Cellular division Mitosis and Meiosis

Cellular division

For prokaryotes (bacteria) and some Protista (protozoa such as amoeba, paramecium..etc) cellular division provides a means of asexual reproduction.

Mitosis in nonsexual eukaryotic cells provides a means of cellular replacement or repair of damaged tissue.
THE CELL LIFE CYCLE

INTERPHASE

- G₁ Normal cell functions plus cell growth, duplication of organelles, protein synthesis
- S DNA replication, synthesis of histones
- G₂ Protein synthesis

8 or more hours

6 to 8 hours

2 to 5 hours

M

1 to 3 hours

Cytokinesis

MITOSIS

(See Figure 2.22)

Indefinite period

G₀ Specialized cell functions

Copyright © 2003 Pearson Education, Inc., publishing as Benjamin Cummings.
Mitosis- a form of cellular division that takes place in non-sex cells of eukaryotes.

Takes place in diploid cells.

**Diploid** – notated by 2(n)

2 = the number of chromosome sets.

N= the number of chromosome pairs

For animals, especially mammals non-sex, diploid cells are referred to as somatic cells.

**Somatic cell**- Eukaryotic, animal, diploid cells of the body.

Example : human diploid or somatic cells have 46 chromosomes or 23 pairs of chromosome.

2(n) = 46  2(23)=46

If a plant cell has 10 total chromosomes how many chromosome pairs would you find in one of its non-sexual, diploid cells?
1. Replication

2. Mitosis

3. Cytokinesis
END OF INTERPHASE
DNA has already duplicated back in the S phase. Centrosome has doubled.

PROPHASE
Mitosis begins. The chromosomes take shape as the DNA condenses. The nuclear envelope begins to break down. The two centrosomes begin to move toward the cellular poles, sprouting microtubules as they go.

METAPHASE
Linkage and alignment. Some microtubules of the mitotic spindle form a cage around the cell's former nucleus while others attach to the sister chromatids and align them at the metaphase plate. Each chromatid now faces the pole opposite that of its sister chromatid.
ANAPHASE

Separation. Sister chromatids are moved to opposite poles in the cell by motor proteins that pull the chromatids along the microtubule “tracks” they are attached to. Each chromatid is now a full-fledged chromosome.

TELOPHASE AND CYTOKINESIS

Exit from mitosis. Chromosomes decondense, the mitotic spindle breaks down, and nuclear envelopes form around the two separate complements of chromosomes. Meanwhile, a cleavage furrow begins to form near the middle of the cell.

COMPLETION OF CYTOKINESIS

One cell becomes two. The cell membrane pinches together completely, the membranes on either side fuse together, and the one cell becomes two. These two cells now enter the G₁ phase of interphase.
(d) Metaphase

(e) Anaphase

(f) Telophase

(g) Daughter cells separate

Metaphase plate

Chromosome microtubule

Daughter chromosomes

Cytokinesis

Daughter cells

Daughter cells separate
The end result of mitosis = from 1 parent cell you get 2 daughter cells, with the same number of chromosomes and the exact, same genetic information.

**Meiosis** – cellular division that takes place in sex cells or gametes. (These cells are haploid).

**Haploid**- a cell that is notated by 1(n) and contains only 1 set of chromosomes or ½ the number of chromosomes of an organism.

Humans have a total of 46 chromosomes but a human egg or sperm cell has only 23 chromosomes.

**Gamete** – a sex cell (egg or sperm).

**The phases of Meiosis**
MEIOSIS I

END OF INTERPHASE → PROPHASE I → METAPHASE I → ANAPHASE I
<table>
<thead>
<tr>
<th>MEIOPSIS II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TELOPHASE I</strong></td>
</tr>
</tbody>
</table>
Meiosis

Interphase – DNA replicates during the S subphase of interphase.

Prophase I – nuclear membrane dissipates, centrioles replicate, homologous chromosomes pair up, this is when recombination, crossing over, chiasmata can occur, spindle fiber (microtubules) attach from the centrosomes (centrioles) to kinetochore of the tetrad arrangement.

Recombination (chiasmata arrangement) - similar chromosomes (one from the mother and one from the father) pair up.
Metaphase I- the centrioles migrate to opposite ends of the cell, causing the tetrad arrangement to align in the middle of the cell.

Anaphase I- the Tetrad arrangement is pulled apart. One chromosome being pulled to one end of the cell the other chromosome is pulled toward the opposite end.

Telophase I- the nuclear membrane starts to form around each new set of chromosomes, the spindle fibers & centrioles become less visible, the chromosomes unravel.

Cytokinesis- there is a rapid cytokinesis then the process proceeds into Meiosis II – Prophase II THERE IS NO SECOND INTERPHASE!

Meiosis II

Prophase II, Metaphase II, Anaphase II, Telophase II the process looks and takes much like Mitosis.
MEIOSIS II

- TELOPHASE I
- PROPHASE II
- METAPHASE II
- ANAPHASE II
- TELOPHASE II
The end result of Meiosis = from 1 parent cell you get 4 daughter cells with \( \frac{1}{2} \) the number of chromosomes, and similar genetic information.

Meiosis provides for genetic variability due to recombination and crossing over.