

The Central Dogma of Biology

DNA → RNA → Protein

The central dogma represents the flow of information within a cell.

The information needed to create a new cell is stored in the DNA ().

That information is transcribed into RNA ().

The RNA is translated into proteins.

DNA Structure

- the structure was determined by James Watson and Francis Crick in 1953 ()

- Rosalind Franklin's contributions in determining the structure of DNA were "the key" to the discovery but she was not included in the Nobel Prize and she was often not even mentioned (!)

- DNA was actually discovered in the 1860's

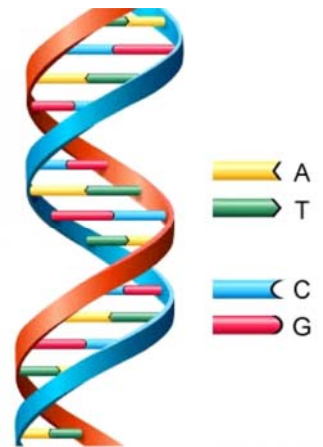
- DNA is made of only 4 nucleotides (Adenine, Thymine, Guanine, and Cytosine) also known as bases

- initially DNA was considered interesting but too simple to be important!

- a molecule of DNA has 2 strands held together by hydrogen bonds (hydrogen bonds are very weak chemical bonds but many of them all together have enough strength to keep the 2 strands together).

- the 2 strands are curved around themselves in a double helix

- the DNA strands can be pulled apart with enzymes ()



DNA Replication

- DNA replication occurs in the nucleus of eukaryotic cells

- the process of making DNA involves many different enzymes

- the most important is DNA polymerase (synthesizes chains of repeating subunits—nucleotides)

- enzymes pull the 2 strands apart and each strand is used as a template to synthesize new DNA

- complementary base pairing is as follows: "A" bonds with "T" and "G" bonds with "C"

Strand 1: - ATCCCAT TGGTC- These 2 strands =
Strand 2: - TAGGGTAACCAG-

- each “new” DNA molecule is actually half old and half new DNA ()
- remember each strand of the original DNA molecule is used as a template for the synthesis of a new complimentary strand

Break for DNA Replication Simulation Game

DNA Transcription

- the information stored in the DNA must be transcribed into RNA (specifically messenger RNA – mRNA)
- transcription occurs in the nucleus of a eukaryotic cell
- a similar enzyme () synthesizes RNA from a DNA template
- an important difference between DNA and RNA is that RNA does not have Thymine (T)
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Template DNA Strand: - TACCCAT TGGT CATC -
 Complimentary mRNA: - AUGGGUAACCAGUAG -

RNA Translation

- translation occurs in the cytoplasm () of all cells
- little “machines” called ribosomes read the mRNA and synthesize proteins by adding amino acids () into chains
- there are 20 different amino acids that make up proteins
- the ribosome reads the nucleotides in groups of three called triplet codons
- each triplet codon codes for a particular amino acid
 - how many triplet codons are there in the complimentary mRNA sequence shown above?

The Genetic Code

- How does a ribosome know where the protein starts and stops? All proteins start with the AUG codon () and end with a stop codon
- How does a ribosome know how to read the mRNA? How does the ribosome know which amino acid to add in the correct order to make a protein? See below.
- remember that each triplet codon codes for a particular amino acid
- see the genetic code chart—look for the first nucleotide in the left column, then look for the second nucleotide across the top row. Triangulate to find the third nucleotide and the amino acid.

		Second letter				
		U	C	A	G	
First letter	U	UUU] Phe UUC] UUA] Leu UUG]	UCU] UCC] Ser UCA] UCG]	UAU] Tyr UAC] UAA Stop UAG Stop	UGU] Cys UGC] UGA Stop UGG Trp	U C A G
	C	CUU] CUC] Leu CUA] CUG]	CCU] CCC] Pro CCA] CCG]	CAU] His CAC] CAA] Gln CAG]	CGU] CGC] Arg CGA] CGG]	U C A G
	A	AUU] AUC] Ile AUA] AUG Met	ACU] ACC] Thr ACA] ACG]	AAU] Asn AAC] AAA] Lys AAG]	AGU] Ser AGC] AGA] Arg AGG]	U C A G
	G	GUU] GUC] Val GUA] GUG]	GCU] GCC] Ala GCA] GCG]	GAU] Asp GAC] GAA] Glu GAG]	GGU] GGC] Gly GGA] GGG]	U C A G

Which amino acids go with this mRNA sequence? - AUGGGUAACCAGUAG -

That is how the cell reads DNA to eventually make proteins. **DNA → RNA → Protein**

Break for Translation Simulation and Worksheet

Study Objectives

1. Who discovered the structure of DNA?
2. What is the central dogma of biology?
3. Describe the structure of DNA including base pairing.
4. Given a DNA sequence, write the complimentary DNA sequence.
5. Given a DNA sequence, write the complementary mRNA sequence.
6. Given an mRNA sequence and the genetic code chart, write the sequence of amino acids.
7. What is a triplet codon?
8. How does a ribosome know where the protein starts and stops?
9. Where inside of a eukaryotic cell does replication, transcription, and translation occur?
10. What are the enzymes used for DNA replication and transcription?