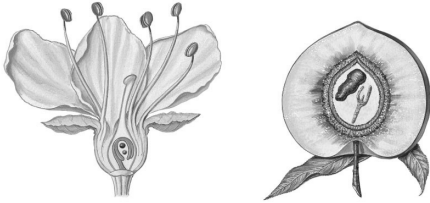Chapter 24:
Plant Reproduction and Development

The Sex Life of Plants...

- Plants can reproduce either sexually or asexually

  - ❖ Asexual: Single plant →new plant (genetically identical)
    - ➢ Daffodil bulbs; Strawberry runners

  - ❖ Sexual: Parental plants → new plant (genetic mix)
    - ➢ Most plants

Asexual reproduction

Seedless navel oranges

Strawberry runners

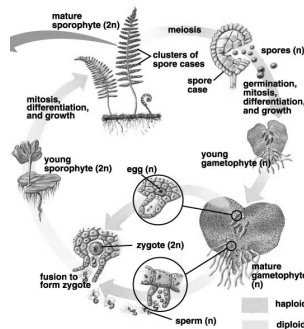## Sexual reproduction
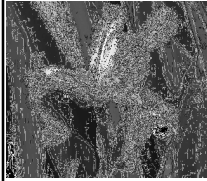
flowers   fruits

seed pods

The Sex Life of Plants...

- **Plant sexual life history is complex:**
  - ❖ Alternation of Generations:
    - ➤ Diploid (2n) plants alternate with haploid (1n) plants

mature sporophyte (2n)

meiosis

spores (n)

clusters of spore cases

spore case

germination, mitosis, differentiation, and growth

mitosis, differentiation, and growth

young sporophyte (2n)

egg (n)

young gametophyte (n)

zygote (2n)

fusion to form zygote

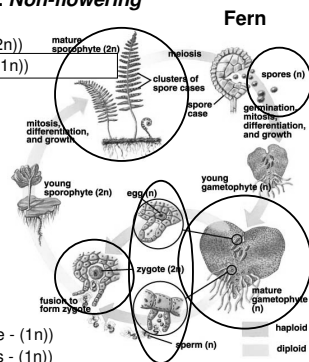mature gametophyte (n)

sperm (n)

haploid

diploid

Alternation of Generations: *Non-flowering*

Fern

1) Diploid adult (sporophyte - (2n))
   - • Produce spores (meiosis - (1n))

Spores germinate

2) Haploid adult (gametophyte - (1n))
   - • Produce gametes (mitosis - (1n))

Gametes Join (Zygote - 2n)

mature sporophyte (2n)

meiosis

spores (n)

clusters of spore cases

spore case

germination, mitosis, differentiation, and growth

mitosis, differentiation, and growth

young sporophyte (2n)

egg (n)

young gametophyte (n)

zygote (2n)

fusion to form zygote

mature gametophyte (n)

sperm (n)

haploid

diploid

(Figure 43.2)

Ferns: sporophyte & gametophyte
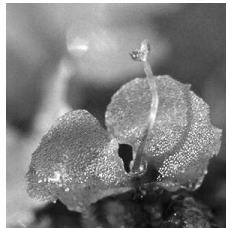
Sporophyte   Gametophyte
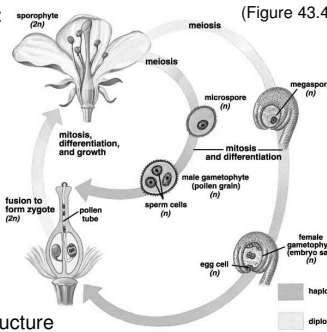

Alternation of Generations:
Flowering Plants

(Figure 43.4)

Gametophytes do not
live independently
of the sporophytes

Flower = Reproductive Structure

- Megaspore (1n) → Embryo sac (female gametophyte)
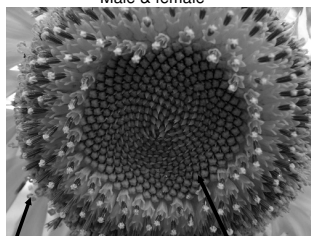- Microspore (1n) → Pollen grain (male gametophyte)
- Seed = Zygote (2n)

