



Genetics: Cell Reproduction

Mitosis and Meiosis



Outline

1. Key concepts
2. Eukaryotes
3. Overview
4. Cell cycle
5. **Mitosis**
6. **Meiosis**
7. **Conclusions**



Key Concepts:

1. The cell cycle includes Interphase and Mitosis
2. Each DNA molecule, with its attached proteins, is a chromosome
3. Members of the same species have the same number of chromosomes in their cells
4. Mitotic cell division is the basis of growth and tissue repair in multicelled eukaryotes
5. Meiosis results in gamete production and divides the chromosome number in half



Eukaryotes

linear chromosomes (in pairs)
homologues = chromosomes have the same type of genetic information
gene – function unit codes some trait.



Overview of Cell Divisions

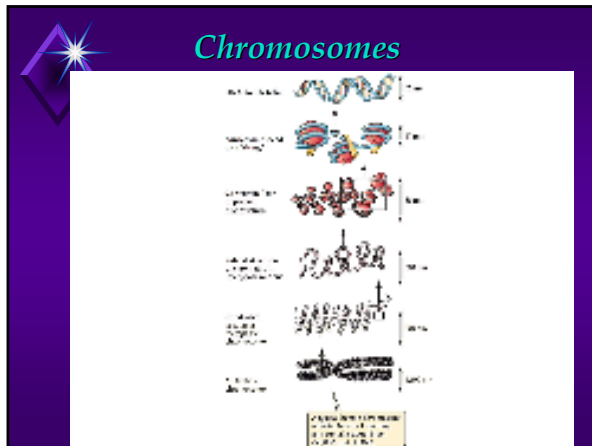
1. **Mitosis**
 1. Somatic cells (body cells)
 2. Growth and repair
 3. One cell to two cells
2. **Meiosis**
 1. Reproductive organs only
 2. Form Gametes
 3. One cell to four cells

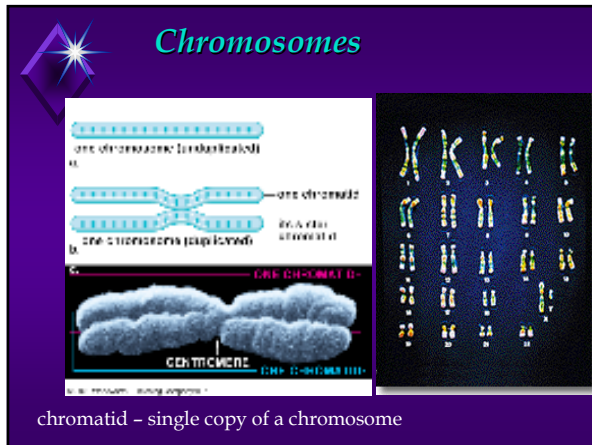


Chromosome Number

1. **Chromosome number: sum total of chromosomes in somatic cells**
2. **Chromosomes are in pairs**

Humans 23 pairs
we can identify them and arrange them from large to small (except the 23rd pair)
2n "diploid"
1n "haploid" (germ cells)





The Cell Cycle

1. A diploid cell produces 2 diploid daughter cells
2. Two phases in cell cycle
 1. **Interphase**
 Longest phase
 Increase in mass, doubles components, and duplicates DNA
 2. **Mitosis**
 Nuclear division

