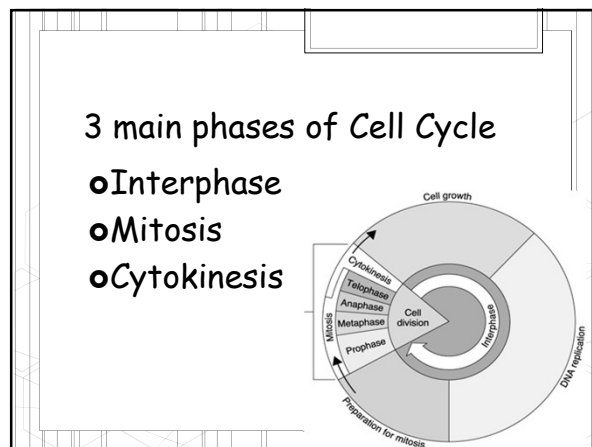
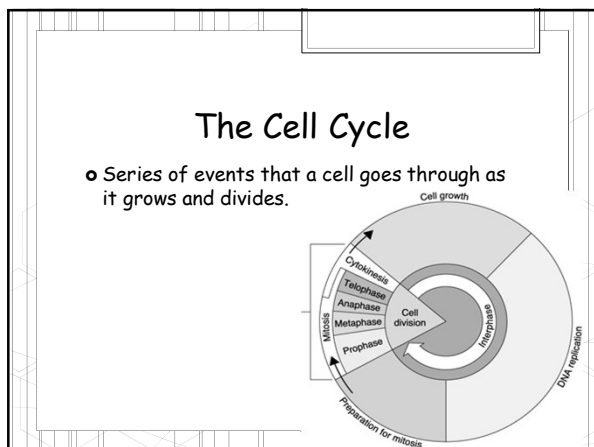


Why must cells divide?

- So an organism can grow
- So an organism can heal itself
- So an organism can maintain cell structure
 - If too small, they cannot contain necessary organelles.
 - If too large they cannot take in enough materials (oxygen, nutrients) or get rid of waste adequately. Large cells do not have adequate surface area for exchange of materials.



INTERPHASE

- "in-between" period of cell growth
- Longest phase
- Includes G_1 , S , and G_2 phases
 - G_1 - cell is growing
 - S - DNA is replicating (copying itself)
 - G_2 - cell is growing & organelles are doubling; cell is ready to divide

INTERPHASE

Chromosomes are not visible.

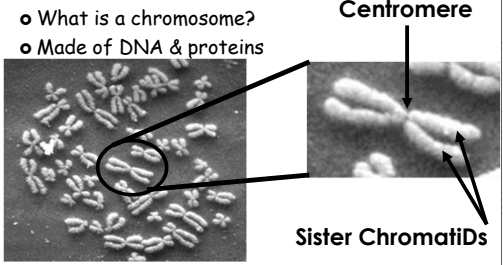
DNA is in the form of chromatiN.

MITOSIS (M-phase)

- Division of the nucleus
- One cell divides and forms 2 genetically IDENTICAL daughter cells
- Each cell must have the same DNA in it.
- 4 phases:
 - Prophase
 - Metaphase
 - Anaphase
 - Telophase

PROPHASE

- Chromosomes become visible
- What is a chromosome?
- Made of DNA & proteins




The image shows a micrograph of several chromosomes. A callout box provides a magnified view of a single chromosome. In this magnified view, the central point where two sister chromatids meet is labeled 'Centromere'. The two identical copies of DNA joined together are labeled 'Sister Chromatids'.

PROPHASE

- Chromatin coils, shortens, and forms a chromatid.
- Two chromatids join at the centromere and form a chromosome. Chromosomes are now visible.
- Paired centrioles separate & move to poles of the cell.
- Spindle fibers form.
- Nucleus and nucleolus disappear.

