***Content Limit and Boundaries***

*Standard 7: Genetics*

**B.7.1 Distinguish between dominant and recessive alleles and determine the phenotype that would result from the different possible combination of alleles in an offspring.**

* Dominant- alleles expressed in an organism (symbolized by a capitol letter)
* Recessive- alleles expressed if no dominant allele is present (symbolized as a lower case letter)
* Allele- variation of a gene, often symbolized as a letter
* Phenotype- physical expression of the allele, organism’s appearance
* Genotype- alleles combination present in an organism
* Homozygous- two of the same alleles; either 2 dominant alleles or 2 recessive alleles; phenotype results as dominant or recessive based upon allele present
* Heterozygous- two different alleles (one dominant and one recessive); phenotype results as dominant

**B.7.2 Describe dominant, recessive, codominant, sex-linked, incompletely dominant, multiple allelic, and polygenic traits and illustrate their inheritance patterns over multiple generations.**

* Basis of dominant vs. recessive
  + Recessive alleles seem to disappear in the F1 generation
  + F2 generation returns to dominant
* Codominance- neither allele disappears in F1 generation; F2 generation returns to normal
  + Phenotypic outcome is a equal expression of the combination of the two alleles
  + Genotype is heterozygous
  + Ex. Red + white = red + white
* Incomplete dominance- neither allele disappears in F1 generation; F2 generation returns to original
  + Phenotypic outcome is an intermediate between the 2 alleles
  + Genotypic outcome is heterozygous
  + Ex. Red + white = pink
* Sex-linked- traits which are carried on sex chromosomes only (X and Y chromosomes)
  + Are primarily observed in one particular sex
  + Can be passed on through a carrier
    - Heterozygous individual- typically not displaying the trait
* Multiple alleles- trait identified by more than 2 versions of an allele
* Polygenic traits- multiple genes all contributing to the same trait
  + Unpredicted subsequent generations result from P generation

**B.7.3 Determine the likelihood of the appearance of a specific trait in an offspring given the genetic make-up of the parents.**

* Punnett square- diagram for predicting outcomes of allele combinations
* Pedigree- illustration to show genetic inheritance through generations; similar to a family tree
* Probability- the likelihood an event will occur based on chance
* Ratio- the relationship of one thing to another
* Use Punnett squares, pedigrees, and probability to predict genotypes and phenotypes of offspring in varying generations
* Predicted results- hypothesized outcome of a cross
* Actual results- outcome of a genetic experiment

**B.7.4 Explain the process by which a cell copies its DNA and identify the factors that can damage DNA and cause it to change its nucleotide sequence.**

* Replication- making a copy of the DNA strand
  + Helicase- enzyme which breaks hydrogen bonds between nitrogen bases of double helix
  + Replication fork- point of double helix where separation of bonds occurs creating a “Y” shape
  + DNA polymerase- enzyme which follows base pairing rules to attach free nucleotides to the separated DNA strand in the 3’🡪 5’ direction
    - Also proofreads the new strands for incorrect base pairing
* End product is 2 DNA strands each composed of 1 old strand and 1 new strand
* Mutations/mutagens- changes to the DNA that can alter the DNA
  + Changes to DNA can change protein sequences altering the organism

**B.7.5 Explain and demonstrate how inserting, substituting, and deleting segments of a DNA molecule can alter a gene, how that gene is then passed to every cell that develops from it and how the results may be beneficial, harmful, or have little or no effect on the organism.**

* Insertion- adding one or more nucleotides to a DNA strand
* Deletion- deleting one or more nucleotides from a DNA strand
* Substitution- exchanging one nucleotide for another
* Mutations can alter a gene by possibly causing a change in a DNA sequence
* Mutated sequences of DNA are copied through replication during interphase of mitosis and meiosis
* Learn about mutations which are beneficial to their survival; such as increased life span, number of offspring, efficient metabolism, etc.
* Learn about mutations which are detrimental to survival