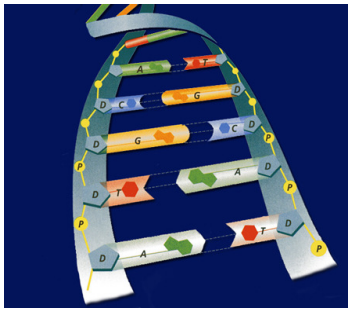
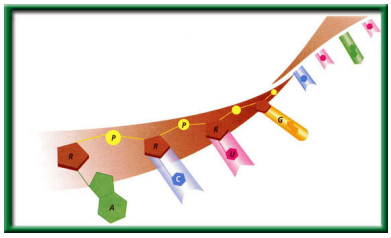
Protein Synthesis- Transcription and Translation



DNA (deoxyribonucleic acid) and RNA (ribonucleic acid) are nucleic acids. They are made up of smaller subunits called nucleotides. Nucleotides are made up of three main parts: a simple sugar (deoxyribose or D), a phosphate group, and one of four nitrogen bases: adenine (A), thymine (T), cytosine (C), and guanine (G). The nucleotides in DNA form two strands, which are held together in the center by the pairing of nitrogen bases. Nitrogen bases always join (or pair) in the same way. Thymine always pairs with adenine and cytosine always pairs with guanine in DNA.



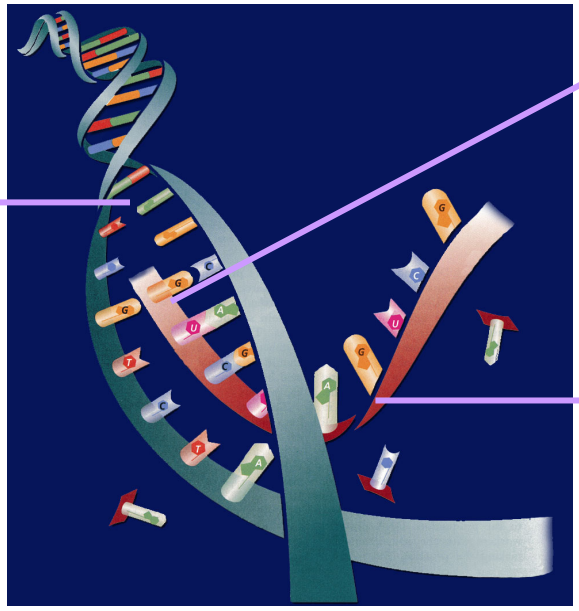
Like DNA, **RNA (ribonucleic acid)** contains four nitrogen bases, but instead of thymine, RNA contains a base called uracil (U). Unlike the double stranded DNA, RNA is made of a single strand of nucleotides, each of which contains the simple sugar ribose (R).

Transcription

DNA is found only in the cell's nucleus, and DNA contains the cell's instructions for how to make proteins. Proteins are made, however, in the cytoplasm of the cell (by the ribosomes). The information must somehow leave the nucleus, but DNA is not permitted to pass through the nuclear membrane. Instead, DNA can be copied into RNA, a copy of instructions that can leave the nucleus and go to the ribosomes. The process of copying DNA into RNA is called **transcription**. (Transcription results in an RNA copy of a DNA strand.) The main enzyme responsible for transcription is **RNA polymerase**.

If a strand of **DNA** is	TAC GCA TCG ATG
its complementary strand of **RNA** will be	AUG CGU AGC UAC

(Remember that RNA has U instead of T!)