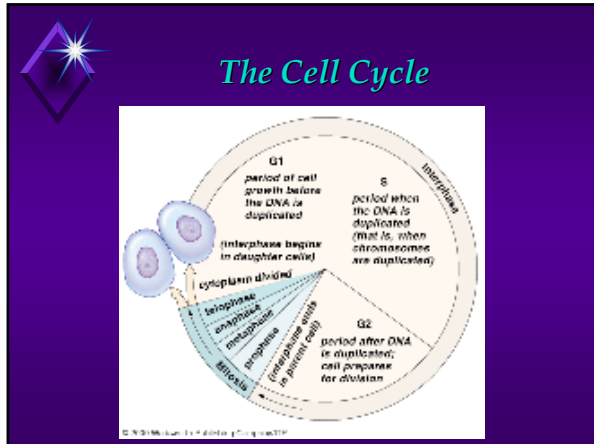
Interphase

G1 - "Gap" - cell growth before DNA replication

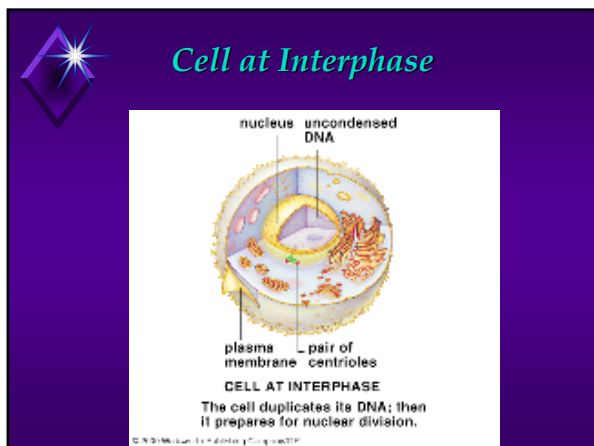
S - "Synthesis" - DNA replication

G2 - "Second Gap" - preparation for division

M - Mitosis

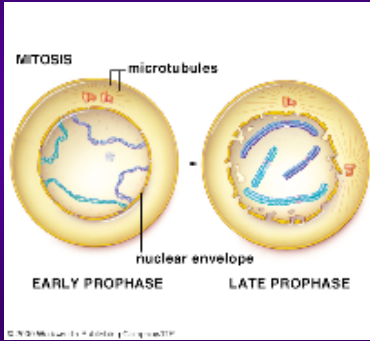


- ## Mitosis
- Four stages**
1. **Prophase** - chromosomes condense (Chromosomes are visible) , spindle apparatus forms, nuclear envelope breaks down
 2. **Metaphase** - chromosomes line up at equator of cell
 3. **Anaphase** - sister chromatids separate
 4. **Telophase** - new nuclear envelopes form, chromosomes decondense
- Cytokinesis**
Cytoplasmic division



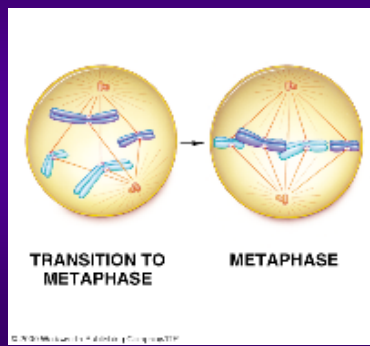


Prophase



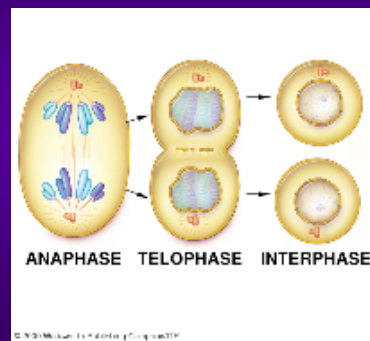


Metaphase





Anaphase to Interphase





The process of meiosis

DNA replication occurs in interphase prior to meiosis

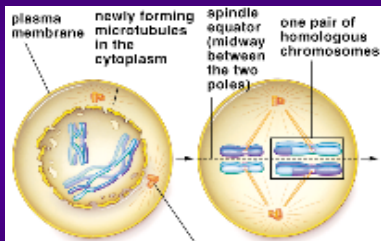
Meiosis I:

1. **Prophase** - chromosomes condense, homologous chromosomes pair
 - a) **Crossing-over** occurs between homologues
 - b) Spindle forms
1. **Metaphase** - chromosomes line up at equator of cell
2. **Anaphase** - homologues separate, sister chromatids remain together (**Random Segregation**)
3. **Telophase** - chromosomes remain condensed

No DNA replication between meiosis I and meiosis II
Meiosis II: (very similar to mitosis)



Meiosis I Prophase I and Metaphase I

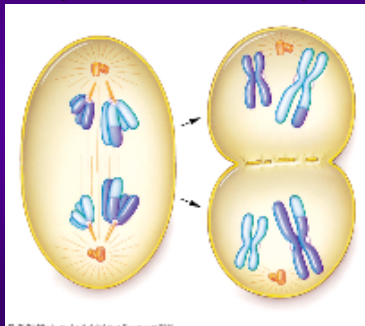


The nuclear envelope is breaking apart; microtubules will be able to penetrate the nuclear region.

Interactions between motor proteins and microtubules are moving one of two pairs of centrioles toward the opposite spindle pole.



