

## UNIT SEVEN: MITOSIS AND MEIOSIS; ASEXUAL AND SEXUAL REPRODUCTION

Upon completion of this unit you will be able to:

- 1. Explain the cell cycle and identify the significant features of the G<sub>1</sub>, S and G<sub>2</sub> phases**
- 2. Name the stages of mitosis and describe major events that distinguish each stage.**
- List cells that lose their mitotic ability and those that retain this capacity.
- Cite prominent differences between plant and animal cells during mitosis.
- 5. Describe the characteristics of a clone and explain how it is produced.**
- 6. Compare and contrast mitosis and meiosis.**
- Explain the importance of crossing-over during meiosis.
- 8. Explain why sexually reproducing organisms must form cells with a haploid number of chromosomes.**
- 9. Distinguish between sexual and asexual reproduction.**
- Cite examples of asexual reproduction displayed by living organisms.
- 11. List advantages and disadvantages of sexual and asexual reproduction.**
- 12. Define Nondisjunction and explain its relevance to chromosomal genetics.**
- 13. Identify the four flower parts, provide their functions and describe which are essential flower parts.**
- Differentiate between pollination and fertilization.
- List several mechanisms of pollination.
- Discuss alternation of generation and distinguish between sporophyte and gametophyte generations.
- 17. Define dioecious, monoecious and synoecious and give examples of plants following each strategy.**
- 18. Identify the plumule, radicle, and cotyledon in the seed embryo.**
- 19. Discuss the development of a fruit; describe the different classifications of fruit.**
- Differentiate between parthenogenesis and parthenocarpy.
- Describe hermaphroditic animals.
- 22. List examples of oviparous, viviparous and ovoviviparous animals.**
- 23. Discuss the efficiency issues facing animals using external and internal fertilization strategies.**
- Compare and contrast the embryo of a seed plant with that of an oviparous animal.
- 25. Provide the functions of the following: testes, testosterone, estrogen, follicle, corpus luteum, progesterone, pituitary gland uterus, FSH, LH, ovulation.**

Unit References: [Text Chapters 9, 22, 27](#)

<http://www.mhhe.com/enger13>

[An Online Biology Text Book](#)

**Unit 7: Mitosis/Meiosis; Sexual/Asexual Reproduction**  
Distribution of Genetic Info

**Biological Trivia: (Objective #3)**

-Average RBC lives ~120 days and there are about 25 trillion in an adult. To maintain, about 2.5 million new RBC's must be produced each second

-Nerve cells lose their capacity to replicate once they mature

-About 2 trillion cell divisions occur in an adult human every 24 hours, that's ~25 million/sec.

## **MITOSIS/MEIOSIS (Objective #6) pg 172-178 of text**

**Mitosis** - nuclear division, maintains chromosome number unchanged from parent

-occurs in somatic cells

-occurs in bacteria (binary fission) and single celled animals

-daughter cells have same genetic makeup as parent cells

-growth/ repair and maintenance

**Check Out :**

[The Cell Cycle and Mitosis Tutorial](#)

[Onion Root Tip Simulation](#)

[Interactive Mitosis Tutorial](#)

**Cell Cycle (Objective #1, 2) text pg 172-177**

**Interphase:**

G1- Gap phase one; cell grows, produces tRNA, mRNA, ribosomes, enzymes

S- synthesis; DNA replication, prep for cell division

G2- Gap phase two; synthesis of fibers needed to pull chromosomes apart

Text pgs. 174-177

**Mitosis:** division of nucleus/genetic material

**Prophase;** chromatin becomes condensed to chromosomes

**Metaphase;** chromosomes line up at equator

**Anaphase;** chromosomes split at centromere and move to poles

**Telophase;** new sets of chromosomes becomes enclosed by new nuclear membrane

**Cytokinesis-** division of cytoplasm, last action

\*gradual and continuous process

\*nerve and muscle cells come to rest in S phase

**End result:** two cells with identical genetic make up.

**Plant Vs. Animal (Objective #4) text pg 176**

\*Plant cells- cell plate forms between new cells

\*Animal cells - have centrioles, cleavage furrow forms between cells

**Meiosis** pg. 182-189- nuclear division, chromosome # reduced from diploid to haploid (Objective #8)

- sexually reproducing organisms, produces variability in chromosome sets
- crossing over produces greater variability
- homologous chromosomes pair.

