Mitosis is conventionally divided into five phases, but these are fluid steps

- **Prophase**
- **Prometaphase**
- **Metaphase**
- **Anaphase**
- **Telophase**

MICROTUBULES SEPARATE SISTER CHROMATIDS- GENETICALLY IDENTICAL DAUGHTER CELLS

Sexual inheritance of genes

•One set of chromosomes is inherited from each parent

•Reproductive cells called gametes (sperm and eggs) unite, passing genes to the next generation

Meioisis

Number of chromosomes must be split in two in gametes for the fertilized zygote to have the proper number of chromosomes

Meiosis & Sexual Life Cycle:

Vocabulary & Figures

•Gametes, somatic cells, Diploid (2N), haploid (N)

•Homologous chromosomes, genes, alleles

•Tetrad, crossing over

•Independent assortment

•Chapter 13, Figures 12.5, 13.3, 7,8,10

Diploid vs. Haploid

- Somatic cells are diploid, and contain two sets of chromosomes
- Gametes are haploid cells, containing only one set of chromosomes
- For humans, the haploid (N, 1 chromosome set) number is **23**, diploid (2N, 2 chromosome sets) is **46**

CONCEPTS:

1. MEIOSIS SPLITS NUMBER OF CHROMOSOMES IN HALF "**HOMOLOGOUS CHROMOSOMES**"
2. GENETIC VARIATION DUE TO CROSSING OVER AND INDEPENDENT ASSORTMENT OF CHROMOSOMES

Homologous chromosomes

- In somatic cells, diploid
- One set is maternal, one set is paternal
- Have same length, staining pattern
- Same **GENES**, different **ALLELES**!

Sister chromatids

- In somatic or gametic cells- diploid or haploid
- Identical chromatids, joined by centromere
- Same **GENES**, Same **ALLELES**!

Meiosis splits number of chromosomes in half:

- 2 divisions, resulting in 4 haploid cells
- DNA is replicated first, in S phase

•Homologous chromosomes align on metaphase plate, are pulled to opposite ends- Meiosis I

•Sister chromatids are pulled to opposite ends of the cell in Meiosis II

•Division in meiosis I (separating homologous chromosomes) occurs in four phases:

Prophase I

Metaphase I

Anaphase I

Telophase I

Prophase I

•Homologous chromosomes pair- **aligned gene by gene**

•Each pair of homologous chromosomes forms a **tetrad**, a group of four chromatids

•In **crossing over**, homologous chromosomes exchange DNA segments

Metaphase I

•Tetrads line up on the metaphase plate, one chromosome facing each pole

•Microtubules from each pole are attached to the centromere of one chromosome from each tetrad

Anaphase I

•Pairs of homologous chromosomes separate

•One chromosome moves toward each pole, guided by the spindle apparatus, sister chromatid attached

Telophase I/ Cytokinesis

•Each half of the cell has a set of chromosomes - sister chromatids still attached

•Cytokinesis forms two haploid daughter cells

•No chromosome replication occurs; beginning of meiosis II: separation of sister chromatids

Prophase II

•Spindle apparatus forms

•Chromosomes (each still composed of two chromatids) move toward the metaphase plate

Metaphase II

•Sister chromatids align on the metaphase plate

•Sister chromatids are no longer genetically identical- **crossing over**

•Centromeres attach to microtubules from opposite poles

Anaphase II

•Sister chromatids separate

•Sister chromatids move toward opposite poles

Telphase II/ Cytokinesis

Nuclei form, Cytokinesis separates the cytoplasm

•4 daughter cells, each with a haploid set of unreplicated chromosomes

•Each daughter cell is genetically distinct from the others and the parent cell

Origins of Genetic Variation Among Offspring

•Crossing over

•Independent assortment of chromosomes

Crossing Over

•Prophase I, when homologous chromosomes pair up gene by gene

•DNA is swapped between homologous chromosomes

•DNA from two parents is combined into a single chromosome

Independent Assortment of Chromosomes

•Homologous pairs of chromosomes orient randomly - metaphase I

•Each pair of chromosomes sorts maternal and paternal homologues into daughter cells independently

•2^n, possible combinations (n= haploid #)