Angiosperms: sporophyte & gametophyte

Gametophytes:
Male & female

Sporophyte

Male pollen   Female ovules

Non-flowering vs. flowering plants

| Non-flowering	Flowering
Ferns, moss, horsetails	All angiosperms
Gametophyte lives independent of the sporophyte	Gametophyte are dependent on the sporophyte Pollen & ovules

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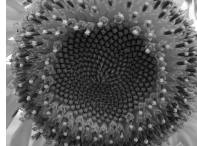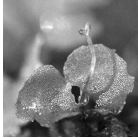
The Flower:

Flowers are modified leaves

- A sexual display that enhances reproductive success
  - ❖ Entices animals to carry pollen to distant plants
    - ➤ Efficient (unlike wind…)

- Evolutionary events:
  1) Nectar: attractant (sugary secretions)
  2) Advertisement = Flashy flowers
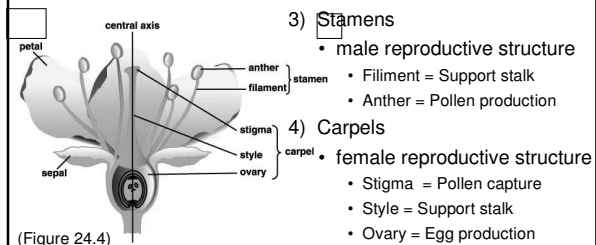- Pollinators = Insects (bees, flies), hummingbirds, mammals (bats)
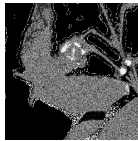
Parts of a <u>Complete</u> Flower:

Incomplete Flower: Lack 1 or more flower parts

1) Sepals
   - Base of flower; usually green
   - Protect flower bud during development
2) Petals
   - Advertise flower location (bright / fragrant)

central axis
petal
anther } stamen
filament
stigma ⎫
style ⎬ carpel
ovary ⎭
sepal

3) Stamens
   - male reproductive structure
     - Filiment = Support stalk
     - Anther = Pollen production
4) Carpels
   - female reproductive structure
     - Stigma = Pollen capture
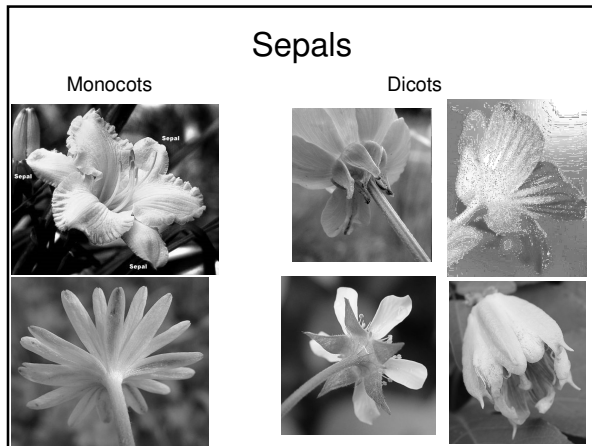   - Style = Support stalk
     - Ovary = Egg production

(Figure 24.4)

Sepals

Monocots

Dicots

Petals

Stamen

• Male reproductive parts

Stamen

carpels

- Female reproductive parts.

Carpels   Stamens

David Webb
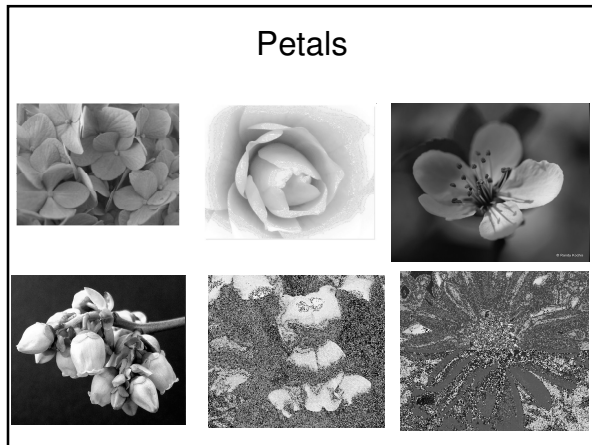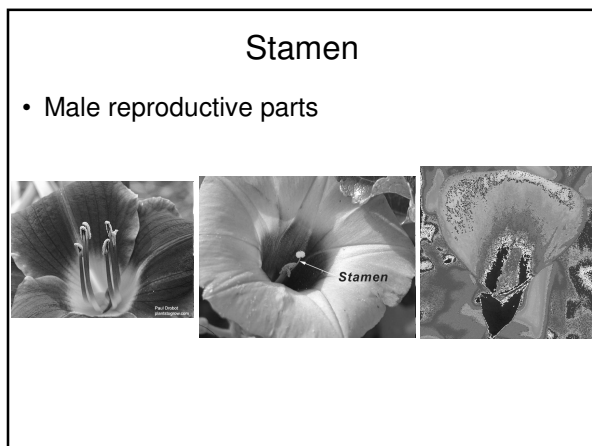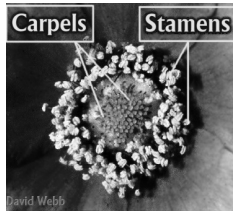
Zuccinis