**Meiosis-** (pgs 182-189 ) 2 divisions rather than one as in mitosis (prophase I . . prophase II . .

Homologous chromosomes synapse creating a tetrad (4)

First division is “reductional” (Meiosis I)

Second division is “equational” (Meiosis II)

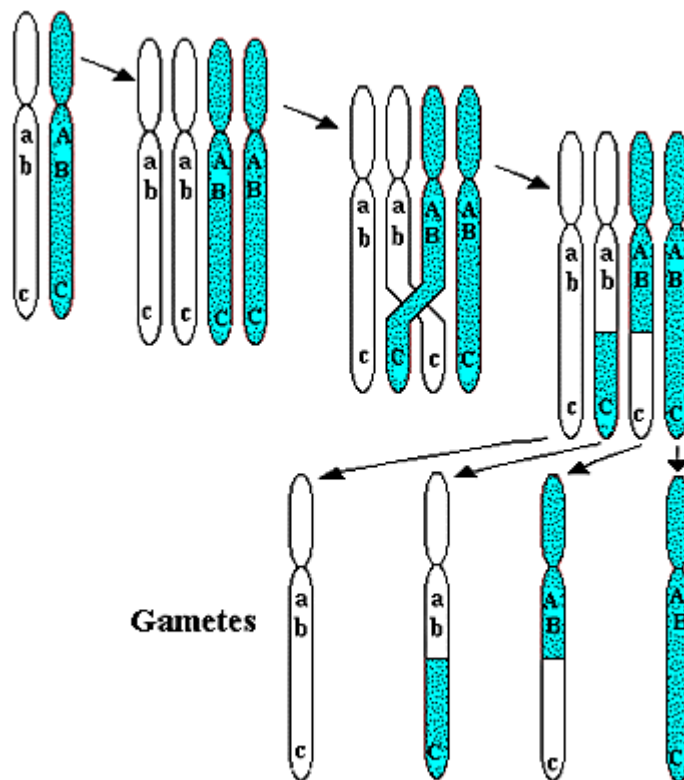
**End Result:** four gametes (sex cells) with haploid content

**Check Out :**

[How Cells Divide: Mitosis vs. Meiosis](#)

[Biology Project Meiosis Tutorial](#)

**CROSSING OVER** (Objective #7) text pg 190-191 events in Meiosis increase genetic variability (allows page by page variability)



**Crossing-over and recombination during meiosis**

**Check Out : [Crossing Over of Chromosomes in Meiosis](#)**

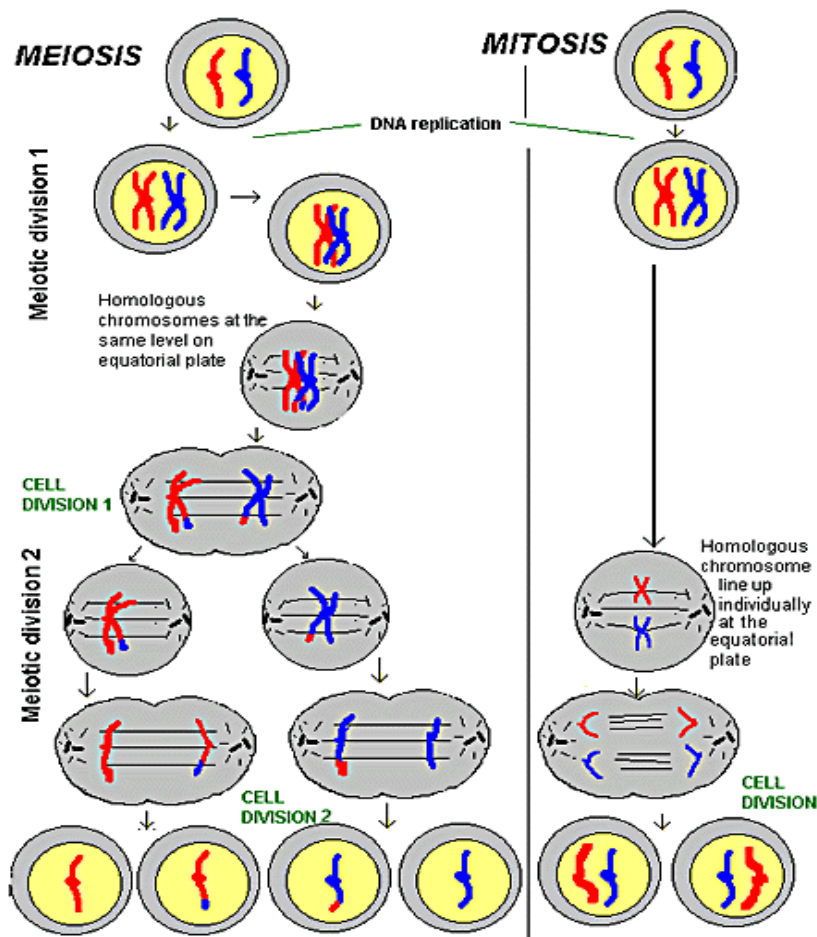
**Problems with Meiosis: Nondisjunction (objective 12) , text pg 193-194**

