PROTEIN SYNTHESIS

The Protein-making Process

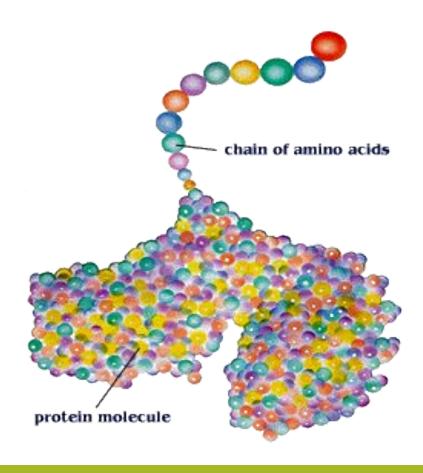
Protein Synthesis (Gene Expression) Notes

Proteins (Review)

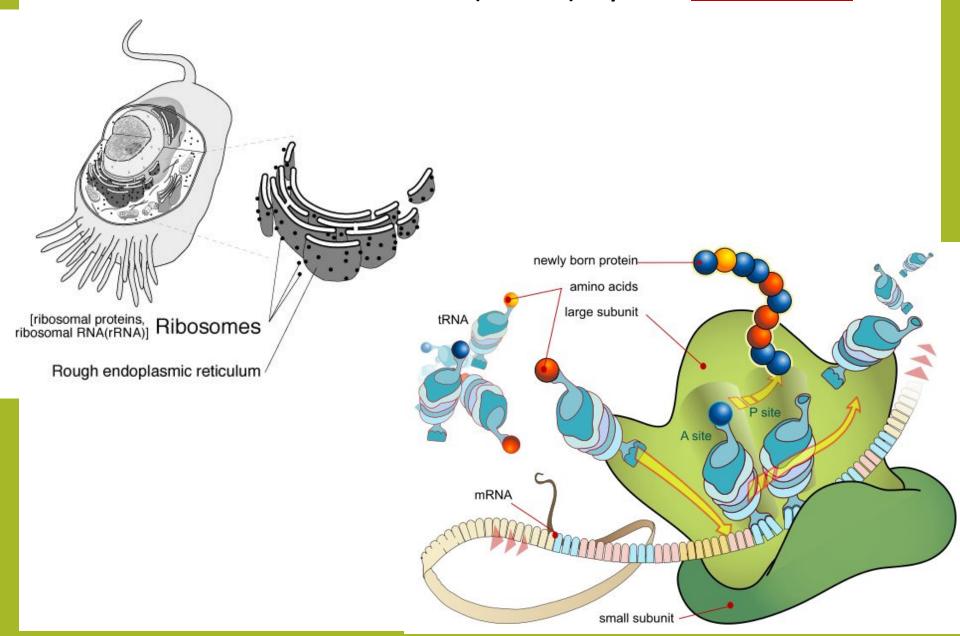
Proteins make up all <u>living</u> materials



- Proteins are composed of <u>amino acids</u> there are <u>20</u>
 different amino acids
- Different <u>proteins</u> are made by <u>combining</u> these 20 amino acids in different combinations



Proteins are manufactured (made) by the <u>ribosomes</u>



- Function of proteins:
- 1. Help fight disease
- 2. Build new body <u>tissue</u>
- 3. Enzymes used for digestion and other chemical reactions are proteins

(Enzymes **speed up** the **rate** of a reaction)