Meiosis I Anaphase I and Telophase I



Meiosis II

Prophase II and Metaphase II

There is no DNA replication between the two divisions

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Meiosis II

Anaphase II and Telophase II

Each daughter cell now has a haploid chromosome number

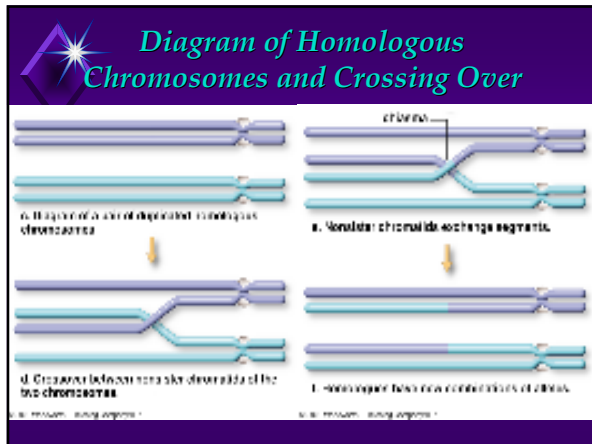
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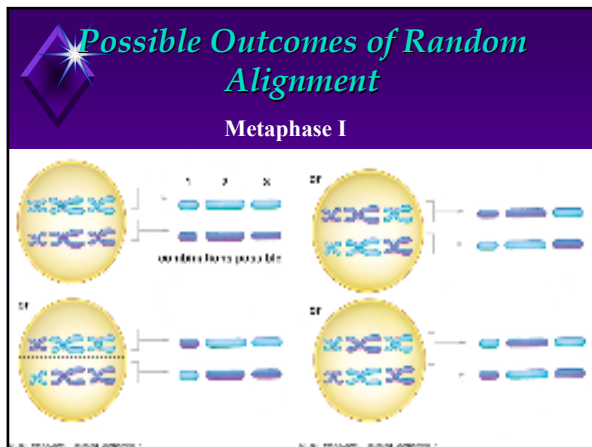
A Closer Look at Meiosis I

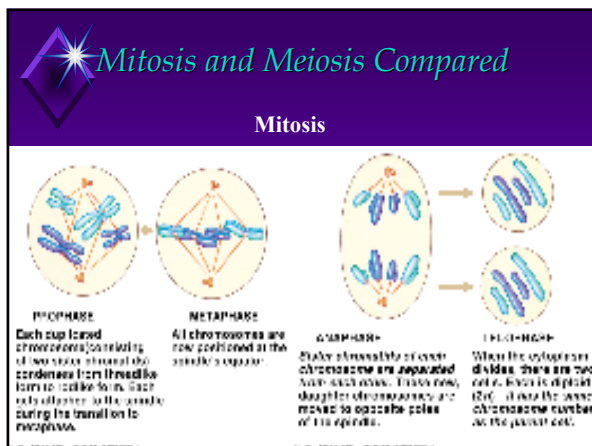
◆ Prophase I

- ◆ Chromosomes as homologues
- ◆ Chromatids are aligned

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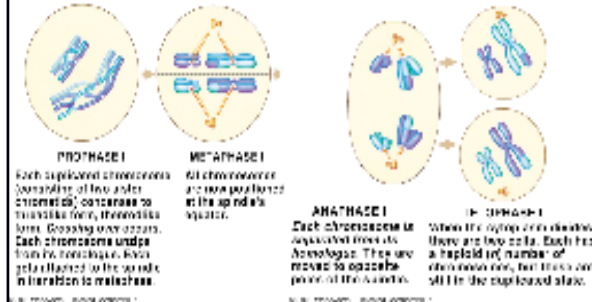






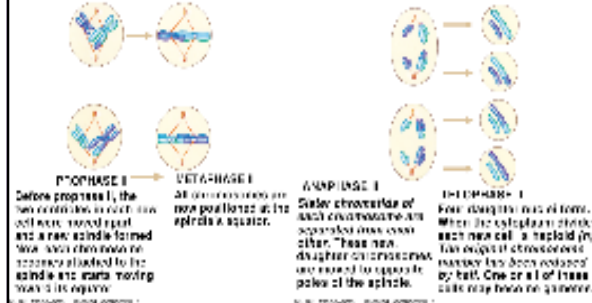
Mitosis and Meiosis Compared

Meiosis I



Mitosis and Meiosis Compared

Meiosis II



Crossing over





In Conclusion

- 1. A parent cell provides each daughter cell with hereditary instructions*
- 2. Eukaryotes divide by mitosis or meiosis and Prokaryotes divide by binary fission*
- 3. Each chromosome is one DNA molecule with proteins attached*
- 4. Cells with a diploid number ($2n$) contain two of each kind of chromosome*
- 5. The phases of Mitosis are Prophase, Metaphase, Anaphase, and Telophase*



In Conclusion (meiosis)

- 1. Meiosis consists of two consecutive divisions*
- 2. In meiosis II, sister chromatids are separated and four haploid cells are the result*
- 3. Crossing over, and random segregation of chromosomes contribute to variation in traits among offspring*