Downs Syndrome- autosomal nondisjunction  
 Klinefelters, Turners- sex chromosome nondisjunction

Nondisjunction in autosomes rarely tolerated

**Mitosis Vs. Meiosis**

Nuclear Division	Nuclear division
Asexual (produces somatic cells)	Sexual (produces sex cells)
Maintains Chromosome number	Reduces Chromosome Number
One donor	Two donors
Clones	Variability



## SEXUAL AND ASEXUAL REPRODUCTION text pgs 172 (Objective #9, 10)

**Asexual reproduction** - \*\*main reproductive event is **mitosis**, one parent (single donor of genetic information), end result is two genetically identical offspring cells (daughter cells)

1. **Fission**- bacteria, single celled animals, yeast, algae
  - nuclear material replicates and then organism divides
  - 2 identical daughter cells produced
2. **Budding**- small projection of cellular material contains DNA, grows from cell (or organism): yeast, hydra
  - as bud grows wall develops between bud and parent, separation occurs, new individual arrives
3. **Fragmentation/regeneration**
  - new organisms formed from pieces; anemonies, sponges
  - starfish can split central disc; Crown of Thorns (at least 1/5 central disc)
4. **Sporulation**- fungi, (some plants), protozoans, bacteria
  - spore- reproductive cell (mitosis), protective coat, widely dispersed. Contains nuclear material
  - mildew, plant rusts, smuts, difficult to destroy
5. **Vegetative**- plants (best known)
  - production of new organisms or portion from part of a living organism.
  - plant cuttings, potatoes, strawberries (runners, stolons), grafts (trees)

### **ADVANTAGES OF ASEXUAL REPRODUCTION** (Objective 11)

- simple process, one parent involved, no waste of energy to find mate
- large numbers can be produced
- spores can be widely dispersed, increases chance of survival

### **DISADVANTAGES OF ASEXUAL REPRODUCTION**

- produces clones. In an environment that changes there is no variability to deal w/changes

### **Check Out:**

#### Asexual Reproducers

#### Breakthroughs in Bioscience- Cloning

**Sexual Reproduction** pg 172 (Objective #9) - requires haploid gametes (eggs and sperm) that unite to produce a zygote

- main reproductive event is **meiosis** (gamete production)

## **ADVANTAGES** (Objective #11)

- introduction of variability to zygote from two parents. Allows greater diversity and adaptability
- care of young

## **DISADVANTAGES**

- 2 kinds of gametes required
- gametes must be brought together, usually deals with large #s of gametes under relatively "iffy" conditions
- Ex. Human egg production vs. Fish egg production; Human infertility

**Check Out :** [Why Sex?](#)

## **Plant Reproduction (Higher plants- flowering plants) (Objective #13) text pg 183, Chapter 22**

### **Flower Parts** (sexual part of the plant) pg 498

- Pistil** (female part of flower) \*essential flower part  
Stigma (pollen receptor)

Style (tube from stigma to ovary)

Ovary (haploid spores or eggs)

- Stamen** (male part of flower) \*essential flower part  
Anther (haploid pollen spores)

Filament (stalk on which anther resides)

Mature pollen contain 2 nuclei:

-generative nucleus ---> sperm

-tube nucleus ---> directs growth of pollen tube

- Petals**- (\*non essential flower part) protect inner reproductive organs and attract insects

- Sepals**- (\*non essential flower part) protects flowers when they are in bud stage

### (Objective #17)

***When dealing with stamens and pistils (and how best to get pollen together with ovum) there are three strategies:***

**Monoecious** plants- both male and female flower on same plant  
Corn: male tassels (stamens only), female silks (pistil only)

**Dioecious** plants- separate sexes, therefore, separate plants  
Cottonwood, honey locus, (humans)

**Synoecious** plants- male and female parts in same flower  
Most "showy" flowers

(Objective #14, 15)

\*\*Pollination Pg 498- transfer of pollen from male to female  
Various strategies: ~65% of all flowering plants are insect pollinated

-grasses, wind; ferns, mosses, water; animal carriers

\*\*Fertilization- union of egg and sperm

**ALTERNATION OF GENERATIONS** (Objective #16) text pg 450, 484-485

\*microspore (male, produced by mitosis) grow into male gametophyte or stage of life cycle that produces pollen/sperm (meiosis)