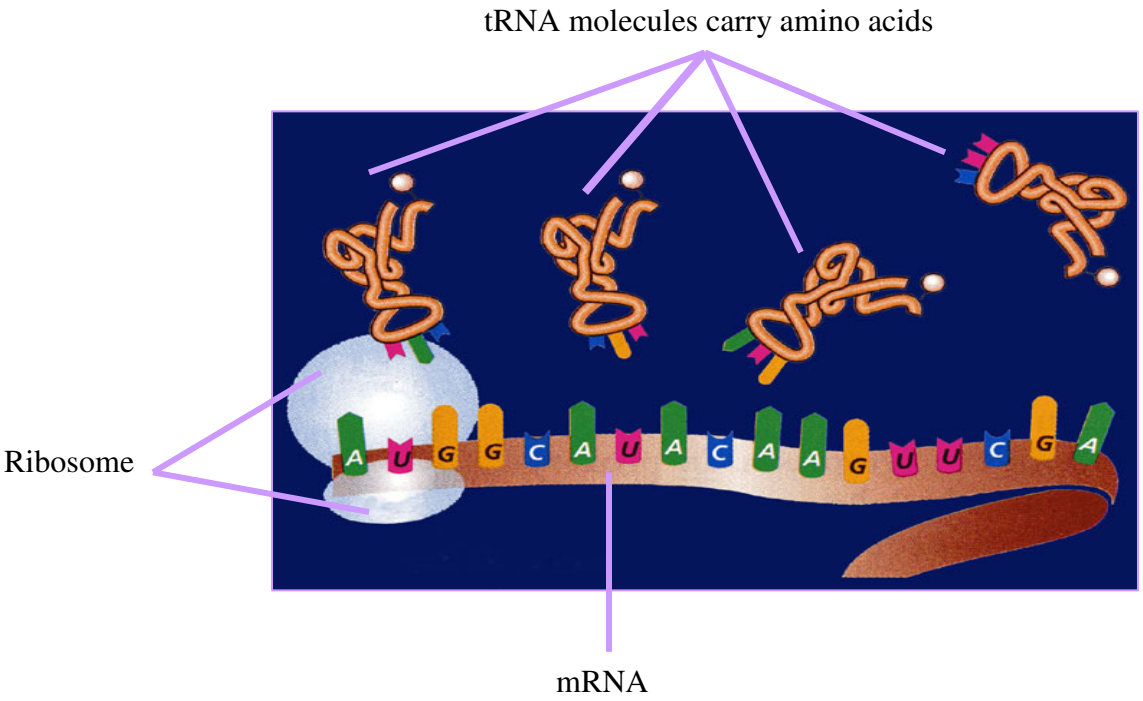
1. DNA molecule is unzipped

2. Free RNA nucleotides pair up with complementary DNA bases

3. A single strand of RNA is produced, which can break away, leave the nucleus, and find ribosomes

Translation

After transcription (DNA is copied into RNA), the messenger RNA (**mRNA**) leaves the nucleus where ribosomes can read the instructions and **make proteins (translation).** Remember that proteins are made up of subunits called amino acids. Translation involves transfer RNA (**tRNA**) molecules, which bring amino acids together in the correct order to build the correct proteins.



The ribosome reads the mRNA in three letter groups called **codons**. You can use a codon chart *(like the one shown below)* to determine which amino acid should be brought in.

1st letter	2nd letter: U	2nd letter: C	2nd letter: A	2nd letter: G	3rd letter
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	stop	stop	A
	Leu	Ser	stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

For example, if a sequence of mRNA is

AUG CAU UGC

then it is coding for the following amino acids:

Met His Cys

Practice

1. How are RNA and DNA similar? How are they different?

_____

_____

2. Which of the following base pairs with adenine (A) in RNA?
   A. Guanine (G)
   B. Uracil (U)
   C. Thymine (T)
   D. Cytosine (C)

3. In order to be transcribed, DNA molecules separate between which of the following parts?
   A. Sugars
   B. Nitrogen bases
   C. Phosphate groups
   D. Ends

4. Which of the following processes results in an RNA copy of a DNA strand?
   A. Transcription
   B. Translation
   C. Replication
   D. Mitosis

5. In order to be translated, RNA must travel to the cytoplasm. In order to reach the cytoplasm, this RNA must pass through
   A. the cell membrane
   B. the mitochondrion
   C. the environment surrounding the cell
   D. pores in the nuclear membrane

6. If a sequence of mRNA is CUG AGU GCA, which of the following is the DNA segment from which it was transcribed?
   A. CGC ATG CGG
   B. GAC UCA CGU
   C. GAG TAC GCC
   D. GAC TCA CGT

7. If a strand of mRNA is CUC GCA GAU, what is the sequence of amino acids that will be produced? *(use the codon chart provided above)*
   A. Ser His Lys
   B. Ile Met Thr
   C. Gly Leu Cys
   D. Leu Ala Asp

8. If a strand of mRNA is UGC CAU GCC, what is the sequence of amino acids that will be produced? *(use the codon chart provided above)*
   A. Cys His Ala
   B. Met Ile Ser
   C. Gly Ala Thr
   D. Tyr Trp Val

9. What is translation?