UNIT #4
FLOWERING PLANT REPRODUCTION

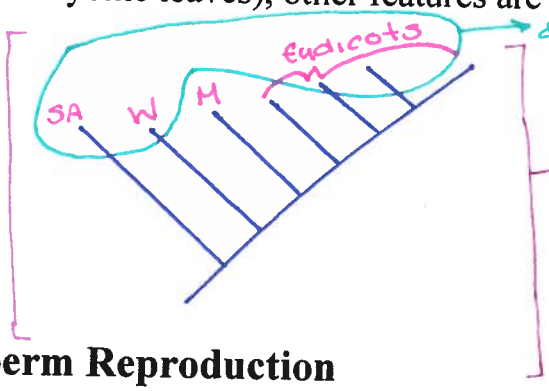
Text: Chapters 5 and 6

OUTLINE:
1. Introduce the Angiosperms (flowering plants).
2. Examine angiosperm reproduction.

1. Introduction

Angiosperm = (flowering plants), a group of vascular plants with seeds enclosed within an ovary → fruit, part of a flower
~250,000 species, largest phylum of plants
- monophyletic group, arose ~130 million years ago
  ↳ all evolved from common ancestor, one branch of phylogenetic tree (the tree of life)

Angiosperms are made up of two major groups: eudicots and monocots. Although their names indicate the main feature that distinguishes them is the number of cotyledons (embryonic leaves), other features are important. (within a carpel) - in flower



Contrast conifer (gymnosperms)

Assignment: contrast Eudicots + monocots

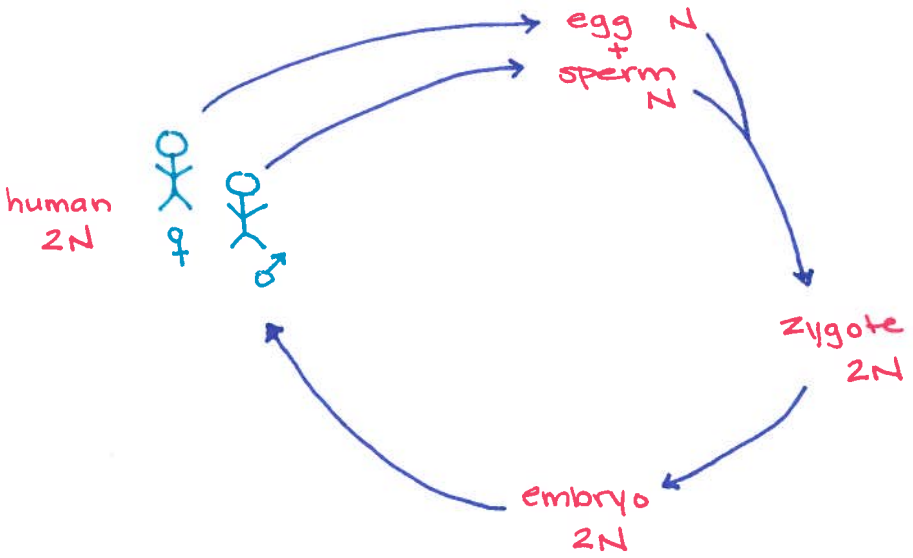
2. Angiosperm Reproduction

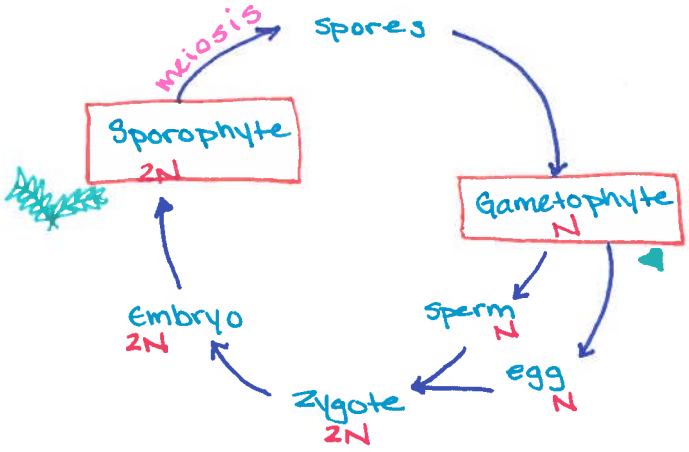
Flowers are believed to be derived from a modified branch, therefore all flower parts are modified leaves.

