

Biology 10 - Introduction to Biology

West Valley College - Norris

Cell Reproduction: Mitosis / Meiosis

I. Definitions

A. Cell Division

1. Nuclear Division

- a. mitosis
- b. meiosis

2. Cytoplasmic Division (Cytokinesis)

B. Chromosome

II. Reproduction and Growth - the roll of cell division

A. Asexual Reproduction / Growth

- type of cell division = mitosis
- chromosome number and composition does not change
 - diploid ($2n$)
 - haploid ($1n$)

B. Sexual Reproduction

- type of division = meiosis (at some point)
- chromosome number cut in half ($2n \rightarrow 1n$)

III. Review of Eukaryotic Cell Structure

1. Plasma Membrane
2. Cytoplasm
3. Nucleus

IV. Composition of the Nucleus

A. Chromosome Structure (= genetic information, made of one DNA molecule and protein)

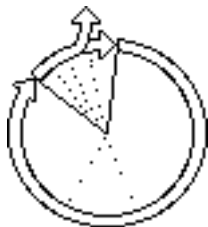
1. Function - contains instructions for synthesis of protein
2. Genes

B. Changes in the Chromosomes in Preparation for Division: Replication and Condensation

1. Replication (duplication of DNA)
2. Condensation (coiling of chromosome)

V. Mitotic Cell Divisions

A. Cell Life Cycle



B. Stages of Mitosis (PMAT)

1. Four Continuous Stages

a. Prophase

b. Metaphase

c. Anaphase

d. Telophase

C. Cytoplasmic Division (Cytokinesis)

IV. Meiotic Cell Divisions

A. Cell Life Cycle (Germ Cell)

B. Stages of Meiosis

1. Meiosis I (reduction Division)

a. Prophase I

b. Metaphase I

c. Anaphase I

d. Telophase I

e. *Cytokinesis*

2. Meiosis II (similar to mitosis)

a. Prophase II

b. Metaphase II

c. Anaphase II

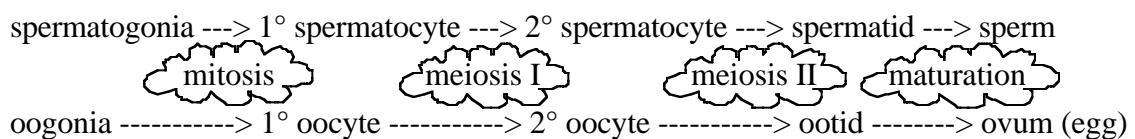
d. Telophase II

e. *Cytokinesis*

C. Cells of Sexual Reproduction

1. Plants

2. Animals - Spermatogenesis & Oogenesis



3. Fertilization

VII. Additional Selected Key Terms

centromere	chromatid	chromatin	condensation	diploid	gamete	gene	haploid
homologous	chromosome	interphase	replication	sister chromatid			somatic
cell spindle apparatus		zygote					

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Terminology: Cell Reproduction

I. DEFINITIONS

centriole - cylindrical structure made of microtubules (2 centrioles make up a centrosome)

centromere - point of attachment between two sister chromatids (also the point of attachment of the spindle fibers during chromosome separation)

centrosome - cytoplasmic organelle that produces the spindle fibers that pull the chromosomes apart during nuclear division

chromatid - one of the two duplicate strands of DNA (and its associated proteins) found in a replicated chromosome (dyad)

chromosome - the genetic material within the nucleus that is composed of DNA wrapped around proteins (histones). In human cells there are 23 pairs of chromosomes (46 total).

crossing over - process that occurs during prophase I of meiosis. Portions of the sister chromatids from homologous chromosomes overlap and may exchange portions of their DNA by breaking and resealing at the point of overlap. This process is significant in that it increases the genetic variability in the gametes produced.

daughter cell - general name given to the cells produced by cell division

diploid - a cell that contains matched pairs of chromosomes (this is the "normal" state for all somatic cells)

dyad - term used to describe replicated chromosomes (chromosomes with two chromatids)

fertilization - process resulting in the combination of two haploid gametes (sex cells)

gamete - haploid cells produced by meiosis (the sex cells - sperm and eggs)

gene - discrete portion of a chromosome (specifically the DNA) that contains the instructions for synthesis of one protein

haploid - a cell that contains unpaired chromosomes (half the "normal" number, only occurs in gametes)

homologous chromosomes - matched paired chromosomes, one half of each pair came from one parent and the other matching half from the other parent)

monad - term used to describe unreplicated chromosomes (composed of only one strand of DNA)

parent cell - name given to the "cell" that divides producing daughter cells

replication - process of DNA duplication (forming two identical DNA stands) that occurs during interphase (S phase)

