M-Phase part 2

Meiosis and Cytokinesis

Meiosis:

- A special type of cell division that produces gametes.
- Cell division that occurs in sex organs.
- 2 successive nuclear divisions
- Genetic mistakes (gene and chromosome mutations, polyploidy and aneuploidy) occur here and get passed on to offspring.

How is meiosis different from mitosis?

- Mitosis is for normal body cells (somatic cells) and meiosis is only for gamete cells (sex cells.)
- In meiosis there is a pairing of homologues, not in mitosis.
- In meiosis, there is a reduction in the number of chromosomes (by half) and in mitosis, the number of chromosomes remains the same.
- Meiosis produces variability in the gene pool.
- Meiosis produces 4 genetically different gamete cells and in mitosis (2 cells are formed) all produced cells are genetically identical.

Some terms:

- Homologue: 2 genetically identical sister chromatids, chromosome pairs (2 sister chromatids,)
- Sister Chromatids: each is a pair of identical DNA molecules after DNA replication, joined at the centromere.
- Centromere: it is the site where spindle fibers of the mitotic spindles attach to the chromosome during mitosis or meiosis, it is the site at which a chromatid and its identical sister attach together during the process of cell reproduction.

Some terms:

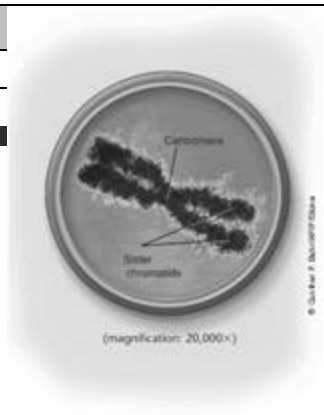
- Synapsis: Process where the chromatids of homologous chromosomes come into very close contact allowing for chiasma.
- Chiasma: places where chromatids of homologous chromosomes become criss-crossed and chromosomes can (but don't have to) exchange segments of DNA.

Some terms:

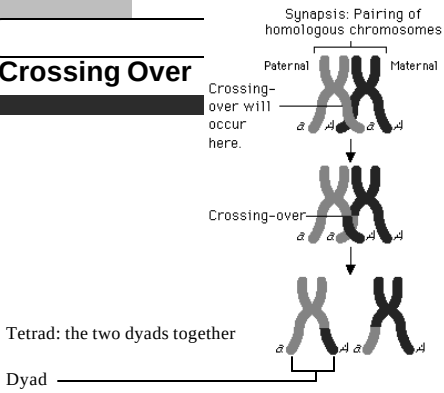
- Crossing over:
  - the mutual exchange of pieces of chromosomes
  - swapping of whole groups of genes between homologous chromosomes
  - results in recombination
  - occurs only in meiosis I.
- Recombination: New combinations of genes, important source of genetic variation in the gene pool of a population.

Some terms:

- Bivalents: 2 homologues paired up, paired homologous chromosomes with 2 chromatids each, aka a tetrad.
- Dyad: 1 pair of sister chromatids, a meiotic chromosome after separation of the two homologous members of a tetrad. (The word "dyad" comes from the Greek "dyas" meaning the number two.)

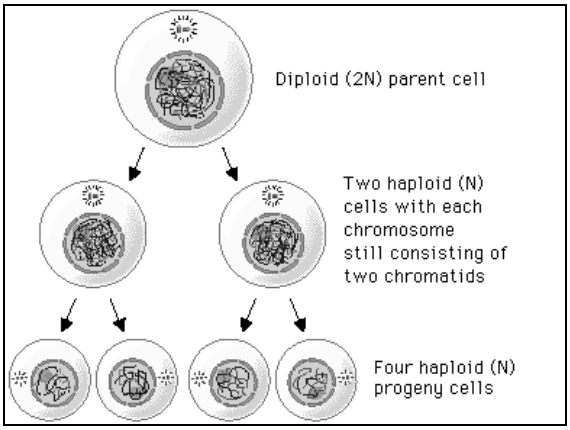


Crossing Over



Some terms:

- **Haploid: ½ the normal number of chromosomes, only one copy of each chromosome instead of two.**
  - All gamete cells are haploid
  - The number of chromosomes in a haploid cell is sometimes represented by the symbol N.
- **Diploid: 2 complete sets of chromosomes**
  - All normal body cells (somatic cells) are diploid
  - The number of chromosomes in a diploid cell is sometimes represented by the symbol 2N.