Incomplete flowers : what is missing from each?

Pollen

Stigma

Photography Neil Bromhall

Male   Female

Complete or incomplete?

Gametophyte Development:

Pollen: (MMC)

1) Pollen sac contains microspore mother cells

2) MMCs (2n) produce microspores (1n)

3) Microspores (1n) form pollen grains:

- Tube cell
- Sperm cells (1n)
- Tough shell

haploid

diploid

anther · pollen sacs · (MMC) · microspore mother cell (2n) · mature pollen grain (n) · nucleus of tube cell · sperm cells · microspores (n) · generative cell · immature pollen grain (n) · nucleus of tube cell

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Gametophyte Development:

Embryo Sac:

1) Ovules form in ovary

2) Ovule contains
   A) Integuments (outer layers)
   B) Megaspore mother cell

3) MgMC (2n) produces megaspores (1n)

4) Megaspore divides to form embryo sac
   - egg (1n)
   - central cell (2n)

(MgMC)

ovule · megaspore mother cell (2n) · integuments · meiosis · polar nuclei within central cell · egg cell · megaspores (n) · Eight nuclei within cytoplasm of single cell · degenerating megaspores · haploid · diploid

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Pollination & Fertilization:

1) Pollen lands on stigma

2) Tube cell (pollen) elongates to ovule (ovary)
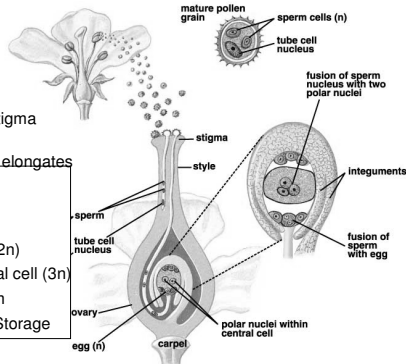
3) Sperm (via tube):
   A) fertilize egg (2n)
   B) fertilize central cell (3n)
      • Endosperm
         • Food Storage

Pollination = Pollen grain lands on stigma
Fertilization = Fusion of sperm and egg

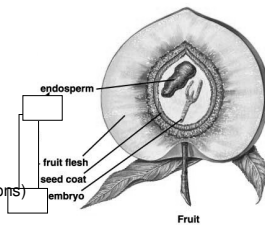(Figure 24.9)

Seed / Fruit Development:

1) Petals / stamen shrivel & fall away

2) Fruit enlarges:
   • Ovule integuments → seed coat
   • Endosperm absorbs nutrients from parent

3) Zygote develops into embryo (cotelydons)
   • Dicots: Completely absorb endosperm
   • Monocots: Partially absorb endosperm
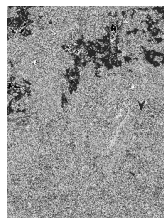   • Fruit body = Ovary wall
      • Aid in seed dispersal

Fruit or vegetable?

• Fruits are the maturing ovary of a plant.
   ❖ Many vegetables are also fruits!