Fruit will ultimately develop from the ovary of the flower. What modifications facilitate fruit and seed dispersal?

- juicy / yummy fruit → animals consume to disperse seeds
- prickly fruit → attachment + dispersal
- prickly seeds → attachment + dispersal
- feathery seeds / or fruit → wind
- extra structures → attachment

(a) Life History





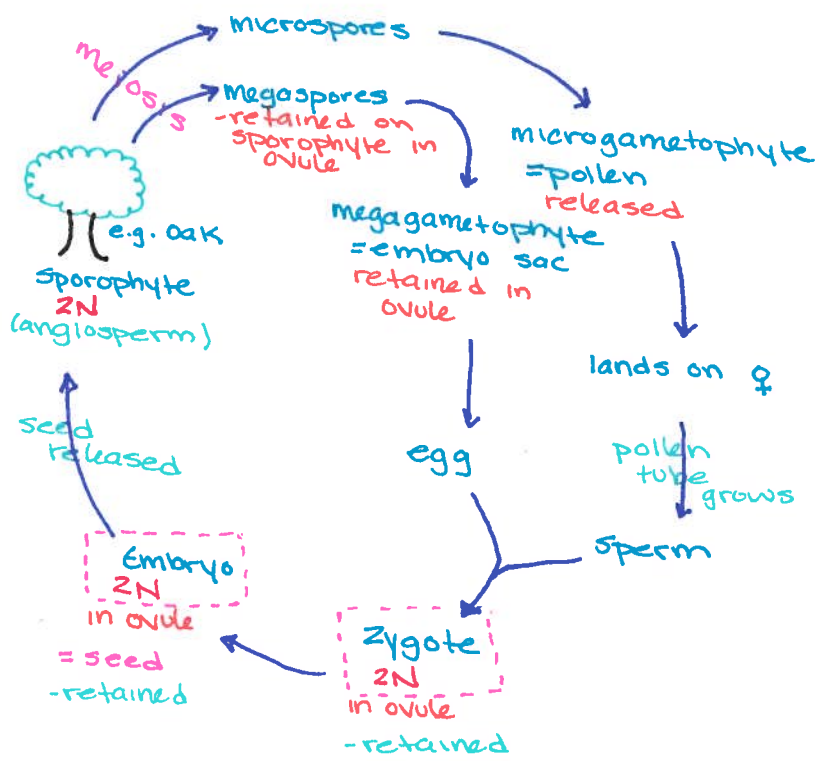
E.g. Fern

But... what happens if you have 2 types of spores (♀ + ♂)?

microspores → microgametophyte (♂)