PROPHASE

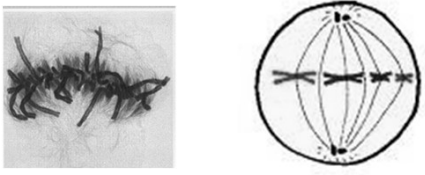


The image consists of two parts. On the left is a micrograph showing a cell in prophase with condensed chromosomes and a visible nuclear envelope. On the right is a schematic diagram of a cell in prophase, showing the nucleus with condensed chromosomes and spindle fibers beginning to form between the poles.

METAPHASE

- Spindle fibers move chromosomes to the middle (or equator) of the cell
- Centrioles are at opposite ends of the cell.

METAPHASE

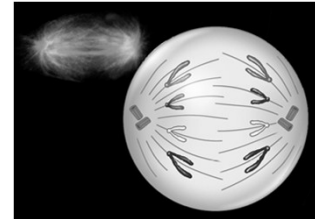


The image consists of two parts. On the left is a micrograph showing chromosomes aligned at the equator of a cell. On the right is a schematic diagram of a cell in metaphase, showing chromosomes aligned at the equator and spindle fibers extending from the poles to the centromeres.

ANAPHASE

- Spindle fibers shorten and pull chromosomes apart to the poles of the cell.

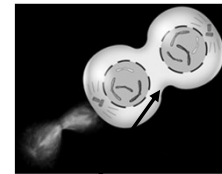
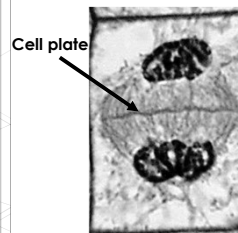
ANAPHASE



TELOPHASE

- Opposite of prophase
- Nucleus reappears around the chromosomes.
- Nucleolus reappears.
- Chromosomes uncoil and become chromatin once again.

TELOPHASE



Cleavage furrow

CYTOKINESIS

- Division of cytoplasm
- ANIMAL CELLS....the cell membrane pinches in and forms a cleavage furrow.
- PLANT CELLS....a cell plate forms in the middle of the cell. This will eventually become the cell wall.

CYTOKINESIS



RESULT OF CELL CYCLE?

- Two daughter cells that are genetically identical to the parent cell (but smaller)
- Same number of chromosomes as the parent cell
- Daughter cells are now in G₁ phase of Interphase and they begin the cycle again.

What happens if cell division is out of control?

CANCER

Cancer cells do not respond to the signals that regulate cell division

- Cancer cells form disorganized clumps called tumors.
- Benign tumors remain clustered in one location and can be removed.
- Malignant tumors metastasize, or break away/spread, and can form more tumors.
- Carcinogens are substances known to promote cancer.

Asexual vs. Sexual Reproduction

Asexual Reproduction

- Involves only 1 parent cell
- Similar to mitosis in unicellular organisms (bacteria)
- Advantage?
 - Faster reproduction rates increase chances of survival
 - Independent of another cell/organism

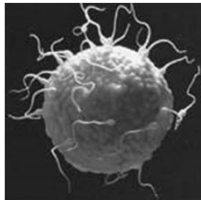

Asexual Reproduction

- Asexual reproduction is the creation of offspring from a single parent. Several types: binary fission, budding, etc.
- Binary fission is similar in function to mitosis.
 - Binary fission produces two daughter cells genetically identical to the parent cell.
 - Binary fission occurs in prokaryotes (bacteria)

Sexual Reproduction

- Requires 2 parent cells (sex cells...aka **gametes**)
- Sperm & egg unite during:
 - Fertilization
- This forms a **zygote**.
- Advantage of sexual reproduction?
 - Greater genetic diversity
 - Increased chance of survival to changing environments of organisms

Sexual Reproduction

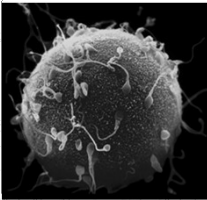
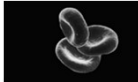
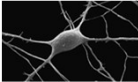
Eggs/Sperm = Sex cells = Gametes

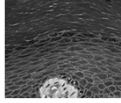
KEY CONCEPT
During meiosis, sex cells are produced.



