Life Science

Chapter 3
Protein Synthesis

RNA – Ribonucleic Acid

- Structure of RNA
  - **Nucleotide** made up of Phosphate group, **Ribose** Sugar and Nitrogenous base
  - Nitrogenous bases: Adenine, Guanine, **Uracil** and Cytosine
    - A-U and G-C
- **Three major difference between DNA and RNA**
  - i. RNA is a single strand, DNA is a double helix
  - ii. RNA there is no thymine. It's replaced by Uracil
  - iii. RNA has Ribose and DNA has Deoxyribose sugar

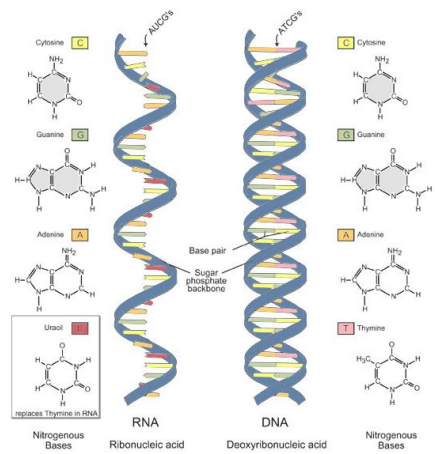
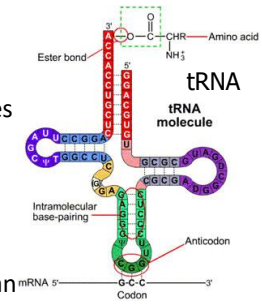
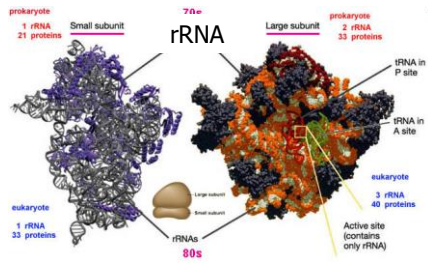


Image adapted from: National Human Genome Research Institute, Talking Glossary of Genetic Terms. Available at: www.genome.gov/Pages/Hyperion/DIR/VIP/Glossary/Illustration/rna.shtml.

RNA – 3 Types



- rRNA – Ribisomal RNA: found in the ribosomes it makes up part of the ribosome structure
- mRNA – messenger RNA: long single strand molecule, made in the nucleus during transcription, it travels to the ribosome and provides a code to manufacture proteins
- tRNA – transfer RNA: cross shaped molecule carrying an amino acid on one end and the "anti codon" on the other end.



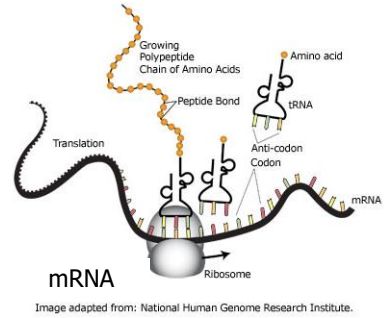
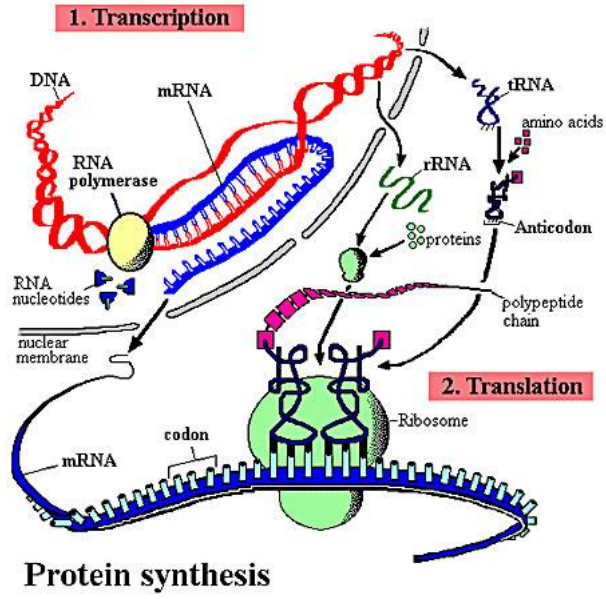


Image adapted from: National Human Genome Research Institute.

