CONCEPT: FUNDAMENTALS OF GENETICS

Genetics Basics

● DNA is the fundamental unit of genetics

□ DNA is made up of four bases (nucleotides): **Adenine (A), Thymine (T), Guanine (G), Cytosine (C)**

- *Chargoff's Rules* state that A & T (2 H^+ bonds) pair together and G & C (3 H^+ Bonds) pair together

- The two strands of DNA are complementary, and form a double helix

□ DNA contains **genes**, which is a stretch of DNA that has the information for a protein

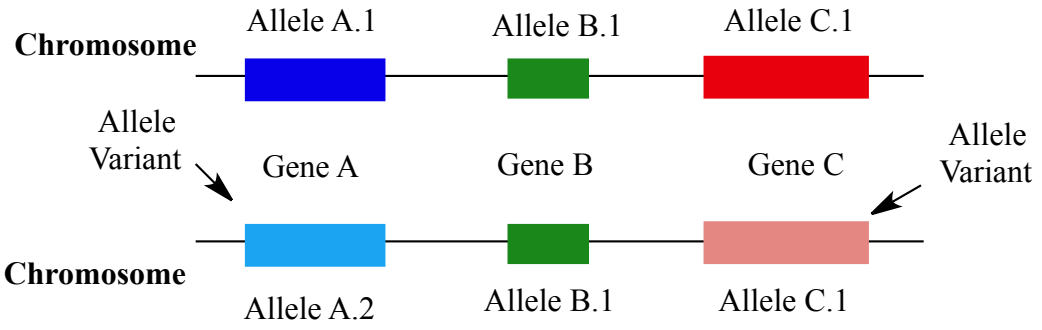
- Genes have **regulatory elements** that control whether or not the gene is expressed

□ Genes come in different varieties

- An **allele** is a gene variant

- In diploid cells there are two alleles per gene

EXAMPLE: Alleles vs. Genes



□ To go from DNA to Protein there are two main steps

- **Transcription** is the process of turning DNA into messenger RNA (mRNA)

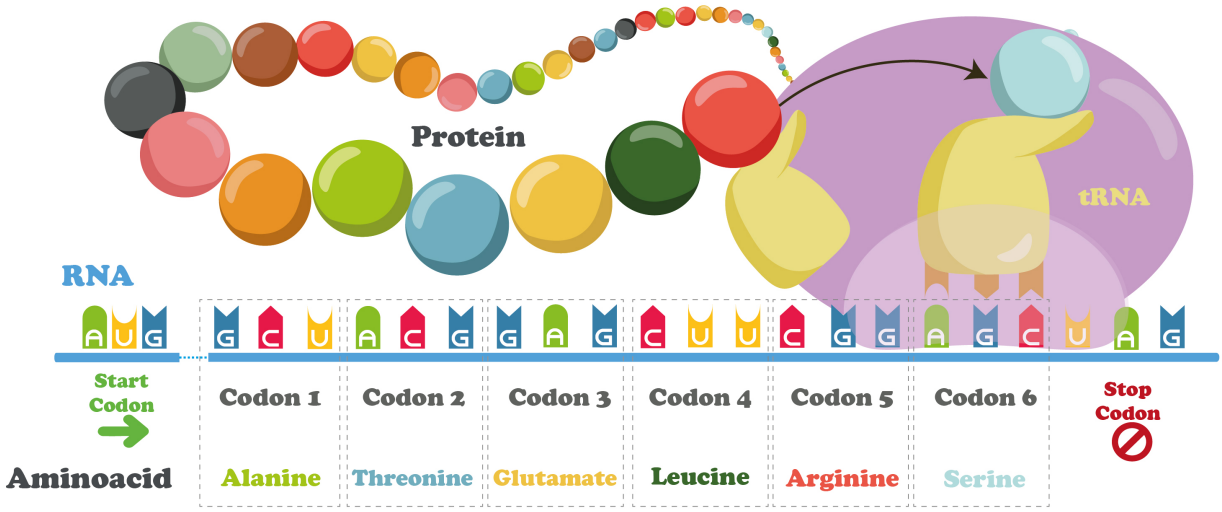
- It can also create transfer RNA (tRNA) and ribosomal RNA (rRNA)

- **Translation** is the process of turning mRNA into proteins

□ DNA does not encode a protein in a 1:1 ratio

- A **codon** made up of three nucleotides encoded for one amino acid, which is used to build proteins

EXAMPLE: Codon Code



Chromosomal Fundamentals

□ Chromosomes contain many genes

- **Homologous chromosomes** are chromosomes that exist in pairs

- **Diploid (2n)** organisms have homologous chromosomes (a chromosome pair)

- **Haploid (n)** organisms have only one chromosome copy

- **Chromosomal theory of inheritance** describes that inherited traits come from genes on chromosomes

- Passed through **gametes** (sex cells)

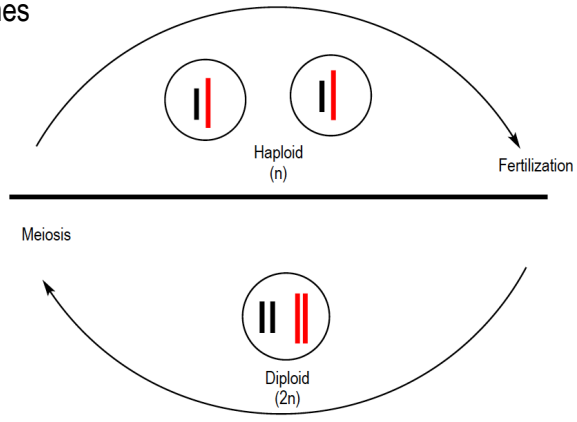
□ **Meiosis** is the process of creating gametes

- In Diploid individuals it takes a (2n) cell and produces 4 (n) cells

□ **Mitosis** is the process of creating somatic cells (all cells but gametes)

- Turns (2n) cells into two (2n cells)

EXAMPLE: Meiosis and Chromosomes



Descriptive Genetics

□ The genetics of an individual can be described in two many ways

- The **genotype** is the set of alleles for a given trait by an organism

- The **phenotype** is the observable features

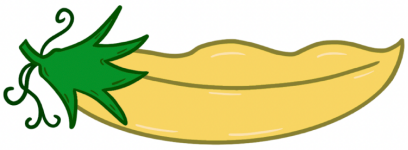
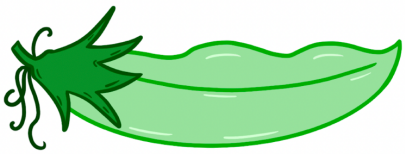
□ Genes can present themselves as many different types of traits

- *Morphological Traits* – affect the appearance of the organisms

- *Physiological Traits* – affect the ability of an organism to function properly

- *Behavioral Traits* – affect the way an organism responds to its environment

EXAMPLE:

Phenotype	Genotype	
		
Yellow	AA or Aa	
		
Green	aa	A= dominant allele a= recessive allele

□ There are three divisions of **Genetics**, which is the study of individual heredity and variation

- **Transmission genetics:** Studies the ability to pass traits onto the next generation

- **Molecular genetics:** Studies the gene activity at a molecular level (DNA replication, transcription, etc.)

- **Population genetics:** Studies genes in terms of an entire population

PRACTICE:

1. True or False: In a diploid cell, the number of alleles is the same as the number of genes.

2. What is an allele?
    a. A nucleotide variant.
    b. Different variants of a gene.
    c. Proteins.
    d. Codon.