

Topic 8: Heredity → Molecules

SCI141

Objectives

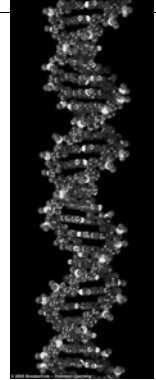
- Describe the function, structure and replication of DNA.
- Describe the process of protein creation.
- Describe the potential for DNA Mutation.

Mystery of the Hereditary Material

- Originally believed to be an unknown class of proteins
- Thinking was
 - Heritable traits are diverse
 - Molecules encoding traits must be diverse
 - Proteins are made of 20 amino acids and are structurally diverse

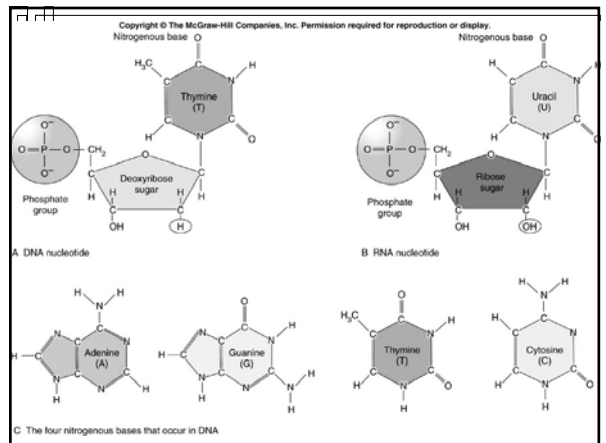
Structure of the Hereditary Material

- Experiments in the 1950s showed that DNA is the hereditary material
- Scientists raced to determine the structure of DNA
- 1953 - Watson and Crick proposed that DNA is a double helix



Structure of Nucleotides in DNA

- Each nucleotide consists of
 - Deoxyribose (5-carbon sugar)
 - Phosphate group
 - A nitrogen-containing base
- Four bases
 - Adenine, Guanine, Thymine, Cytosine



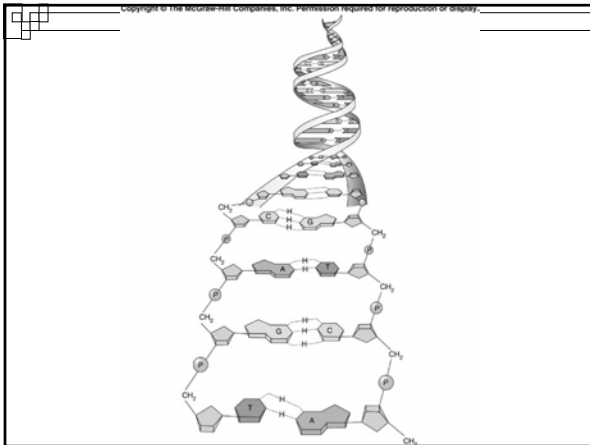
Composition of DNA

- Amount of adenine relative to guanine differs among species
- Amount of adenine always equals amount of thymine and amount of guanine always equals amount of cytosine

$$A=T \text{ and } G=C$$

Watson-Crick Model

- DNA consists of two nucleotide strands
- Strands run in opposite directions
- Strands are held together by hydrogen bonds between bases
- A binds with T and C with G
- Molecule is a double helix

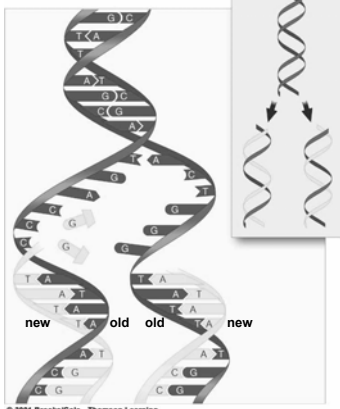


DNA Structure Helps Explain How It Duplicates

- DNA is two nucleotide strands held together by hydrogen bonds
- Hydrogen bonds between two strands are easily broken
- Each single strand then serves as template for new strand

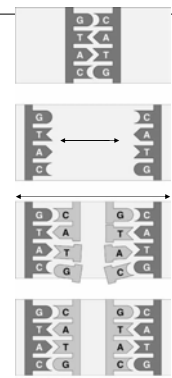
DNA Replication

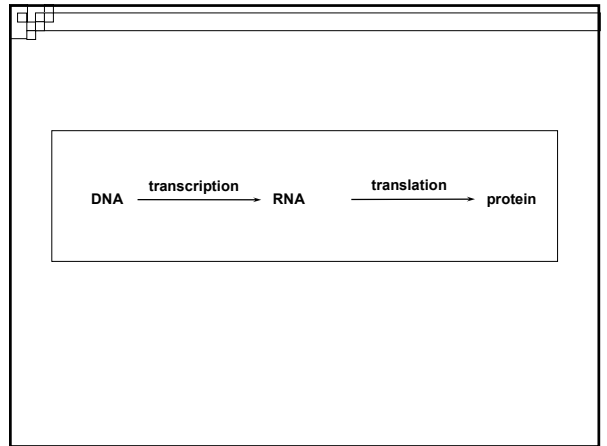
- Each parent strand remains intact
- Every DNA molecule is half "old" and half "new"