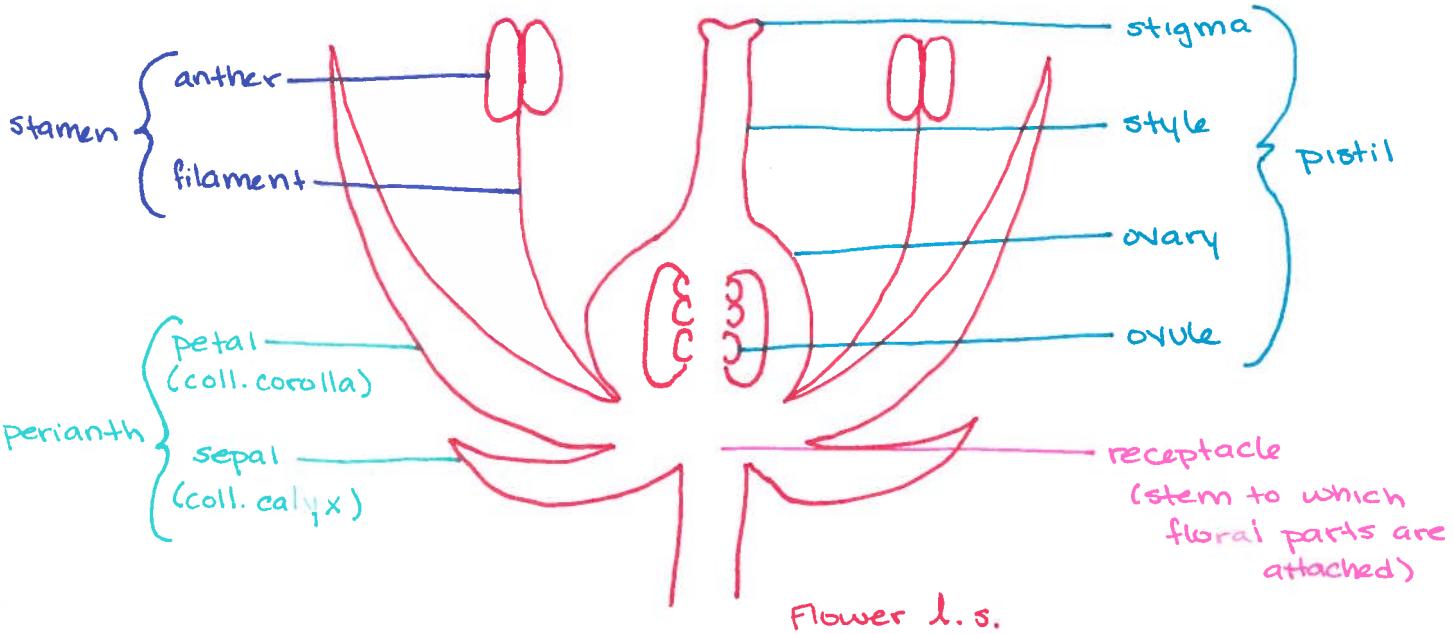
megaspores → megagametophyte (♀)

Gymnosperms (includes conifers) + Angiosperms ⇒ seed!!



E.g. Oak Angiosperm

(b) Flower Structure



sterile floral parts

(i) Calyx

- collective term for sepals → Penstemon unaria, snapdragon
- may be leaf-like, petal-like → lilies, bristle, absent — when petals + sepals look alike = tepals
- may have protective function (eg. in *Rosa* they cover the developing flower bud)
- attraction

(ii) Corolla

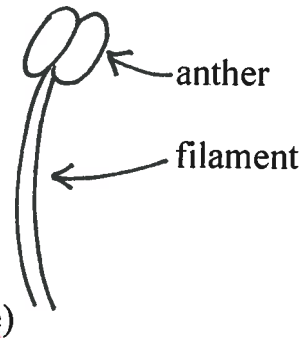
- collective term for petals, often pigmented
- attracting pollinators! → carotenoids, anthocyanins, betalains, others — which ones not pigmented? ... or absent?

Collective term for calyx and corolla = perianth

Although leaf-like in venation (arrangement of veins) these structures do not have palisade or spongy mesophyll

(iii) Stamen - collective androecium

- male components of the flower
- made up of stamen: function is the production of pollen
- stamen is made up of:
  - (a) filament
  - (b) anther: where pollen is made and released
    - pollen sacs = microsporangium — carries container
    - meiosis occurs in the microsporangia producing microspores (unicellular)
    - the microspore nucleus ~~nucleus~~ divides into two cells within the spore wall, this is now considered a pollen grain (=male gametophyte) → each will produce 2 sperm nuclei