4. Component of all **cell membranes**



MAKING PROTEINS

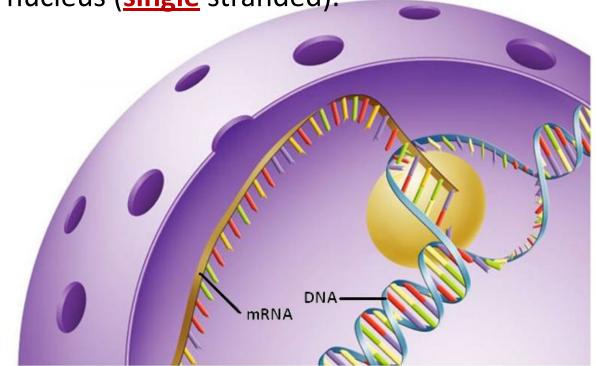
Step 1: Transcription

Making a Protein—Transcription

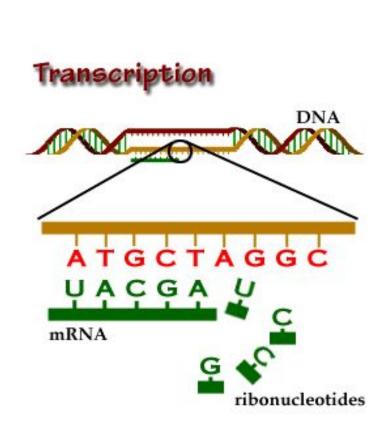
<u>First Step</u>: <u>Copying</u> of genetic information from <u>DNA</u> to <u>RNA</u> called <u>Transcription</u>

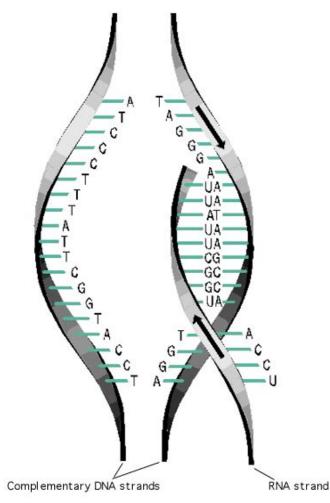
<u>Why</u>? DNA has the <u>genetic code</u> for the <u>protein</u> that needs to be made, but proteins are made by the ribosomes—ribosomes are outside the <u>nucleus</u> in the <u>cytoplasm</u>.

DNA is too <u>large</u> to leave the nucleus (<u>double</u> stranded), but RNA <u>can leave</u> the nucleus (<u>single</u> stranded).

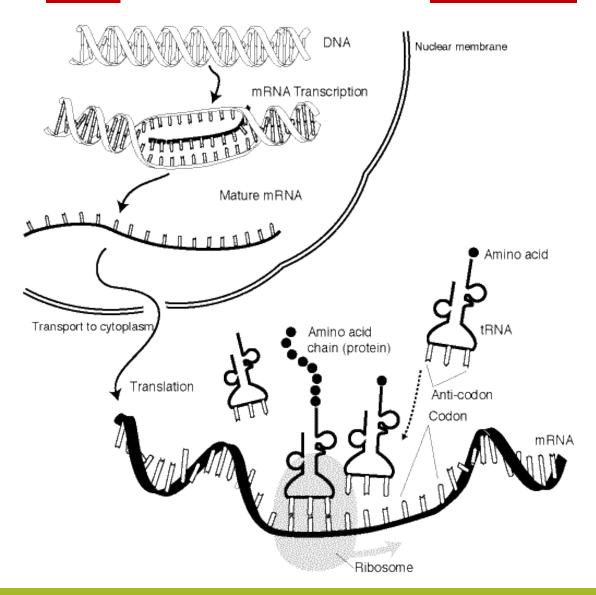


 Part of DNA temporarily <u>unzips</u> and is used as a <u>template</u> to assemble <u>complementary</u> nucleotides into <u>messenger RNA</u> (mRNA).





 mRNA then goes through the <u>pores</u> of the nucleus with the DNA <u>code</u> and attaches to the <u>ribosome</u>.