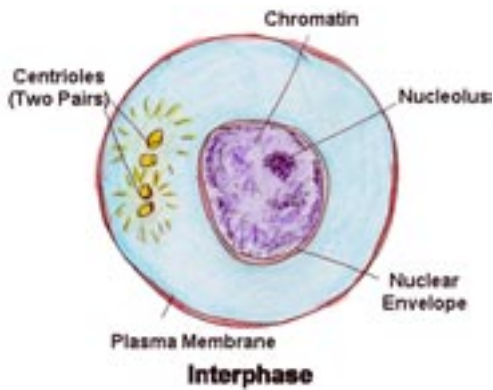
sister chromatids - the two exact copies of each chromosome produced during replication that are fused together at the centromere (forming a replicated or dyad chromosome)

somatic - Greek term meaning "body", used here to distinguish between body cells and germ cells (gametes and the cells that will develop into gametes)

synapsis - the pairing up and coming together of homologous chromosomes during prophase I of meiosis

zygote - the diploid cell produced from the fusion of two haploid gametes during fertilization.

II. INTERPHASE CELL



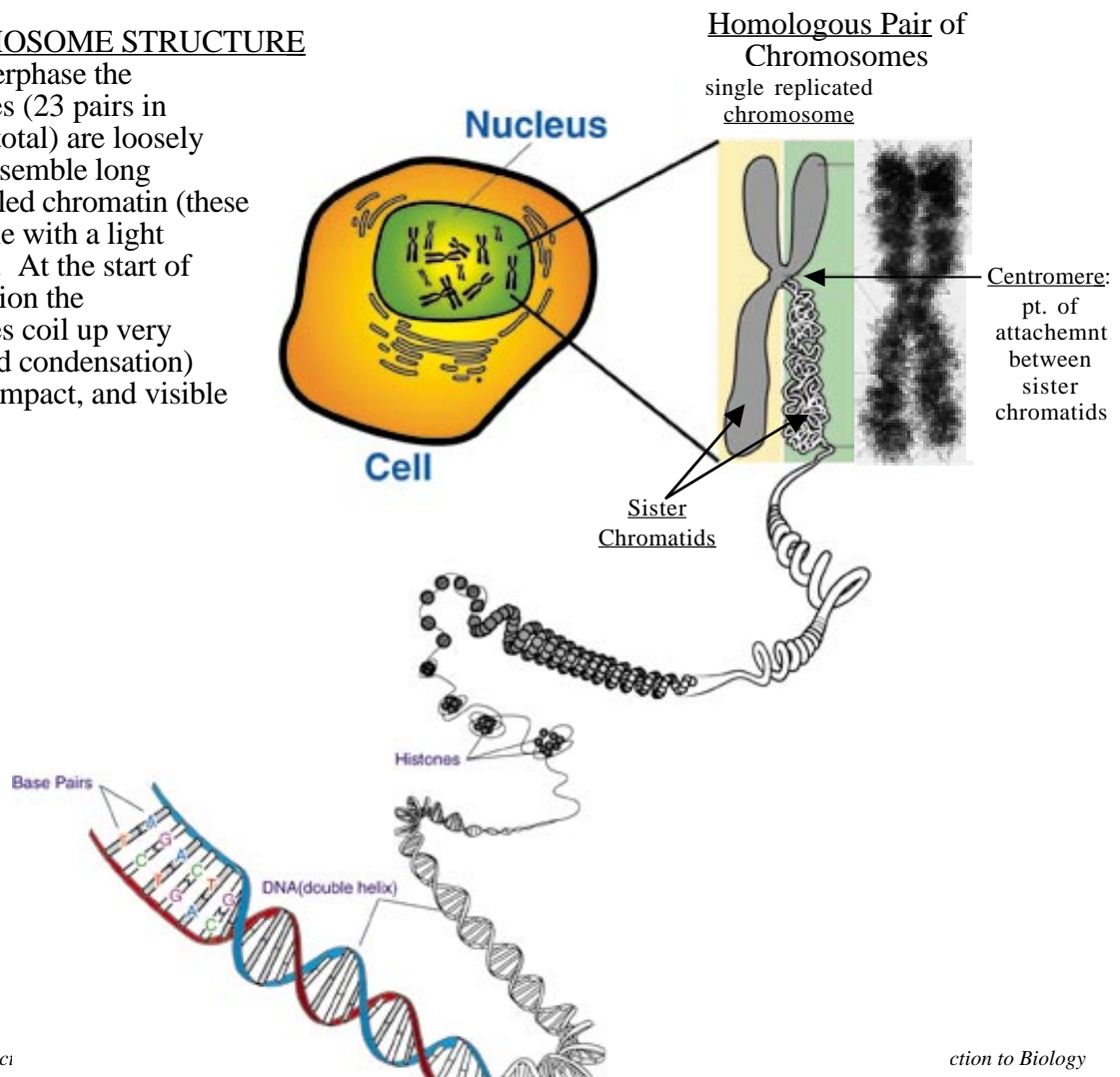
- A. Plasma Membrane
- B. Cytoplasm
 - Centrosome - organelle that forms the spindle fibers responsible for moving the chromosomes during nuclear division
- C. Nucleus
 - nuclear envelope (with nuclear pores)
 - nucleoplasm - contains chromatin (loosely coiled chromosomes)
 - nucleolus - darker portion of the nucleoplasm where ribosomes are being synthesized