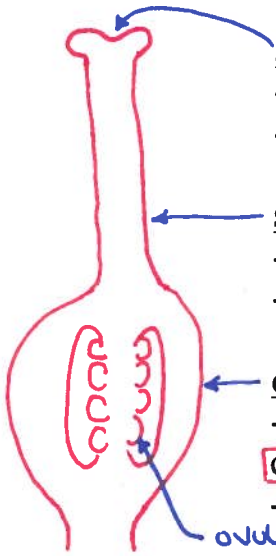


Pollen

- has specific morphological characteristics → see in lab!
- plants can often be identified by pollen alone → important archaeologically

(iv) Pistil (single or fused carpels)

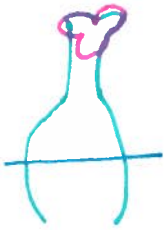
- female component of the flower, basic unit is the carpel (each carpel is a modified leaf)



stigma
- receptive surface
- may be site of self-incompatibility

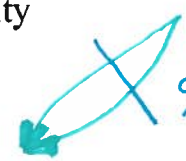
style
- stalk that connects stigma to style
- may be another site of incompatibility

ovary
- ovary refers to the basal part of the carpel or fused carpels = pistil
- it contains ovules → seeds !!



cross-section of ovary

carpel
3 carpels in this pistil

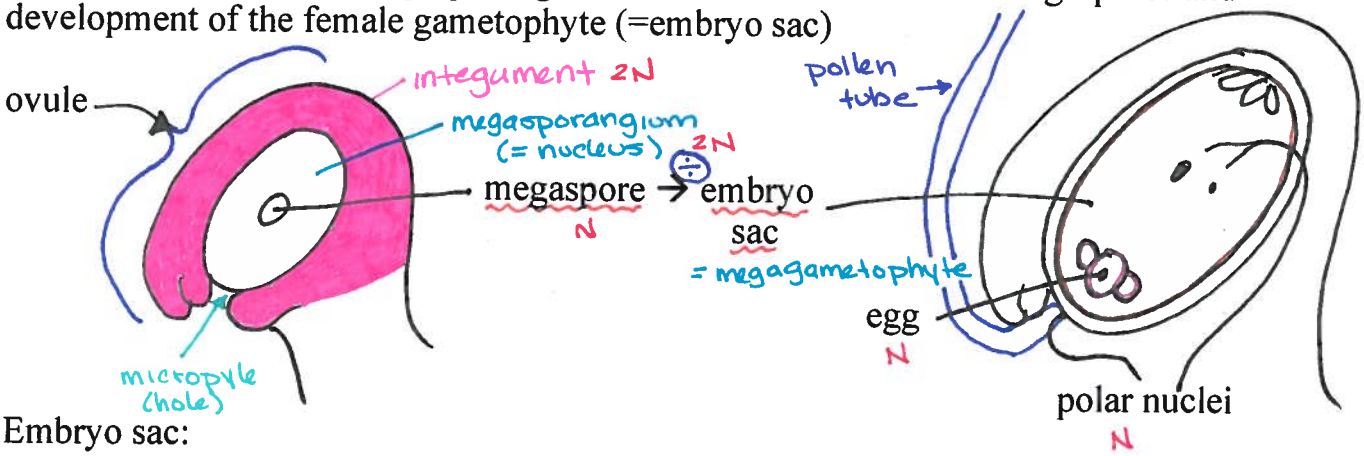


e.g. bean

cross-section

1 carpel in this pistil

ovule = "integumented megasporangium", the site of formation of megaspores and development of the female gametophyte (=embryo sac)



Embryo sac:

- usually has 8 nuclei / 7 cells - count 'em!

- Think about floral diversity
  - → 1 ovule per ovary
  - → many ovules per ovary ∴ Think of fruit.

Although all flowers are made up of the same parts there is great variation between flowers. The number of the different components varies. In some flowers you will have only one pistil (e.g. lily, bean, Penstemon), while in others you will find many (e.g. strawberry, rose). In some cases the flowers are showy to attract pollinators (e.g. lily, Penstemon, orchid) whereas in others the flowers are inconspicuous and their pollen is carried by the wind (e.g. grasses, alder). The position of the ovary may be different in relation to the rest of the flower parts. The ovary may be above where all other flower parts are attached (superior) (e.g.. lily, Penstemon) or sunken below where the rest of the flower parts are attached (inferior) (e.g. orchids, daffodil, zucchini, fuchsia, dandelion, sunflower).