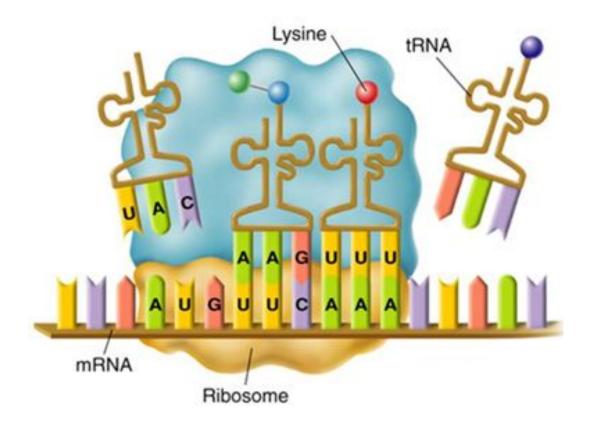


MAKING PROTEINS

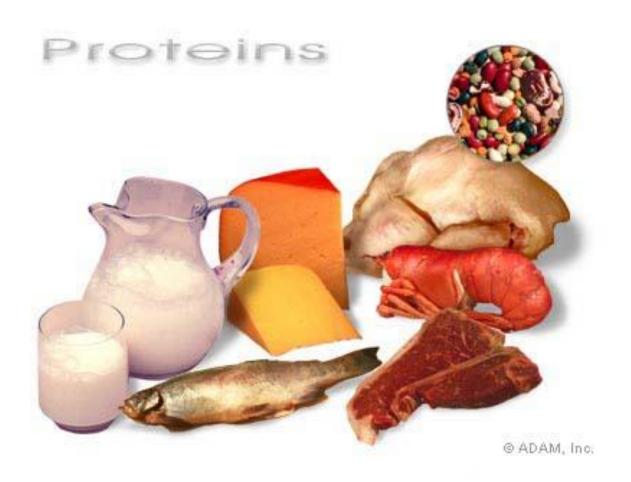
Step 2: Translation

Making a Protein—Translation

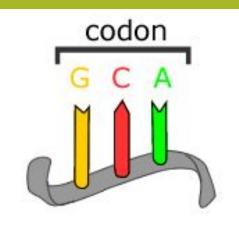
- Second Step: <u>Decoding</u> of mRNA into a <u>protein</u> is called <u>Translation</u>.
- •<u>Transfer RNA</u> (tRNA) carries <u>amino acids</u> from the cytoplasm to the <u>ribosome</u>.



These amino acids come from the <u>food we eat</u>. Proteins we eat are broken down into individual <u>amino acids</u> and then simply <u>rearranged</u> into new <u>proteins</u> according to the needs and directions of our <u>DNA</u>.

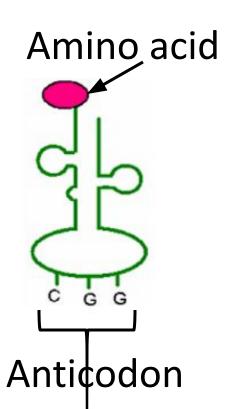


 A series of <u>three</u> adjacent <u>bases</u> in an mRNA molecule codes for a specific amino acid—called a <u>codon</u>.



 Each <u>tRNA</u> has 3 nucleotides that are <u>complementary</u> to the <u>codon</u> in mRNA.

• Each **tRNA** codes for a **different** amino acid.

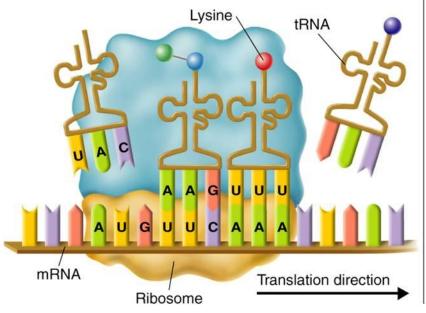


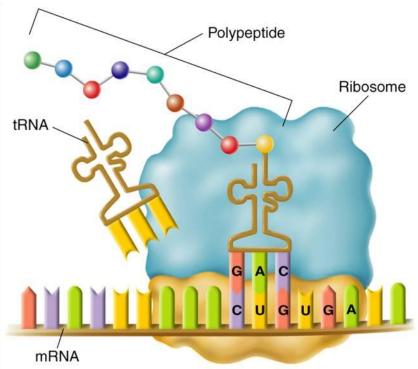
 mRNA carrying the <u>DNA instructions</u> and tRNA carrying amino acids meet in the ribosomes. **Nucleus** A Messenger RNA Messenger RNA is transcribed in the nucleus. mRNA Lysine Phenylalanine tRNA -Methionine **B** Transfer RNA The mRNA then enters the cytoplasm and attaches to a ribosome. Translation begins at AUG, the start codon. Each transfer RNA has an anticodon whose bases are complementary to a codon on the mRNA strand. The ribosome positions the start codon to attract its anticodon, which is part of the tRNA that binds methionine. The ribosome also binds the next codon and its Ribosome anticodon. Start codon mRNA

Amino acids are joined together to make a <u>protein</u>.

