**B-4.5 Summarize the characteristics of the phases of meiosis I and II.**

The process of \_\_\_\_\_\_\_\_\_\_\_ and its importance to sexual reproduction just as mitosis is to asexual reproduction. In order for the offspring produced from sexual reproduction to have cells that are *\_\_\_\_\_\_\_\_\_\_* (containing two sets of chromosomes, one set from each parent), the egg and sperm cells must be *\_\_\_\_\_\_\_\_\_\_\_* (contain only one of each type of chromosome). The division resulting in a reduction in chromosome number is called *\_\_\_\_\_\_\_\_\_\_\_.*

Meiosis occurs in two steps:

• *Meiosis I*, in which the chromosome pairs replicate, results in two haploid *daughter cells* with duplicated chromosomes different from the sets in the original diploid cell.

• *Meiosis II*, in which the haploid daughter cells from Meiosis I divide, results in four haploid daughter cells called *\_\_\_\_\_\_\_\_\_*, or sex cells (\_\_\_\_\_\_\_\_ and sperm), with undoubled chromosomes.

***Meiosis I***

Meiosis I begins with *interphase*, like in mitosis, in which cells: (1) increase in size, (2) produce RNA, (3) synthesize proteins, and (4) replicate DNA

• *Prophase I*

○ The nuclear membrane breaks down; centrioles separate from each other and take up positions on the opposite sides of the nucleus and begin to produce spindle fibers.

○ Chromosomes pair up and become visible as a cluster of four chromatids called a *tetrad.*

♦ A *homologous* chromosome pair consists of two chromosomes containing the same type of genes.

∗ the paternal chromosome in the pair contributed by the organism’s male parent

∗ the maternal chromosome in the pair contributed by the organism’s female parent

♦ Each chromosome consists of two *sister chromatids* attached at a point called the *centromere.*

♦ Because the homologous chromosome pairs are in close proximity, an exchange of chromosome genetic material between pairs often occurs in a process called “*Crossing over.”* (see also B-4.7)

• *Metaphase I*

• *Anaphase I*

• *Telophase I & Cytokinesis*

• Each of the two daughter cells from meiosis I contains only one chromosome (consisting of two sister chromatids) from each parental pair. Each daughter cell from meiosis I proceeds to undergo meiosis II.

*Meiosis II*  (PMATII) and then cytokinesis

**B-4.6 Predict inherited traits by using the principles of Mendelian genetics**

*\_\_\_\_\_\_\_\_\_\_\_\_\_* is the study of patterns of inheritance and variations in organisms. Genes control each trait of a living thing by controlling the formation of an organism’s proteins.

• Since in all cells (except gametes) chromosomes are diploid (exist as a pair of chromosomes), each cell contains two genes for each trait, one on the maternal chromosome and one on the paternal chromosome.

• The two genes may be of the same form or they may be of different forms.

○ The different forms of a gene are called *alleles. These are the Letters!!! TT, Tt*

○ The two alleles are **segregated** during the process of gamete formation (\_\_\_\_\_\_\_\_ \_\_\_).

***Law (Principle) of Dominance***

states that some alleles are dominant whereas others are recessive.

• When an organism has two identical alleles for a particular trait that organism is said to be *homozygous* for that trait.

• When an organism has two different alleles for a particular trait that organism is said to be *heterozygous* for that trait.

The *\_\_\_\_\_\_\_\_\_\_\_\_\_\_* (genetic makeup) of an organism reveals the type of alleles that an organism has inherited for a particular trait.

**• TT represents a homozygous dominant genotype.**

**• tt represents a homozygous recessive genotype.**

**• Tt represents a heterozygous genotype.**

The *\_\_\_\_\_\_\_\_\_\_\_\_\_* (physical characteristics) of an organism is a description of the way that a trait is expressed in the organism.

**• Organisms with genotypes of TT or Tt would have a phenotype of tall.**

**• Organisms with a genotype of Tt would have a phenotype of short.**

***Law (Principle) of Segregation***

The *law (principle) of segregation* explains how alleles are separated during meiosis.

• Each gamete receives one of the two alleles that the parent carries for each trait. Each gamete has the same chance of receiving either one of the alleles for each trait.

• During fertilization (when \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_ unite), each parent organism donates one copy of each gene to the offspring.

***Law of Independent Assortment***

The *law of independent assortment* states that the segregation of the alleles of one trait does not affect the segregation of the alleles of another trait.

• Genes on separate chromosomes separate independently during meiosis.

• This law holds true for all genes unless the genes are *\_\_\_\_\_\_\_\_\_\_\_\_*. In this case, the genes that do not independently segregate during gamete formation, usually because they are in \_\_\_\_\_\_\_\_ proximity on the same chromosome.

A *\_\_\_\_\_\_\_\_\_\_\_\_ square* can be used to predict the probable genetic combinations in the offspring that result from different parental allele combinations that are independently assorted.

• A *monohybrid cross* examines the inheritance of one trait. The cross could be homozygous-homozygous, heterozygous-heterozygous, or heterozygous-homozygous.

**B-4.7 chromosome theory of inheritance and relate that theory to Gregor Mendel’s principles of genetics.**

*Chromosome theory of inheritance* is a basic principle in biology that states genes are located on chromosomes and that the behavior of chromosomes during meiosis accounts for inheritance patterns, which closely parallels predicted Mendelian patterns.

**• *Gene linkage***simply means that genes that are located on the same chromosome will be inherited together. These genes travel together during gamete *formation*.

○ This is an exception to the Mendelian principle of independent assortment because linked genes do not segregate independently.

• ***Crossing-over***is a process in which alleles in close proximity to each other on homologous chromosomes are exchanged. This results in new combinations of alleles.

○ When chromosomes pair up during meiosis I, sometimes sections of the two chromosomes become crossed. The two crossed sections break off and usually reattach.

* ***Incomplete dominance***is a condition in which one allele is not completely dominant over another. The phenotype expressed is somewhere between the two possible parent phenotypes.

Red x white = pink

• ***Codominance***occurs when both alleles for a gene are expressed completely. The phenotype expressed shows evidence of both alleles being present.

Red x White = both red and white

• ***Multiple alleles***can exist for a particular trait even though only two alleles are inherited. For example, three alleles exist for blood type (A, B, and O), which result in four different blood groups.

• ***Polygenic traits***are traits that are controlled by two or more genes. These traits often show a great variety of phenotypes, e.g. skin color.

**• These conditions go beyond Mendel’s principle of dominance.**

***Sex-linked traits*** are the result of genes that are carried on either the X or the Y chromosome.

○ The pair of sex chromosomes in females consists of two X chromosomes, each carrying the same genes; the pair of sex chromosomes in males consists of one X chromosome and one Y chromosome.