Meiosis: Two parts

- Meiosis I: is called reduction division because it separates the homologous chromosomes and reduces the number of chromosomes per cell.
- Meiosis II: is like normal mitotic division where the chromatids are pulled apart, the number of chromosomes does not change in this phase of mitosis.

Process:

- Interphase
- Prophase I
- Metaphase I
- Anaphase I
- Telophase I
- Interkinesis
- Prophase II
- Metaphase II
- Anaphase II
- Telophase II
- Cytokinesis

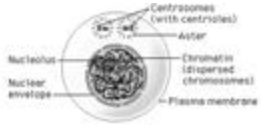
Meiosis I

Meiosis II

Meiosis

Interphase:

- Again before meiosis
- Again Normal Life cycle and genetic material is duplicated.
- For each chromosome, there are 2 genetically identical sister chromatids.

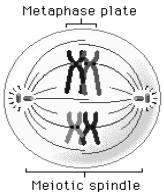


Prophase I

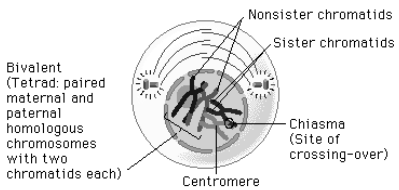
- 90% of meiosis time is spent here.
- Homologous chromosomes pair up and form synapses
- Paired chromosomes are called bivalents or tetrads (2 chromosomes or 4 chromatids)
- Temporary overlap happens (crossing over) to cause genetic variation.
- Other mitotic prophase concepts happen here as well.

Metaphase I

- Bivalents (tetrads) align at the equator



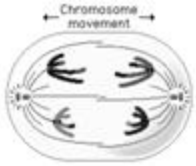
Prophase I



Anaphase I

- Chromosome bivalents separate into dyads.
- Haploid sides of cell – each side of the cell has one chromosome with 2 chromatids.
- Mistakes in separation occur here
  - Aneuploidy: a single chromosome fails to separate
  - Polyploidy: complete sets of chromosomes fail to separate.

Anaphase I



Telophase I

- Nuclear membrane never fully reforms
- Spindle fibers never completely break down
- Cell does begin pinching inward though

Interkinesis

- 2 haploid daughter cells form
- 1st Cytoplasmic division
- Cells formed are not necessarily identical and are definitely not identical to the parent cell.
- There is no duplication of genetic material.

Prophase II

- Not long- remember, the processes usually completed in prophase do not need to be done because they were not undone in telophase I.
- Though any membrane that did form breaks back down.
- Any spindle fibers that broke down reassemble.

Prophase II

Metaphase II

- The dyads line up down the center of the cell at the equator.
- Single chromosomes align on the metaphase plate, much as chromosomes do in mitosis. This is in contrast to metaphase I, in which homologous pairs of chromosomes align on the metaphase plate.

Metaphase II

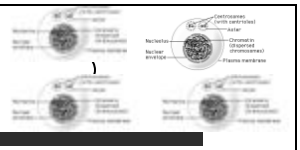
Anaphase II

- The dyads separate leaving each chromosome having only one chromatid.
- Sister chromatids separate and we now have individual chromosomes.

Telophase II

- Same processes as telophase of mitosis.

Cytokinesis



- Each cell formed has ½ the normal chromosomes as the original parent cell.
- 4 daughter cells are formed
- All 4 cells formed are genetically different from each other and the original parent cell due to recombination.
- The 4 cells are germ cells produced
  - In male animals all 4 form viable sperm cells
  - In female animals, quite often, 3 will abort and 1 will become an egg cell.