BIOLOGY CHAPTER 11 – DNA and the Language of Life

- **Genes** = small pieces of DNA
- Multiple experiments, beginning in the 1920s, were conducted to determine that DNA is the material of heredity.
  - For diagrams that illustrate these experiments, see pages 226-228, figs. 11-1, 11-2, 11-3, and 11-4.

- **What is DNA?**
  - A type of organic molecule known as a nucleic acid
  - Full name: Deoxyribonucleic acid
  - Monomer is a **nucleotide**; polymer is a nucleic acid (either DNA or RNA).
  - What is a nucleotide?
    - A nucleic acid monomer (building block) – For a review of monomers and polymers, refer to chapter 5 of your book, p. 93.
    - Each nucleotide has three parts:
      - A ring shaped sugar
      - A phosphate group
      - A nitrogenous base; it is this base that makes one nucleotide different from another
        - If the nitrogenous base is made of **two nitrogen-rings**, it is called a **purine**. (A way to remember this is if an angel has two halos, he is extra pure.)
        - If the nitrogenous base is made of **just one nitrogen-ring**, it is called a **pyrimidine**.

- DNA is made of four nucleotides:
  - Adenine (A)
  - Thymine (T)
  - Cytosine (C)
  - Guanine (G)

- Adenine and Guanine are purines; Cytosine and Thymine are pyrimidines.

- **What does DNA look like?**
  - Double stranded; looks like a ladder
  - Each strand’s backbone is the vertical part of the “ladder”; this backbone (on each strand) is made of the sugar and phosphate groups of the nucleotides.
  - The “rungs” of the ladder are made of the nucleotides; one nucleotide from one strand pairs with a nucleotide from the other strand.
    - **Adenine always pairs with thymine**
    - **Guanine always pairs with cytosine**
  - The double strands twist around each other, forming a **double helix**.
  - See p. 230-231, figs. 11-7 and 11-8 for pictures of DNA structure.
- **DNA replication** – the process of DNA copying itself prior to mitosis or meiosis
  - Several steps take place to make DNA replication possible:
    - Each strand of the “parent” DNA acts as a template for a new, complementary strand
    - The first step uses enzymes that will unwind the double helix of the parent DNA so that each strand is exposed.
    - Enzymes called **DNA polymerases** shuttle in nucleotides to pair up with each parent strand. These polymerases also make the bonds between the nucleotides.
    - When a new DNA double strand is formed, realize that one of those strands is a “parent strand” and one is a “new strand”.
    - See p. 233, fig. 11-9 and p. 234, fig. 11-10.

- **What does a gene actually do?**
  - A gene provides the information for making a specific protein.
  - Scientists Beadle and Tatum came up with the “one gene, one polypeptide” hypothesis (every gene codes for a unique protein).
  - The gene contains the recipe for protein production; the protein actually determines the phenotype of the trait.

- **Steps of protein production:**
  - In order for a protein to be made, DNA has to be “re-copied” into a more readable form called **RNA**. (Basically, the recipe found in DNA is not in a writing that can be easily read by the ribosome, so the recipe must be copied into a neater handwriting that is RNA!)
  - **Transcription** = the process of making RNA from DNA.
  - **Transcription occurs in the nucleus**.
  - Once RNA is made, the RNA leaves the nucleus and goes to ribosomes (either free-floating ribosomes or ribosomes attached to the ER).
  - **Translation** = the process of making protein from RNA.
  - **Translation occurs on ribosomes (either free-floating in the cytoplasm or on ribosomes attached to the ER)**.
  - See p. 236, fig. 11-12 for diagram.

- **Note: understand that RNA is different from DNA.**
  - RNA is single stranded.
  - RNA also has four nucleotides, but they are not exactly the same as those found in DNA.
  - RNA’s four nucleotides:
    - Adenine
    - Cytosine
    - Guanine
    - Uracil
  - During transcription, adenine from DNA will pair with uracil from RNA.

- **The flow of information from gene to protein is based on codons.**
  - **Codon** = a set of three nucleotides in RNA that codes for one amino acid.
  - See page 237, fig. 11-13 for table of codons.