Important Vocabulary:

Gametes - sex cells (egg & sperm) **Somatic Cells** - body cells (not sex cells)

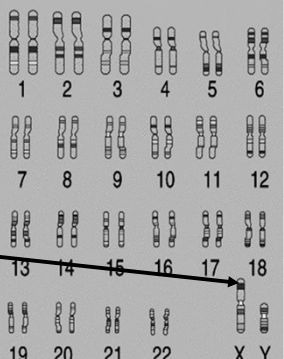






Important Vocabulary:

Autosomes
chromosomes that do *not* contain genes related to gender

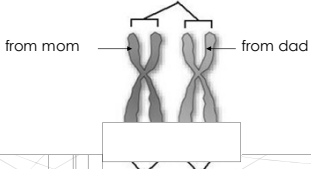
Sex Chromosomes
chromosomes that *do* contain genes related to gender (X or Y)

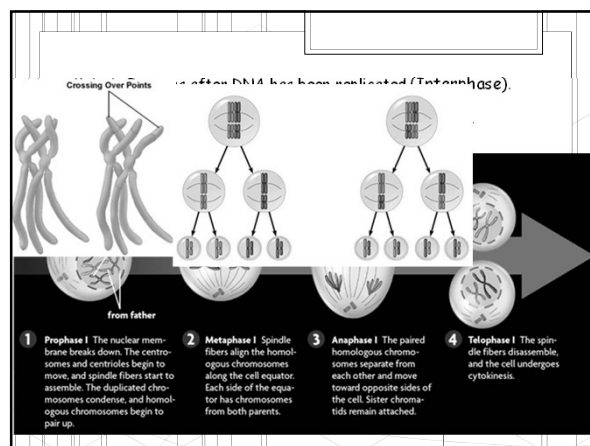
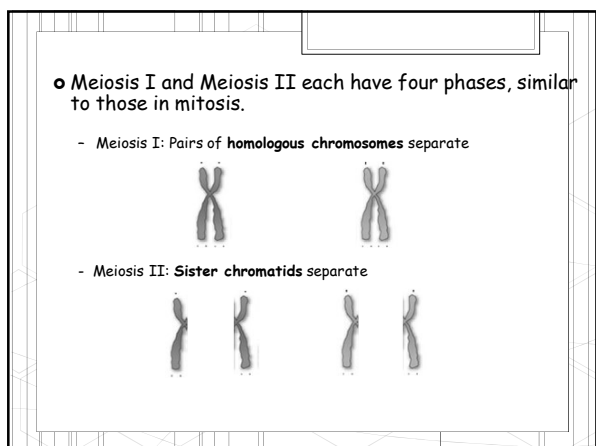
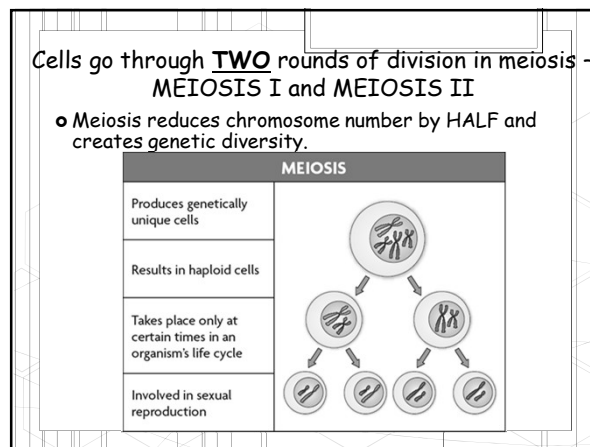
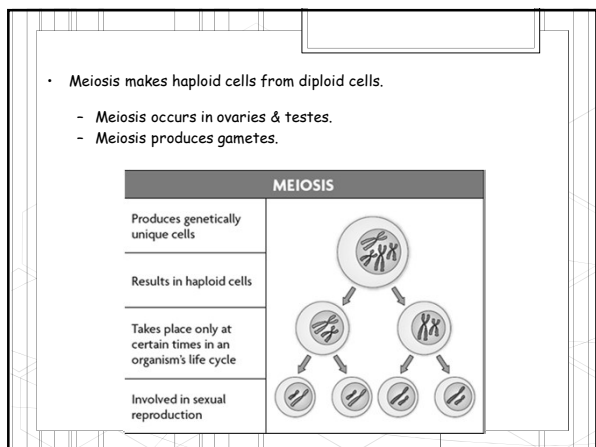
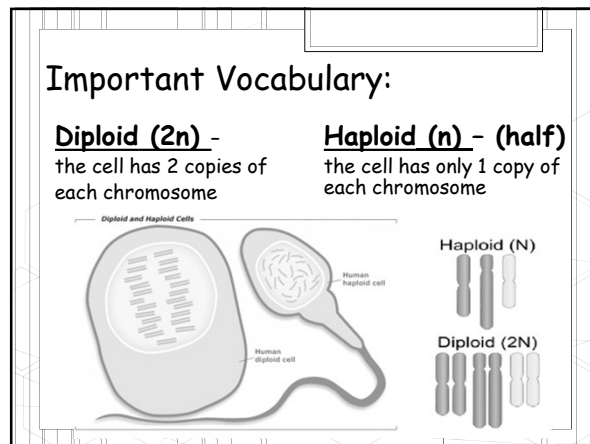
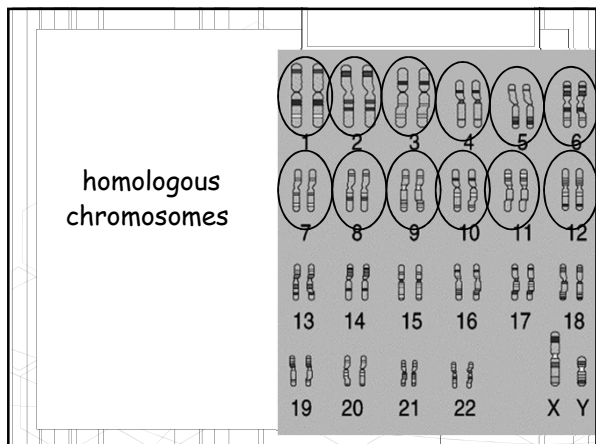