Page 8

Germination:

Seeds stay dormant until germination signaled:
1) Drying: Seed must dry out
   • Seed doesn't germinate in fruit

2) Cold: Seed must be exposed to prolong cold period
   • Seed doesn't germinate in winter

3) Seed Coat Disruption: Seed must have coat broken
   • Seed doesn't germinate off periods (e.g. dry)

Germination Events:
1) Roots emerge (gather water / minerals)

2) Shoots push through to surface
   • Monocots: Coleoptile protects apical meristem

Monocot Germination:

Corn (monocot) — seed coat
endosperm — coleoptile
cotyledon — leaves — root
coleoptile — leaves
root tip — primary root
branch roots

(Figure 24.12a)

Germination:

Seeds stay dormant until germination signaled:
1) Drying: Seed must dry out
   • Seed doesn't germinate in fruit

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Germination Events:
1) Roots emerge (gather water / minerals)
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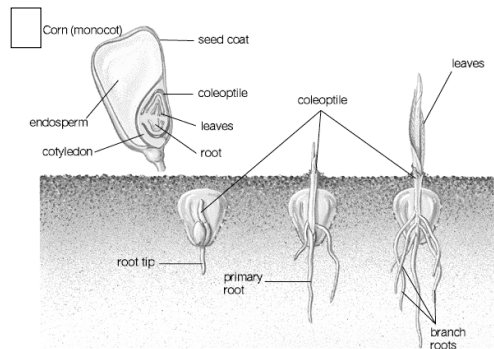   • Dicots: Stem bends into hook

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Dicot Germination:

Bean (dicot)
hypocotyl
root
leaves
seed coat
cotyledons
true leaves
cotyledons
hypocotyl
hypocotyl
epicotyl
withered cotyledon
seed coat
primary root
branch roots

(Figure 24.12b)

Germination:

Seeds stay dormant until germination signaled:
1) Drying: Seed must dry out
   • Seed doesn't germinate in fruit
2) Cold: Seed must be exposed to prolong cold period
   • Seed doesn't germinate in winter
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Germination Events:
1) Roots emerge (gather water / minerals)
2) Shoots push through to surface
   • Monocots: Coleoptile protects apical meristem
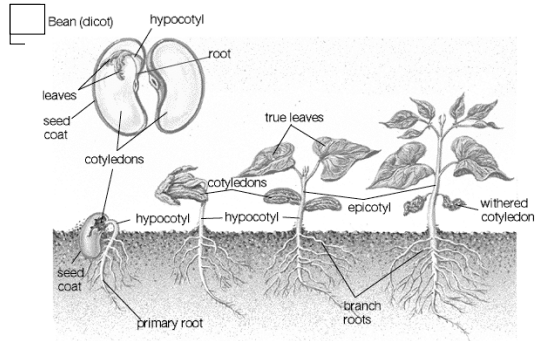   • Dicots: Stem bends into hook
3) Cotyledons nourish sprouting seed

Adaptations for Pollination:

Coevolution matches Plants and Pollinators:

Coevolution = One species acts as major force driving the evolution of another species
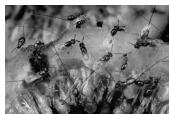
Flowers: Attract pollinators / detract unwanted visitors

Pollinators: Identify / locate useful flowers & extract nectar

Sometimes coevolution is so specialized that a single flower species will attract only one pollinator.

If one goes extinct, the other follows.

Especially true with orchids

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Types of Benefits:

1) Flowers Offer Food for Pollinators:

Nectar - Insects

Nectar - Birds

Nectar - Mammals

Pollinators locate flowers via:

Vision

(Ultraviolet)

Odor

_____

_____

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Types of Benefits:

2) Flowers Offer 'Sex':

Fly Orchid

'Confused' Wasp

The Birds and the Bees?

_____

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Types of Benefits:

3) Flowers Offer Nurseries:

Yucca

Yucca Moth

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Seed Dispersal:
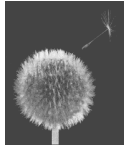- Important so young don't compete w/ adult
- Seed dispersal is function of fruit

Approaches for Seed Dispersal:
1) Shotgun Dispersal:
    - Seeds explosively ejected from fruit (e.g. mistletoe)
2) Wind Dispersal:
    - Lightweight fruits carried by wind

Dandelion

Maple Seeds

Approaches for Seed Dispersal:
3) Water Dispersal:
    - Seeds float on water
4) Animal Dispersal:
    - Cling to fur
    - Eaten and passed

Coconuts

Cocklebur

Bat