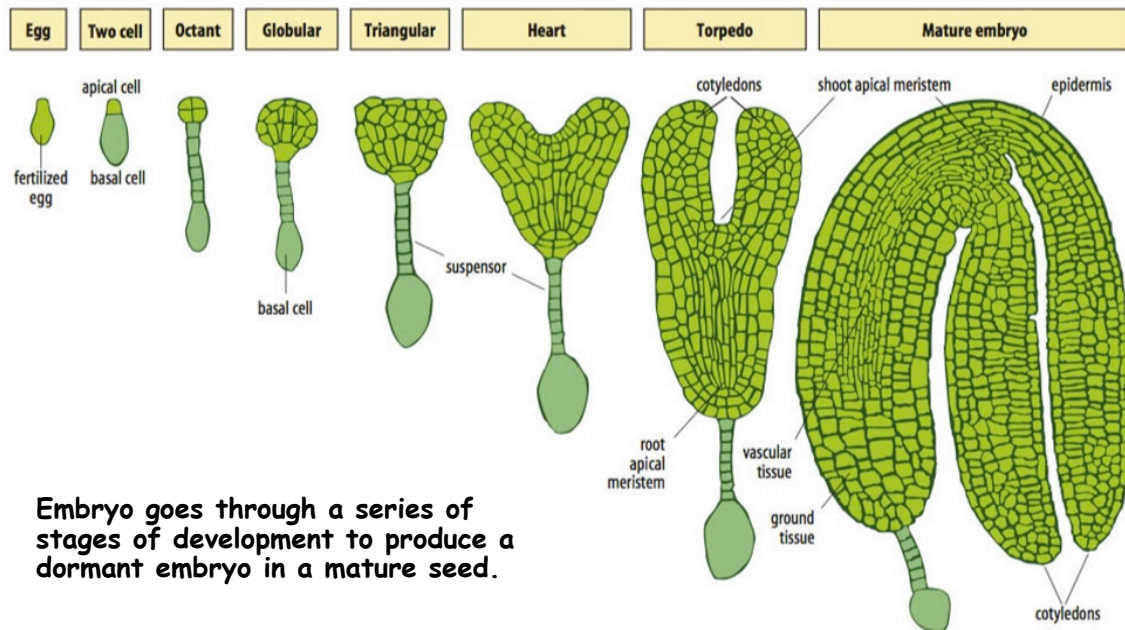


What is Double Fertilization?

- Flowering plants have 2 fertilization events
 - Two sperm
 - One fertilizes the egg to create embryo
 - One fertilizes the polar nuclei to create endosperm
 - Outer layer of the ovule (integument) gives rise to the seed coat

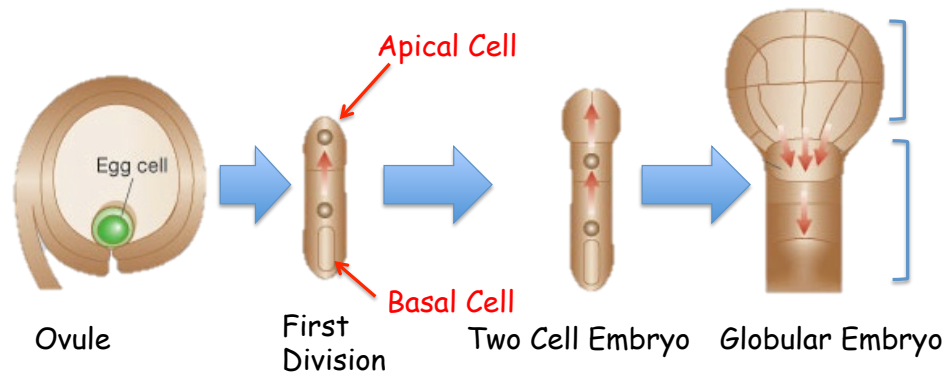


How Does Embryo Develop?