Protein Synthesis

(2 Parts)

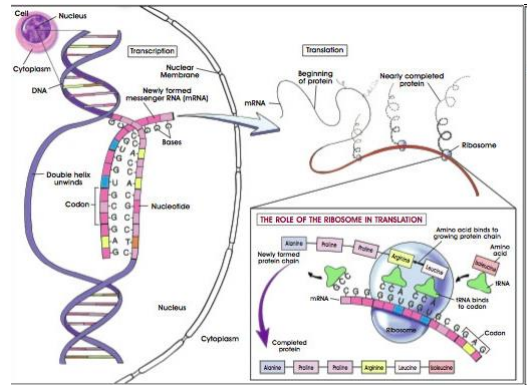
Transcription & Translation



Protein Synthesis – 2 Parts

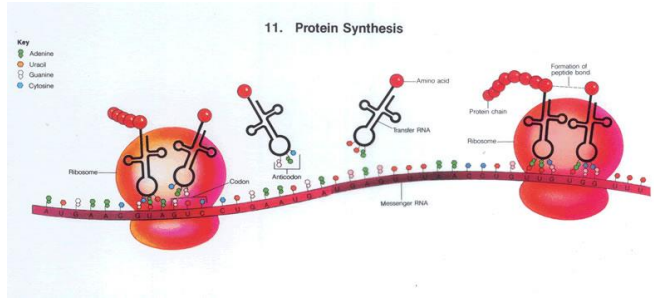
- **Transcription**: process by which a molecule of DNA is copied into a complimentary strand of mRNA
  - a. An enzyme splits one a portion of the DNA (the valuable "master plans") molecule
  - b. Another enzyme transcribes the DNA and takes RNA nucleotides and synthesizes a strand of mRNA (the usable "Blue prints")
  - c. mRNA moves out of the nucleus into the rough ER to a ribosome

mRNA made inside the nucleus



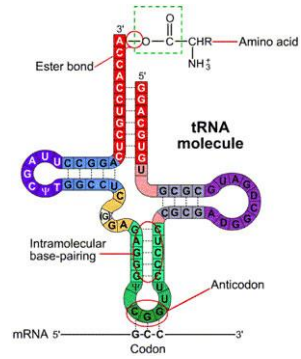
Protein Synthesis – 2 Parts

- **Translation**: Process of decoding the mRNA and attaching amino acids together to create a specific protein.
  - a. Proteins and Amino Acids
    - **Three nucleotides on the mRNA make up a "codon"**
    - Each codon specifies a particular amino acid
    - There are **20 different amino acids**
    - There are 64 different combinations of A, U, G, and C that a codon could have (4x4x4)
    - There are **three "stop"** codons acting as a "period" in a sentence
    - The "sentence" is that strip of mRNA produced by the section of exposed DNA



Protein Synthesis – 2 Parts

- Details of Translation:
- a ribosome (made up of a protein and rRNA) slides down the piece of mRNA, it's a "one-way" movement down the mRNA so there can only be one way to translate the mRNA code
- enzymes bring individual tRNA molecules to the ribosomes
  - i. tRNA is shaped like an "Upside down Cross"
    - 1. the bottom has three nucleotides exposed (the anti codon)
    - 2. the top has a site for the attachment of a specific amino acid
    - 3. 61 different tRNA's (one for each possible codon)
  - ii. the tRNA is lined up in a special order depending on the code of the mRNA
  - iii. as the tRNAs are lined up, the attached amino acid is removed and attached to the continuing chain of amino acids
  - iv. when the ribosome reaches a "stop" codon, the collection of amino acids is complete and a specific type of protein has been formed



Codon to Amino Acid

- Codon : Amino Acid
- UGG : Trytophan
- UGA : "Stop"
- ACC : Threonine
- CCU : Proline

First Base in Code Word	Second Base in Code Word: A	Second Base in Code Word: G	Second Base in Code Word: U	Second Base in Code Word: C	Third Base in Code Word
A	Lysine	Arginine	Isoleucine	Threonine	A
	Lysine	Arginine	Methionine	Threonine	G
	Asparagine	Serine	Isoleucine	Threonine	U
	Asparagine	Serine	Isoleucine	Threonine	C
G	Glutamic Acid	Glycine	Valine	Alanine	A
	Glutamic Acid	Glycine	Valine	Alanine	G
	Aspartic Acid	Glycine	Valine	Alanine	U
	Aspartic Acid	Glycine	Valine	Alanine	C
U	"Stop" codon	"Stop" codon	Leucine	Serine	A
	"Stop" codon	Trytophan	Leucine	Serine	G
	Tyrosine	Cysteine	Phenylalanine	Serine	U
	Tyrosine	Cysteine	Phenylalanine	Serine	C
C	Glutamine	Arginine	Leucine	Proline	A
	Glutamine	Arginine	Leucine	Proline	G
	Histidine	Arginine	Leucine	Proline	U
	Histidine	Arginine	Leucine	Proline	C

How to determine which codon codes for which one of the 20 different amino acids:

1. Find the 1st base on the left side of the table.
2. The middle base is then located on the top of the table. Where they intersect determines the 4 possible outcomes.
3. Find the 3rd base on the right side of the table, follow that row to the left until they all intersect. This identifies the amino acid or a "stop" codon.

C Ya….
No mas!!