(c) Pollination and Fertilization

- pollen grain lands on receptive site (pollination)
- pollen grain germinates, pollen tube penetrates stigma and grows down through carpel tissue
- all of pollen grain cytoplasm moves down tube carrying the sperm nuclei. (2)
- the pollen tube absorbs nutrients as it grows, but cytoplasm doesn't increase in volume
- enters embryo sac, sperm discharged
- one sperm nucleus fuses with the egg, the other with polar nuclei

Back to ovule diagram!

DOUBLE FERTILIZATION OCCURS IN THE ANGIOSPERMS

① egg + sperm → zygote → embryo (2N)

② polar nuclei + sperm → endosperm nucleus → endosperm (>2N)

Summary:

zygote → embryo

endosperm nucleus → endosperm (nutrient source for some germinating seedling)

integument → seed coat

ovary → fruit

(d) Flowers to Fruit

The flower is the distinguishing characteristic of the angiosperms (the 'flowering plants'). In the majority of the angiosperms each flower contains both male and female parts, that is, the flower is **bisexual (perfect)**. [entire plant synoecious]

In some species, however, either the male or the female parts are lacking and the individual flower is male (**staminate**) or female (**carpellate**). When a flower is missing either male or female components the flower is said to be **imperfect**. If both staminate and carpellate flowers grow on the same plant the species is **monoecious**; if the staminate and carpellate flowers grow on separate plants the species is termed **dioecious**.

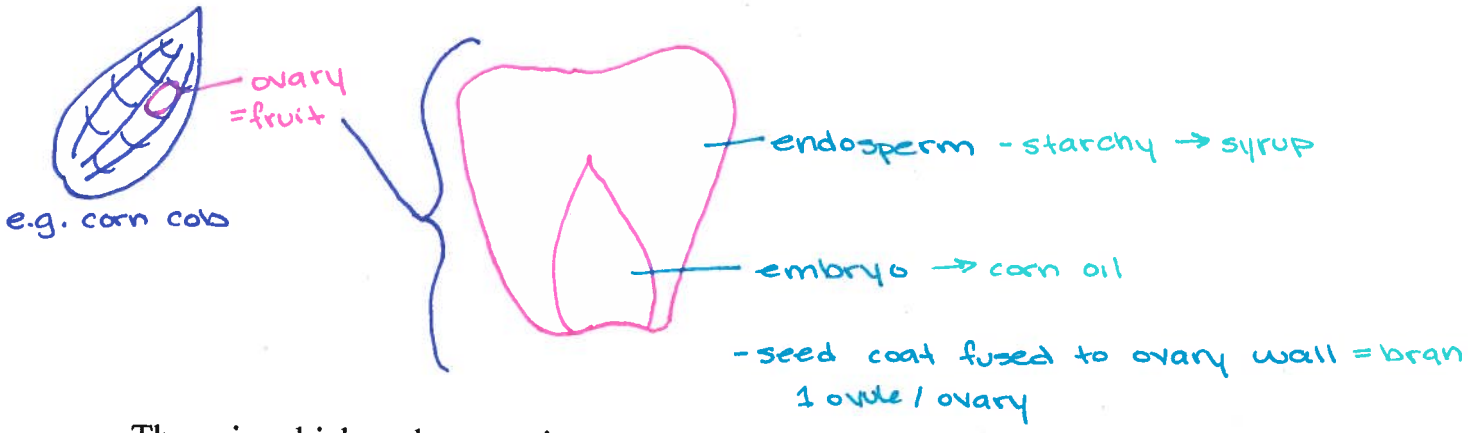
The shape, arrangement and number of floral parts are useful features for identification, and depending on the pollinating agent, some or all of these parts may be modified.