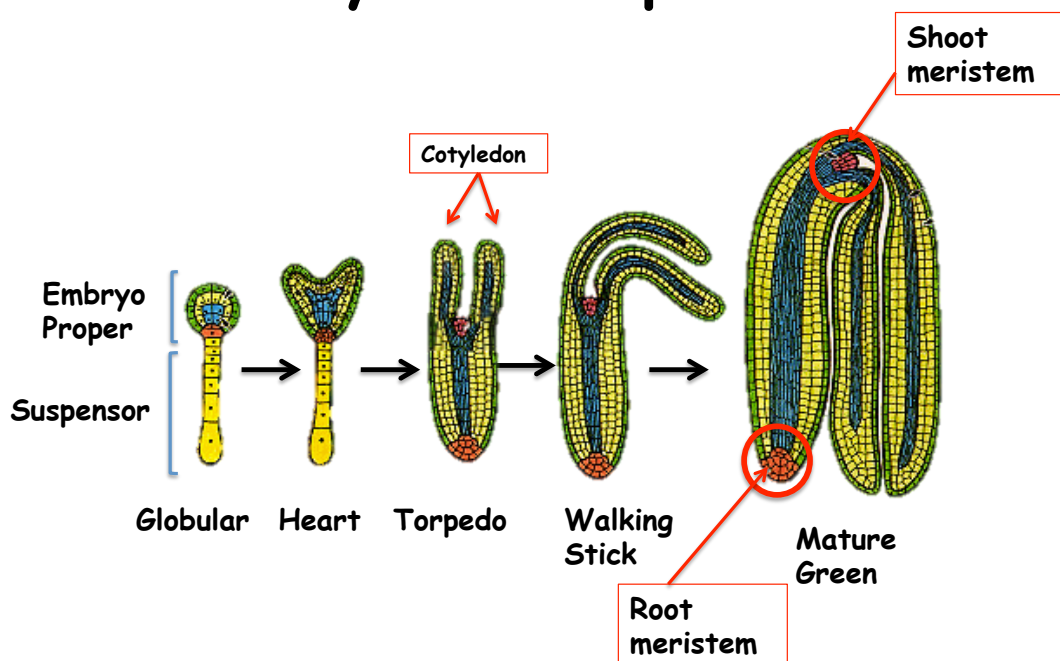


What Happens during Early Embryo Development?

- After fertilization of the egg cell, zygote is formed.
- Zygote divides into two cells: Apical cell and Basal cell.

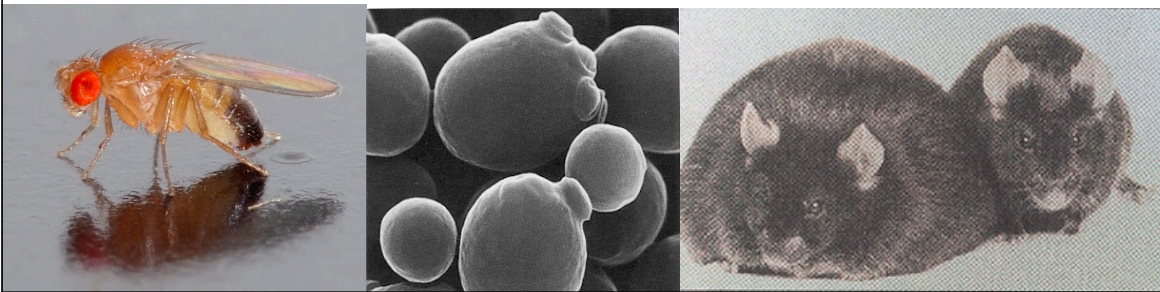


What Happens during Late Embryo Development?



What is a Model Organism?

- In order to study seeds, we need a model organism
- An organism scientists use to study biological processes in controlled lab conditions.
- Traits: small size, short generation time, common, cheap to maintain, easy to manipulate, small genome.

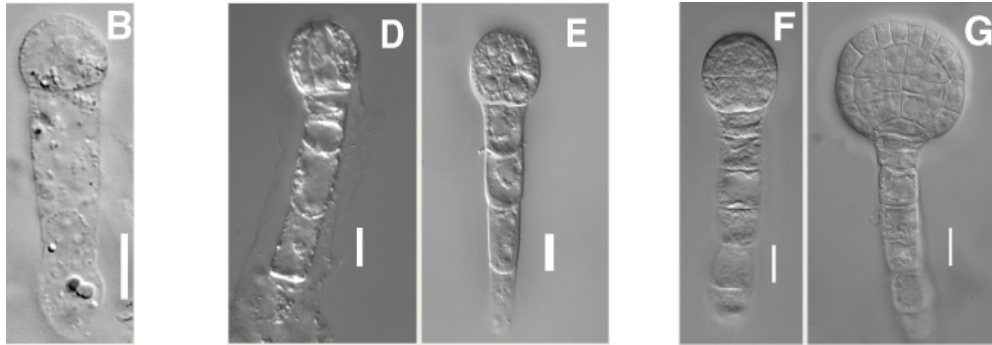


What Makes *Arabidopsis thaliana* a Good Model Organism?



- Small plant and has a relatively fast generation time (3 months).
 - Making it easy to work with
- Has a small genome that has been sequenced
- There is a library of knockouts
 - There is a plant with a mutation in one gene for each gene
- Large scientific community
 - Many resources (TAIR, SALK) and has been extensively researched

How Does the Arabidopsis Embryo Develop in Its Early Developmental Stages?

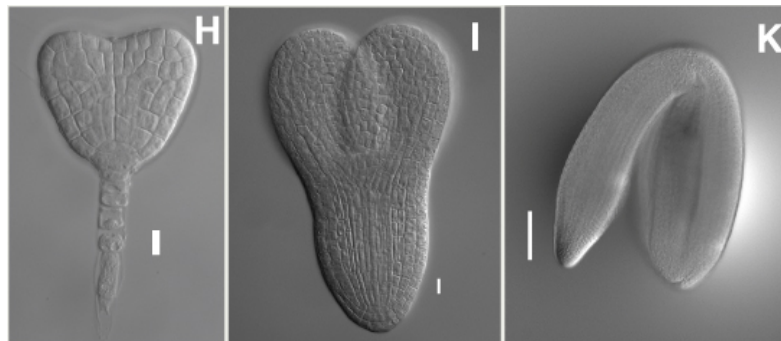


One Cell

Octant

Globular

How Does the Arabidopsis Embryo Develop in Its Late Developmental Stages?



Heart

Torpedo

Mature Green

Why Is Studying Arabidopsis Embryo Development Important?

- **Implications: Create the perfect seed with knowledge of all genes related to seed development**
 - Pathways, circuits
- **Arabidopsis is related to major crops, such as broccoli, cauliflower, cabbages, etc**