CHAPTER 8
CELL REPRODUCTION

READ TOP OF PG. 145 IN TEXTBOOK

- Chromosome – single "super coiled" DNA molecule with its associated proteins (histones and non-histones).

  -Histones - help maintain the shape of the chromosome.

  -Non-histones – help control the activity of specific regions of DNA.

NOTE: a cell only coils its DNA into chromosomes when it is about to divide….normally chromosomes are uncoiled to form Chromatin.

- Chromosome from a dividing cell: has doubled itself so that when the cell divides, each new cell will get a copy……..

- Chromatids – the name for each copy of the doubled chromosome.
- Centromere – holds the chromatids together until they separate when the cell divides.
- See figure 8-2 on page 146.
- Each species has its own characteristic number of chromosomes. See table 8-1 on pg. 146.
- Sex Chromosomes – (X and Y in humans) – determine the sex of an organism.
  - Females = XX Males = XY

- Autosomes – all of the chromosomes in an organism except the sex chromosomes (X,Y).
- In Humans – 2 sex chromosomes + 44 autosomes for a total of 46 OR 23 Homologous pairs….
- Homologous Chromosomes – 2 copies of each autosome (a copy from each parent)….they are the same size and shape, and carry genes for the same traits such as eye color or hair color, etc.
- Karyotype – Photograph of chromsomes from white blood cells - used to examine someone's chromosomes. See figure 8-3 on pg.147.

- Diploid Cells – (2n) – have both chromosomes for each homologous pair (1 from mom and 1 from dad). All cells in the human body are diploid except sperm and egg.
- Haploid Cells – (1n) – have only 1 set of chromosomes, or ½ the number present in diploid cells. In humans, the only cells that are haploid are sperm and egg.
- Sperm (1n) + Egg (1n) = Offspring (2n)
- In this chapter, we will study 2 processes (Mitosis and Meiosis) that produce new diploid and haploid cells.

THE CELL CYCLE – REPEATING SET OF EVENTS THAT MAKE UP THE LIFE CYCLE OF A CELL. (INCLUDE S MITOSIS) SEE FIG. 8-5 PG. 149

- Steps of the cell cycle:

1. Interphase = time between cell divisions….cells spend most of their life in this phase.

   - G1 Phase – (can be hours, weeks, months) newly divided cells grow to full size…time gap from 1 division until the cell begins to prepare for the next division.

   - S Phase – DNA synthesis..cell is getting ready to enter mitosis by copying its DNA.

   - G2 Phase – growth and preparation for cell division…cell organelles are being copied.

   - G0 Phase – some cells exit the cell cycle here and go into the G0 phase = cell no longer divides……Ex. Nerve cells.

- Prokaryotic cell division = binary fission or simple cell division. There are no distinct phases like in eukaryotic cell division.
- Eukaryotic cell division – 2 types:
  1. Mitosis – results in new cells with a chromosome number identical to the original cell.
  2. Meiosis – reduces the number of chromosomes by ½ in the offspring cells → Haploid cells (sperm/egg).

2. Mitosis = M Phase = Division of the nucleus. See fig. 8-6 on pg. 150…….

a. Prophase – Doubled DNA coils into chromosomes, therefore, there are 2 copies of each chromosome = 2 chromatids attached by the centromere. Nuclear membrane breaks down. Centrosomes (dark spots) appear and move toward opposite poles of the cell… they form the anchors for the Mitotic Spindle. Spindle Fibers – radiate from the centrosomes and attach to the doubled chromosomes.

b. Metaphase – spindle fibers line chromosomes up in the middle of the cell.

c. Anaphase – Chromatids of each doubled chromosome separate at the centromere and move toward opposite poles of the cell. NOTE – The former chromatids are now considered full fledged chromosomes!!!!!!

d. Telophase – chromosomes reach opposite poles of the cell. Spindle fibers disassemble. Chromosomes uncoil to form chromatin. Nuclear membrane reforms around each new set of chromosomes and Cytokinesis occurs.

- Cytokinesis = division of the cytoplasm. 2 ways this occurs in plant vs. animal cells:

1. Cleavage Furrow – (animal cells) – cell membrane pinches inward and cuts the cell in half (looks like a belt tightening around cell).

2. Cell Plate – (plant cells) – a wall (cell plate) is built at the midline of the cell and it extends to cut cell in half.

See figs. 8-7 and 8-8 on pg. 151.

MEIOSIS

- Meiosis – process of cell division that produces Haploid (1n) reproductive cells called Gametes (sperm and egg). Chromosome number is cut in half so that when fertilization takes place, the fusion will result in a cell that is diploid (2n).
- Meiotic cells – undergo G1, S, and G2 of Interphase – just like in Mitosis. The Difference: When a cell enters Meiosis, its chromosomes are doubled. It will divide TWICE (Meiosis I and Meiosis II). The result will be FOUR HAPLOID (1n) REPRODUCTIVE CELLS.

STUDY PICTURES ON PGS. 154 AND 155

- Meiosis I:

  a. Prophase I – DNA coils into chromosomes. Spindle fibers appear. Nuclear membrane breaks down. Synapsis occurs – homologous chromosomes line up together LENGTHWISE. Tetrad = each pair of homologous chromosomes ("tetra" means 4)….because there are 4 chromatids in each pair. Chromosomes line up lengthwise gene for gene. Crossing Over – sometimes occurs at this point (see fig. 8-10 on pg. 154). This results in a mixing of genes = more variety.

b. Metaphase I – Tetrads line randomly along the midline of the cell. Spindle fiber attach to homologues.

"Law of Independent Assortment" – mother and father chromosomes line up randomly. When they later separate, the offspring cells will get a mix of mom and dad genes. This is why children in a family can look very different from one another.

c. Anaphase I – each homologous chromosome moves to opposite poles of the dividing cell.

d. Telophase I = final phase of Meiosis I. Homologous chromosomes reach opposite poles. Cytokinesis I begins. Remember – each chromosome is still doubled at this point.

- Meiosis II – occurs in each of the 2 cells formed in meiosis I. It is not preceded by the copying of any DNA.

  a. Prophase II – Spindle fibers form and attach to the doubled chromosomes.

  b. Metaphase II – chromsomes line up on the midline.

  c. Anaphase II – Chromatids (from the doubled chromosome) separate and move toward opposite poles.

  d. Telophase II – nuclear membrane reforms in each of the 4 newly forming cells.

  Cytokinesis II occurs - This results in 4 new Haploid (1n) cells and each chromosome is now single.

- Gametes = haploid (1n) reproductive cells = sperm and egg.
- Somatic Cells = diploid (2n) body cells = all of body's cells except sperm and egg.
- Meiosis only occurs in the reproductive organs (testes and ovaries).
- Spermatogenesis and Oogenesis – see fig. 8-12 on pg. 155.
- Asexual Reproduction – production of offspring from 1 parent only…..creates no genetic variety.
- Sexual Reproduction – production of offspring from 2 parents….creates a significant amount of variety in offspring.
- Remember – "Variety is the spice of Life" !!