C The Polypeptide "Assembly Line"

The ribosome joins the two amino acids—methionine and phenylalanine—and breaks the bond between methionine and its tRNA. The tRNA floats away from the ribosome, allowing the ribosome to bind another tRNA. The ribosome moves along the mRNA, binding new tRNA molecules and amino acids.





D Completing the Polypeptide

The process continues until the ribosome reaches one of the three stop codons. The result is a complete polypeptide.

Polypeptide = Protein

Base

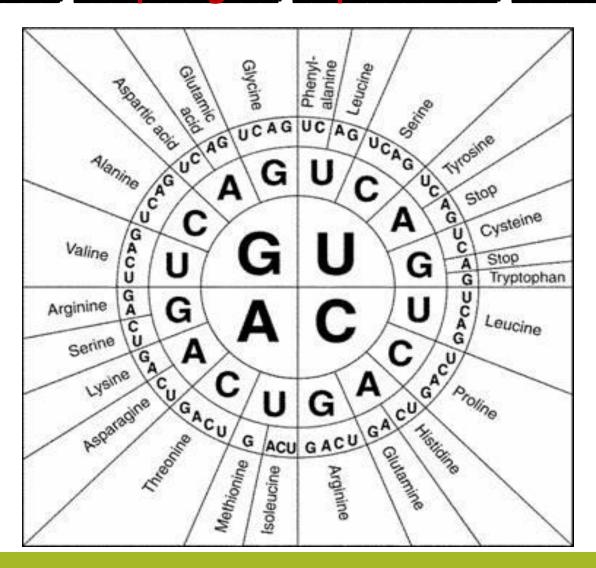
Genetic code has codons, which codes amino acids. 3 base = 1 codon = amino acid

2nd Base

	U		С		Α		G		
U	UUU	Phenylalanine Phenylalanine	UCU	Serine Serine	UAU	Tyrosine Tyrosine	UGU	Cysteine Cysteine	U
	UUA	Leucine	UCA	Serine	UAA	Stop	UGA	Stop	A
	UUG	Leucine	UCG	Serine	UAG	Stop	UGG	Tryptophan	G
С	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine	U
	CUC	Leucine	CCC	Proline	CAC	Histidine	CGC	Arginine	C
	CUA	Leucine	CCA	Proline	CAA	Glutamine	CGA	Arginine	Α
	CUG	Leucine	CCG	Proline	CAG	Glutamine	CGG	Arginine	G
Α	AUU	Isoleucine	ACU	Threonine	AAU	Asparagine	AGU	Serine	U
	AUC	Isoleucine	ACC	Threonine	AAC	Asparagine	AGC	Serine	C
	AUA	Isoleucine	ACA	Threonine	AAA	Lysine	AGA	Arginine	A
	AUG	Methionine (Start)	ACG	Threonine	AAG	Lysine	AGG	Arginine	G
G	GUU	Valine	GCU	Alanine	GAU	Aspartic Acid	GGU	Glycine	L
	GUC	Valine	GCC	Alanine	GAC	Aspartic Acid	GGC	Glycine	C
	GUA	Valine	GCA	Alanine	GAA	Glutamic Acid	GGA	Glycine	Д
	GUG	Valine	GCG	Alanine	GAG	Glutamic Acid	GGG	Glycine	G

AUG/AAC/GAC/UAA

Methionine / Asparagine/Aspartic Acid/ Stop



Protein synthesis