Floral variation	Flower with many pistils	Flower with inferior ovary

(e) Seed Germination

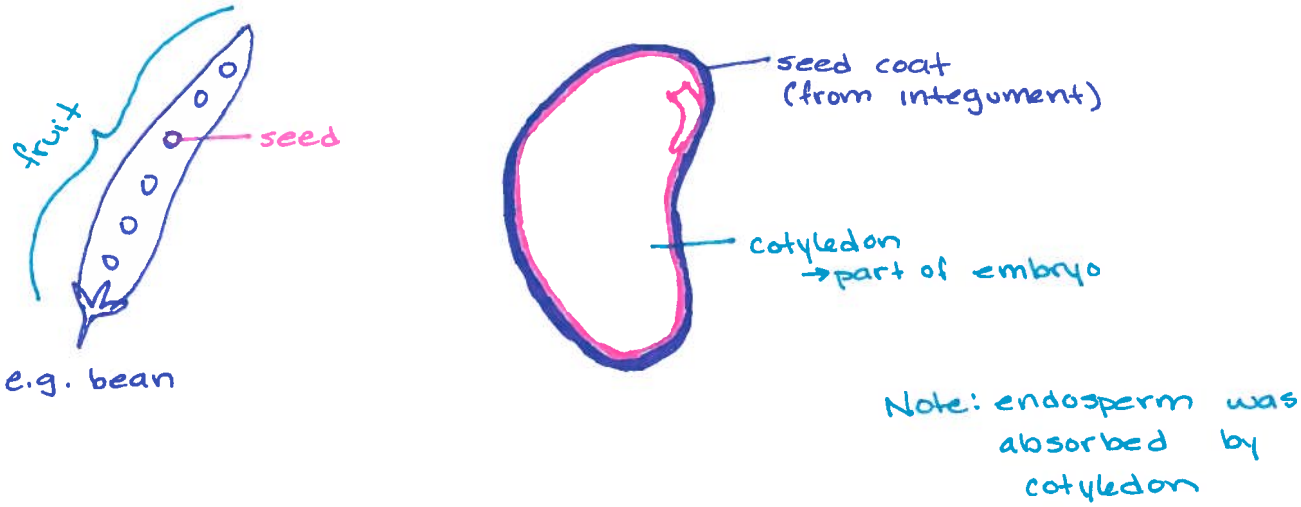
Food storage in mature seeds is usually in one of two forms:

Seeds with endosperm (eg. corn) are called **endospermous** or albuminous seeds.



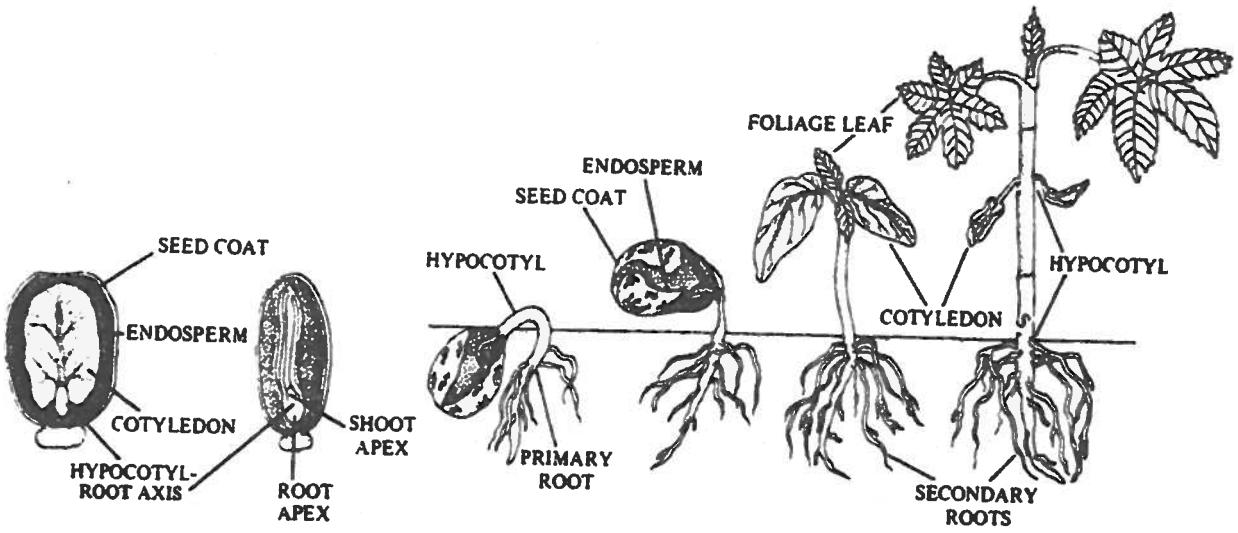
Those in which endosperm is sparse or absent at maturity are called **non-endospermous or** exalbuminous.