III. CELL DIVISION

- A. Nuclear Division - equal division of the parent cells chromosomes between the daughter cells
 1. **Mitosis** - division of sister chromatids resulting in two genetically identical daughter cells, the number and composition of the chromosomes is unchanged (this type of nuclear division occurs in somatic cells resulting in growth)
 2. **Meiosis** - two consecutive nuclear divisions resulting in separation of homologous pairs (meiosis I) and separation of sister chromatids (meiosis II), the end result is four unique haploid daughter cells (this type of division only occurs in germ cells in the testis or ovaries producing gametes)
- B. Cytoplasmic Division or "**cytokinesis**" - constriction of the plasma membrane around the cell equator resulting in splitting of the cytoplasm into two daughter cells

IV. CHROMOSOME STRUCTURE

During interphase the chromosomes (23 pairs in humans, 46 total) are loosely coiled and resemble long filaments called chromatin (these are not visible with a light microscope). At the start of nuclear division the chromosomes coil up very tightly (called condensation) forming a compact, and visible structure.



Study Questions – Cell Reproduction: Mitosis & Meiosis:

1. What are the two general processes that must occur to complete cell division?
2. Describe the general outcome of nuclear division. What is the significance of nuclear division?
3. Identify and differentiate between the two types of nuclear division.
4. Define “cytokinesis”.
5. Diagram and describe the general structure of a chromosome. Describe, define and illustrate all of the following: homologous pair, unreplicated chromosome, replicated chromosome, centromere, sister chromatid.
6. What is the relationship between chromatin, DNA and chromosomes?
7. Define “diploid” and “haploid”.
8. What type of cell division is associated with growth and asexual reproduction? Why?
9. What type of cell division is associated with sexual reproduction? Why?
10. What is the relationship between DNA and genes? How does this relate to the chromosome?
11. Define “replication” and “condensation”.
12. Diagram the cell life cycle. Indicate all of the phases (interphase, G1, G2, S, PMAT, cytokinesis), and briefly describe what is occurring during each phase.
13. When does “replication” occur? When does “condensation” occur?
14. Illustrate and/or describe the condition of the chromosomes at each stage of the cell life cycle.
15. Illustrate all of the stages of mitosis including cytokinesis. What is occurring during each stage? What do the cell and the chromosomes look like at each stage? What is significant about each stage?
16. Describe the cells after completion of mitosis and cytokinesis.
17. Illustrate all of the stages of meiosis including cytokinesis. What is occurring during each stage? What do the cell and the chromosomes look like at each stage? What is significant about each stage? How do the stages compare to what occurs during mitosis?
18. Describe the cells after completion of meiosis and cytokinesis.

“Nature does nothing uselessly.”
Aristotle