Important Vocabulary:

Homologous Chromosomes - two chromosomes that contain the same types of genes; one comes from mother, one comes from father

homologous chromosomes





- Meiosis II divides sister chromatids in four phases.
(DNA is not replicated again between meiosis I and meiosis II.)

Meiosis II divides sister chromatids. The overall process produces haploid cells.

5 Prophase II The centrosomes and centrioles move to opposite sides of the cell, and spindle fibers start to assemble.

6 Metaphase II Spindle fibers align the chromosomes along the cell equator.

7 Anaphase II The sister chromatids are pulled apart from each other and move to opposite sides of the cell.

8 Telophase II The nuclear membranes form again around the chromosomes, the spindle fibers break apart, and the cell undergoes cytokinesis.

- Meiosis differs from mitosis in significant ways.
 - Meiosis has two cell divisions while mitosis has one.
 - In mitosis, homologous chromosomes never pair up.
 - Meiosis results in haploid cells; mitosis results in diploid cells.

| MITOSIS | MEIOSIS |
|---|---|
| Produces genetically identical cells | Produces genetically unique cells |
| Results in diploid cells | Results in haploid cells |
| Takes place throughout an organism's lifetime | Takes place only at certain times in an organism's life cycle |
| Involved in asexual reproduction | Involved in sexual reproduction |

Haploid cells develop into mature gametes.

- Gametogenesis is the production of gametes.
- Gametogenesis differs between females and males.
 - Sperm become streamlined and motile.
 - Sperm primarily contribute DNA to an embryo.
 - Eggs contribute DNA, cytoplasm, and organelles to an embryo.
 - During meiosis, ONE egg gets most of the contents; the other 3 cells form polar bodies and become waste.

spermatogenesis

oogenesis

Genetic Variation

- Important to increase an organism's chances of survival
- Some unfavorable traits from parents may not be passed on to offspring, while favorable ones are
- Sources of genetic variation:
 - Crossing over (during Prophase I)
 - Independent Assortment (during Metaphase I)
 - Fertilization (random)