In this case the cotyledons are usually the sites of nutrient storage in the seed (eg. bean).

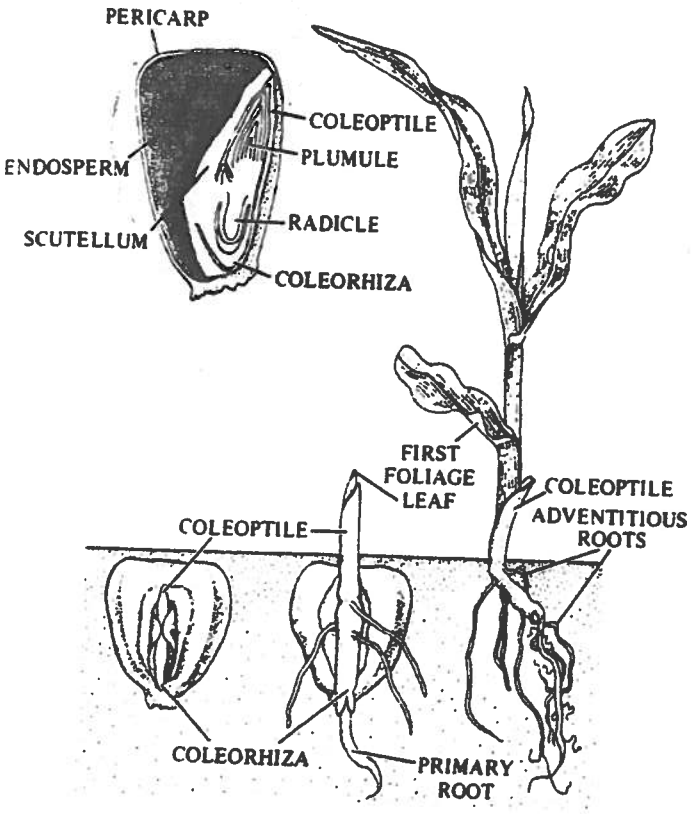


Examples of each type are illustrated on the next two pages. Note the structure of the types of seeds and the stages of seed germination.