\*megaspore (female, produced by mitosis) grow into female gametophyte or stage of life cycle that produces egg/ovum (meiosis)

Alternation between: \*\*Asexual and Sexual stages

\*\*A haploid and a diploid

\*\*A spore producer (sporophyte) and a gamete producer (gametophyte)

1. Mature male gametophyte ---> produces pollen grain (1N) (releases sperm)  
Female gametophyte retained in flower and produces ovum (1N)

2. Fertilization results in an embryo (2N zygote) that is eventually enclosed as a seed and covered by a fruit

-fertilization double --> generative nucleus (pollen) + egg (ovum) = embryo (2N)

--> tube nucleus + polar cells = endosperm

Endosperm- nutrient material for seed; Polar cells (2 of seven nuclei in embryo sac, other 5 absorbed)

**Seed** (Objective #18) text pg 500- structure formed by the maturation of the ovule after fertilization

**Contains:** 1. sporophyte embryo  
2. stored food (endosperm)

\*\*Fruit is a mature ovary that surrounds and protects seed, aids in dispersal

Seed Coat- protective

Cotyledon- food storage

Radicle- root origin

Plumule- shoot

Bean Seed (dicot)

**Fruits** (Objective #19) text pg 499-500- ovary wall thickens and becomes pericarp

\***Simple fruits**- single pistil w/ one to many ovum

Fleshy pericarp

Simple ovary, one seed (drupe)- peach, plum, cherry

Compound ovary, w/many seeds (berry)- orange, tomato, grape

Compound ovary, w/many seeds seperated into wedges (hisperidium)- orange

Compound ovary, flesh from recepticle (pome)- apple, pear

Dry pericarp

often simple ovary that splits in various ways; milkweed, beans, peas, sunflower, grains

\***Compound fruits**- develop from groups of individual ovaries

-aggregate fruits- ovaries from single flower (blackberries, strawberries, raspberries)

-multiple fruit- ovaries from separate flowers clustered together (pineapple)

**Animal Reproduction pg 183, 615-638 (chapter 27)**

Male- spermatogenesis (testes, sperm) testosterone

Female- oogenesis (ovary, egg) estrogen

**Various Strategies**- some involve great expenditures of energy just to find a mate!

1. **Hermaphroditism** (Objective #21) - organism contains both male and female parts

self-fertilization (rare)- Hydra

Cross-fertilization- must find mate despite having both sexes (earthworms)

2. **Parthenogenesis** (Objective #20)- unfertilized eggs develop into adults

Bees- haploid males (chromosome # determines sex)

Aphids-

Parthenocarpy (plants)- fruit development without fertilization

(Objectives #22, 23)

3. **External Fertilization**- eggs deposited, sperm shed over eggs. Least efficient Numbers game. Little control over fate of eggs

**Oviparous**- "egg producing"- eggs released, fertilization and development external

4. **Internal Fertilization**- sperm deposited inside receptor of female

**Ovoviviparous**- "live egg producing"

eggs fertilized and develop within female, nourishment in egg, hatch within parent or immediately after laying. (pit vipers, guppies, birds)

**Viviparous**- "alive producing"- eggs develop within female body, nutritional aid from mother (placentals).

(Objective #25) text pg 622-629

### **Hormonal Control of Human Reproduction**

Female: Anterior lobe of pituitary gland ---> **FSH** (Follicle Stimulating Hormone).

One follicle per menstrual cycle. Follicle contains egg.

#### **Follicle produces estrogen**

effects hypothalamus and pituitary so that FSH production slows and **LH** (Leutinizing Hormone) released by pituitary

**LH** causes follicle to mature and rupture (ovulation)

**Corpus Luteum** (ruptured follicle) makes progesterone, helps prepare uterus for pregnancy

If fertilization  
9 months ---> baby

No fertilization  
progesterone drops, menstrual flow, repeat cycle

#### **Feedback Inhibitors pg. 630-632**

"pill"- estrogen, inhibits FSH release, therefore, follicle never stimulated to form

progesterone, reduces amount of LH, therefore, prevents ovulation

### **OBJECTIVE #24**

	<b>Oviparous embryo</b>	<b>Seed embryo</b>
production	large #s	large #s depending on species
protection	little if any	seed coat
development begins upon fertilization		begins at fertilization but experiences a dormant period prior to germination
c	continues through birth	
dispersal	little, usually stay in one spot to develop	winds and animals contribute to wide dispersal of seeds away from

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