Base Pairing during Replication

Each old strand serves as the template for complementary new strand

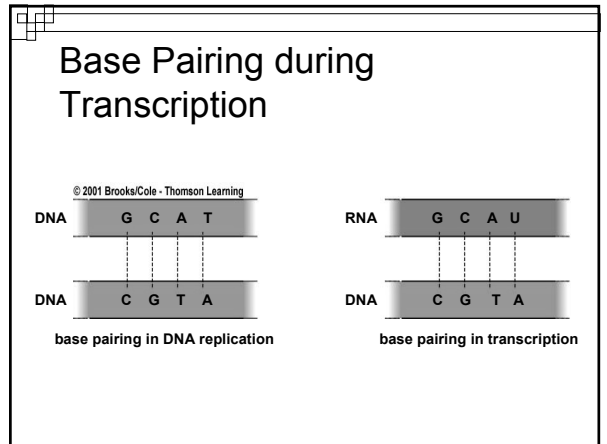




Steps from DNA to Proteins

Same two steps produce all proteins:

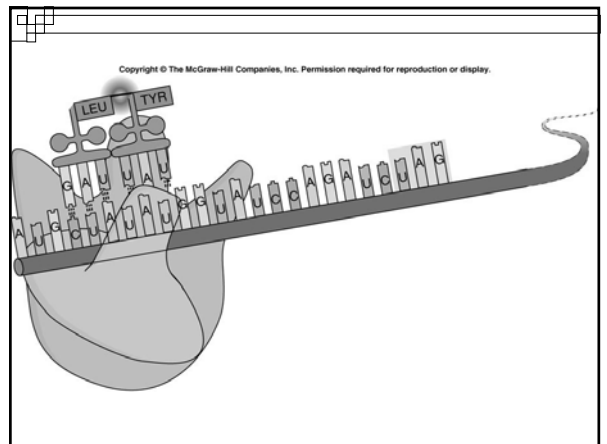
- 1) DNA is transcribed to form RNA
 - Occurs in the nucleus
 - RNA moves into cytoplasm
- 2) RNA is translated to form polypeptide chains, which fold to form proteins

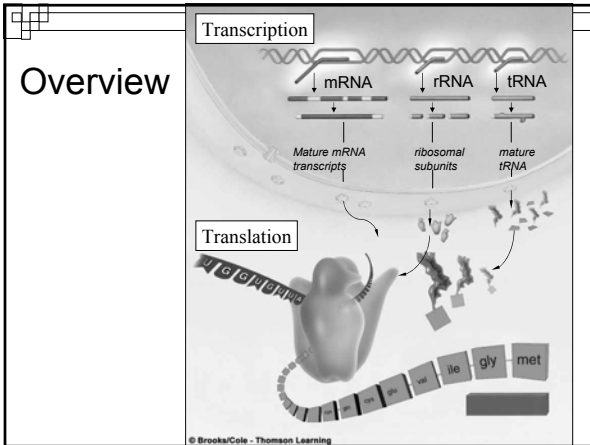
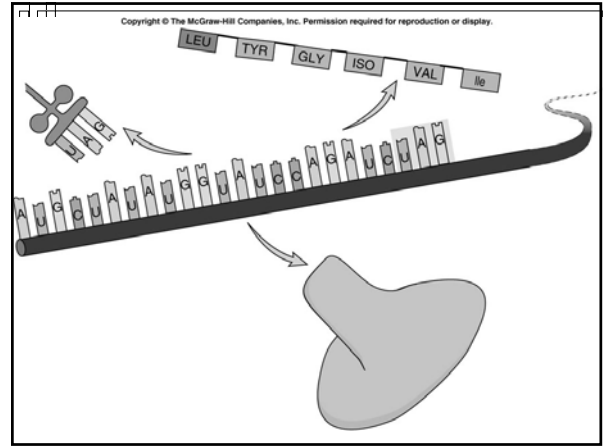
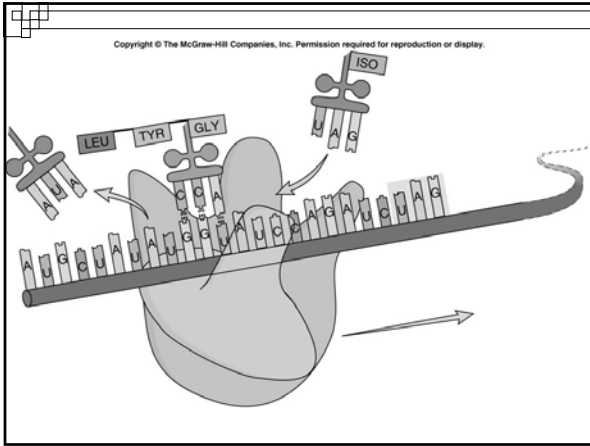


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Protein synthesis

| DNA | | Transcription | | Translation | | Protein |
|-----------------------------------|-----------|--------------------------------------|--|-----------------------|--|---------------|
| DNA: Cover complementary to gene) | DNA: Gene | mRNA: Codons (complementary to gene) | tRNA: Anticodons (complementary to mRNA) | Amino acids specified | | |
| T | A | U | A | | | |
| T | A | U | A | Phe | | Phenylalanine |
| T | A | U | A | | | |
| T | A | U | A | | | |
| C | G | C | G | Ser | | Serine |
| T | A | U | A | | | |
| A | T | A | U | Lys | | Lysine |
| A | T | A | U | | | |
| C | G | C | G | | | |
| G | C | G | C | Arg | | Arginine |
| T | A | U | A | | | |





Mutations

Normal: the one big fly had one red eye

Misense → thq one big fly had one red eye

Nonsense → the one big

Frameshift → the one qbi gfl yha don ere dey e

Deletion → the one big had one red eye

Insertion → the one big eye fly had one red eye