(i) Examples of Endospermous Seeds: Seeds, Germination, and Seedling

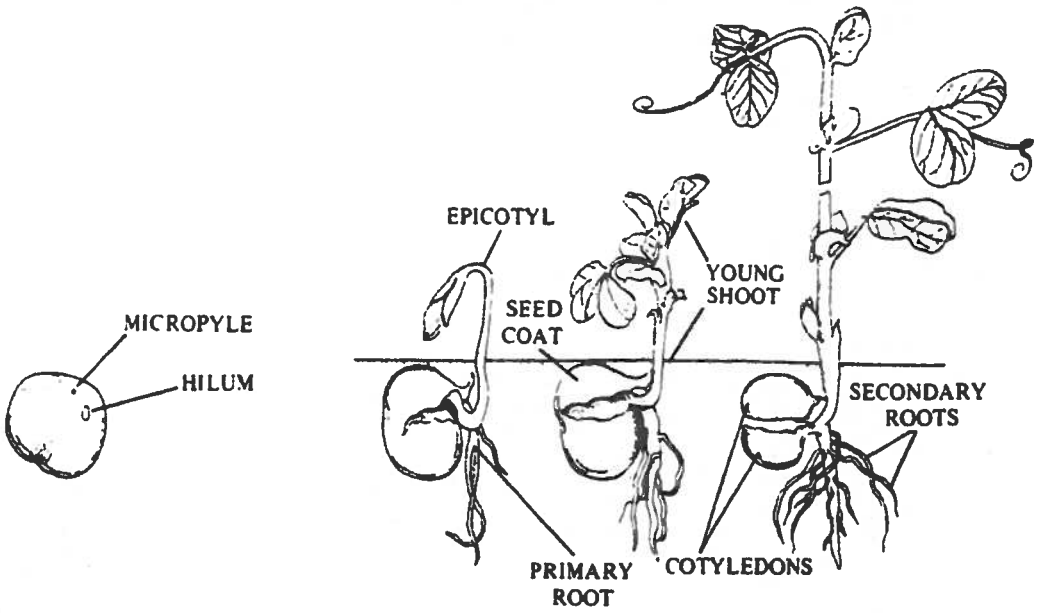


A. ***Ricinus communis*** **(castorbean)**

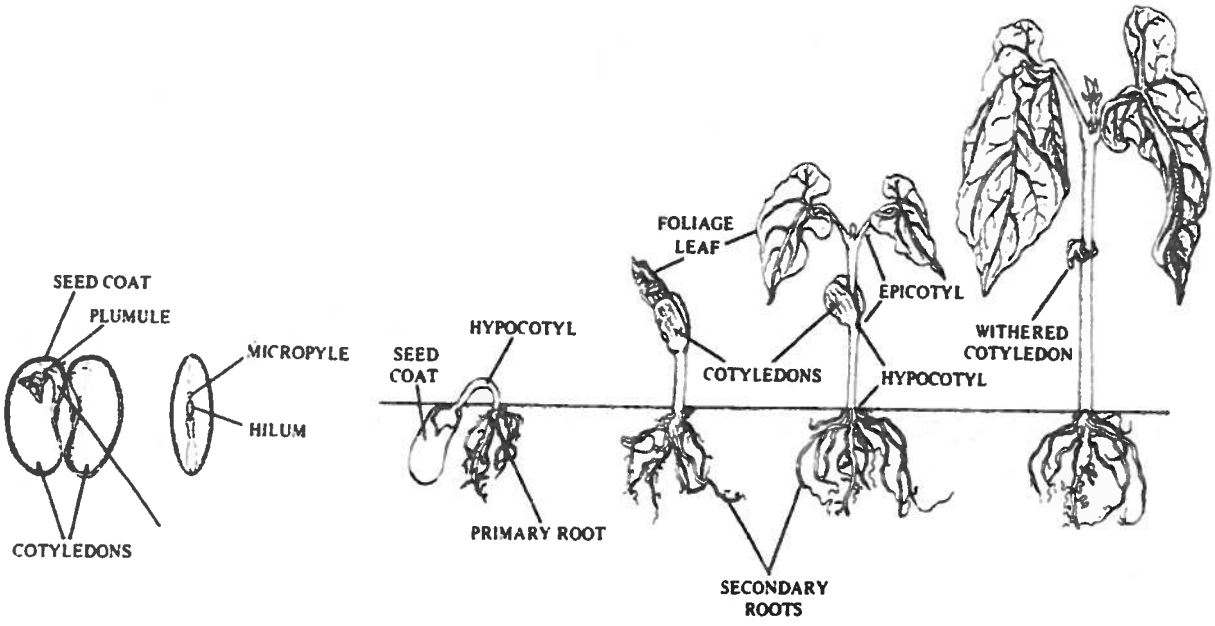


B. ***Zea mays*** **(corn)**

A. (ii) Examples of Non-endospermous Seeds: Seeds, Germination, and Seedling



A. *Pisum sativum* (pea)



B. *Phaseolus vulgaris* (garden bean)