

## **CHAPTER 11**

### **DNA AND GENES**

#### **I. DNA : The Molecule of Heredity**

##### **A. DNA Structure**

1. the molecule that determines traits.
  2. controls the production of proteins.
  3. the instructions to make the organism.
  4. A long molecule made of repeating sub units (nucleotide).
  5. Nucleotides are made of sugar, phosphate, and base.
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6. Types of nucleotides
    - a. Adenine (A)
    - b. Guanine (G)
    - c. Thymine (T)
    - d. Cytosine (C)

B. 1953, James Watson and Francis Crick

1. Discover the structure of DNA, a double helix.

2. The sequence of the bases forms the unique genetic information in an organism.

3. The closer the relationship between two organisms, the greater the similarity of the DNA.

C. **DNA Replication** ( DNA copying itself )

1. DNA replication occurs during interphase.

2. Steps in replication

a. separation of the strands

b. base pairing

c. bonding of the bases

d. results of replication

3. A complete copy of DNA for each new cell.

## II. From DNA to Protein

### A. Transcription (DNA to mRNA)

1. Proteins become the structures of the organism.  
Example: muscle tissue, blood vessels, enzymes.
2. **Each gene codes for a protein. About 30,000 genes are in a human.**
3. mRNA is a single stranded copy similar to DNA with a few differences.
  - a. **ribose sugar instead of deoxyribose sugar.**
  - b. **Uracil base instead of a thymine base.**
  - c. **single strand rather than double strand.**see figure 11.5
4. types of RNA
  - a. mRNA - messenger RNA, recipe to make protein
  - b. rRNA - ribosomal RNA, work bench to read mRNA
  - c. t RNA - Transfer RNA, brings the proper amino acid to the ribosome.

### B. The Universal Genetic Code (the language of RNA)

1. All proteins are made from 20 amino acids.
2. **mRNA codes for the amino acids 3 bases at a times. a codon.**
3. the order of mRNA bases determines the order of amino acids in the protein.

4. **All organisms share the same RNA code. p298.**
  5. the codon **AUG** is the “start” amino acid for every protein in every organism discovered so far.
  6. The codons **UAA, UAG, UGA** all code for “stop” in every organism.
- C. Steps in Translation. figure 11.8
1. mRNA migrates to a ribosome and attaches.
  2. tRNA anticodon reads the **AUG**.
  3. another tRNA reads the next mRNA codon. The two amino acids are bonded together through dehydration synthesis.
  4. Ribosome moves along the mRNA 1 codon at a time reading the mRNA until a stop codon is reached.

### III. Genetic Change ( changes in DNA )

#### A. Mutation

1. Mutation in reproductive cells carry the DNA change to the next generation.
2. Mutation in body cells do not carry the DNA change to the next generation.

#### B. Types of mutations

1. Point mutations
  - a. a change in a single base pair. can result in the change of one amino acid.

2. Frame shift mutation
  - a. Occurs when a DNA base pair is added or deleted.
  - b. Shifts the reading frame and changes the order of many codons, changes the order of many amino acids.
3. Chromosomal Mutation
  - a. Changes in large pieces of chromosome  
Entire genes are gained or lost.
  - b. Deletion: pieces of chromosome are missing or left out.
  - c. Insertion: pieces of chromosome are added in.
  - d. Inversion: chromosome breaks and reverses.  
Gene is read backwards.
  - e. Translocation: chromosome breaks and reattaches to a different chromosome.

### C. Causes of Mutation

1. Spontaneous: mutations occur randomly at extremely low rates.

2. Mutagen: an agent that causes mutation.
    - a. radiation- Xray, microwave, ultra violet, gamma
    - b. chemical: 228 carcinogens, asbestos, dioxins, cyanide
    - c. high cell temperatures will cause mutations
- D. Repairing DNA
1. Enzymes repair errors in DNA transcription and replication . DNA polymerase, DNA ligase
  2. People should limit their exposure to mutagens.