Cell Reproduction

Chapter 8
Cell Division in Prokaryotes

- DNA is a circular chromosome attached to the inner surface of the plasma membrane like a rope attached to the inner wall of a tent.
- Most prokaryotes divide through a process called Binary Fission
- The division of a prokaryotic cell into two offspring cells.
Binary Fission

- DNA is copied, resulting in two identical chromosomes.
- A new cell membrane begins to develop between the two DNA copies.
- Cell grows until it reaches close to twice its size.
- Growing cell membrane pushes inward and the cell is constricted in the center.
- New cell wall forms around the new membrane.
- Two independent cells are formed.
Cell Reproduction in Eukaryotes
Cell Cycle

The repeating set of events in the life of a cell.

It starts with the formation of a new cell and continues until the cell itself has divided into 2 new cells.

*Cytokinesis*: division of the cell’s cytoplasm.
Interphase

Stage where a cell spends most of its life between divisions.

Although a cell may appear to be inactive, chemically it is very active indeed.

All normal metabolic activities take place and intricate preparations for division occur in precise sequence.

Divided into three phases.
$G_1$ phase: First stage of Interphase

Offspring grow to mature size

$S$ phase: Cell’s DNA is copied

$G_2$ phase: Time during which the cell prepares for cell division.

$G_0$ phase: Phase cells go into when they exit the cell cycle. Cells do not copy their DNA and do not prepare for cell division. Ex: Fully developed cells in the Central Nervous System.
MITOSIS

The replication of chromosomes & formation of 2 identical cell nuclei in one cell.

Body cells – cells that make up most of the body, such as:
Steps of Mitosis
**PROPHASE**

1. The long, thin chromosomes coil into shorter & thicker bodies.

2. Each chromosome consist of 2 chromatids & appears as a double structure.

3. Two dark spots called *centrosomes* appear next to the disappearing nucleus. Each centrosomes contains the centrioles.
4. Spindle fibers radiate from the centrioles. Two types of spindle fibers make up the mitotic spindle: kinetochore fibers and polar fibers.

Kinetochore – chromatid to centrosomes

Polar – centrosome to centrosome but do not attach to chromosomes.

5. Two centrioles begin to move opposite ends of the cell.

6. Nuclear membrane begins to disappear, centrioles move towards opposite poles and threadlike spindle fibers stretch from pole to pole.
Sister Chromatids

The 2 strands of a chromosome after it becomes doubled. Each chromatid is an exact copy of the original chromosome.
METAPHASE

1. Each chromosome (2 chromatids) aligns itself on the spindle midway between the poles by the kinetochore fibers.
ANAPHASE

1. Centromeres divide & the 2 chromatids split apart.
2. New chromosomes are pushed & pulled to opposite ends of the cell by the spindle fibers.
TELOPHASE

1. Chromosomes approach the poles & group together, spindle fibers disappear, nuclear membrane begins to appear and the cytoplasm divides in half.

2. 2 new cells (DAUGHTER CELLS) are formed.

Homolog

Each member of a chromosome pair consists of 2 homolog that are similar in appearance.
Genome

The total genetic content of the chromosomes of the cell.

In human cells, the genome consists of 23 pairs of chromosomes.
Haploid – one set of chromosomes
the $N$ number of chromosomes
the gametes are haploid cells
Diploid – the total # of chromosomes in the zygote and all body cells. The 2N number.
Gametes
(sex cells)

Sperm cell

- Produces by males
- Consists of a little more than a nucleus, a tail that can move the cell about, and an energy generator in its mitochondria
Egg cell (Ovum)
• Produced by females
• Maybe large, sometimes thousands of times larger than a sperm cell
• It often contains a reserve food supply
Meiosis

• Special cell division process where the # of chromosomes is reduced from diploid to haploid
• Stages are similar to Mitosis
• Occurs in special reproductive organs
  – Testes – males
  – Ovaries – females

• there are 2 nuclear divisions, Meiosis I & Meiosis II
Meiosis I – Reduction Division
Prophase I

- Long, thin chromosomes shorten & thicken
- Each homolog finds its partner & they pair with one another along their entire lengths
- Homologs lie very close & are often twisted around one another
- Chromatids actually can break at various places & join with broken chromatids from the other homologs. Known as *crossing over* and results in recombination of genes.
- Toward the end, the chromosome pairs move to the equatorial plate
Metaphase I

- Chromosomeprs. arrive in the center of the cell
Anaphase I

- The homologs of each pair separate & begin to move toward opposite poles of the spindle
- Each chromosome still consists of 2 chromatids, attached at the centromere
Telophase I

- Cytokinesis occurs & 2 cells are formed
- Each new cell has only half as many chromosomes as in a body cell. Each new cell has only half the parent cell’s total genetic info.
Meiosis II

- Usually begins almost immediately
- There is no new replication of DNA in the period between Meiosis I & Meiosis II
Prophase II

- Remaining chromosomes move toward the equatorial plate on a new spindle
- The 2 chromatids of each chromosome are about to separate at the centromere
Metaphase II

- Chromosomes align themselves on the new equatorial plate
Anaphase II

- The centromeres divide & the 2 chromatids of each chromosome separate & move towards opposite poles
- Each chromatid is now an independent chromosomes from this time forth
Telophase II

- Chromosomes gather at the poles & are enclosed by a new nuclear envelope
- Cytoplasm divides again
- Cells undergo further cytoplasmic changes, such as developing a tail
- 4 mature sperm cells are formed, only 1 mature egg cell is formed

**Polar bodies:** tiny cells w/very little cytoplasm produced in meiosis which are expelled.