Protein Synthesis

Total Recall:

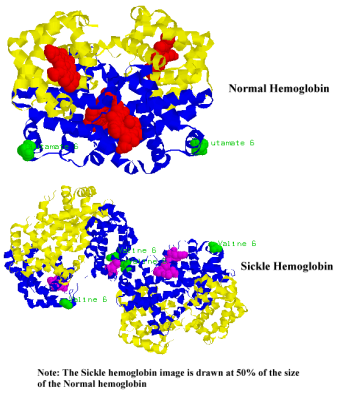
1. Where are proteins made in a cell?

   AT THE RIBOSOME

2. Where are the instructions for all of the life functions contained in a cell?

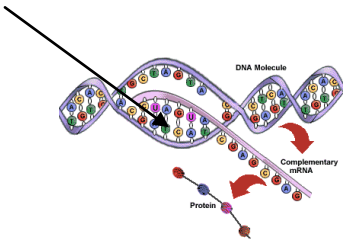
   IN THE DNA BASE SEQUENCE IN THE NUCLEUS

The ribosome receives instructions regarding what proteins to create and at the appropriate time. These instructions are originally found in DNA in the nucleus. A segment of DNA that codes for a particular protein is referred to as a **gene**. The specific sequence of nitrogen bases contained in the gene determines the **shape** of the protein and in turn, its **function**.



Note: The Sickle hemoglobin image is drawn at 50% of the size of the Normal hemoglobin

STEP 1: In order to access the gene within the DNA structure, the segment of **DNA must unwind and unzip**.



STEP 2: A molecule of messenger RNA (mRNA) is created using the gene as a template.

1. Why does mRNA have to be created if the gene on DNA contains the instructions for the protein? (Hint : Recall why starch can't diffuse through the cell membrane even if there is a concentration gradient)

DNA IS TOO LARGE TO FIT THROUGH THE NUCLEAR MEMBRANE AND THEREFORE CANNOT LEAVE THE NUCLEUS.

2. Compare DNA to RNA and explain why mRNA is ideal for delivering the instructions.
DNA IS TOO LARGE AND IS DOUBLE STRANDED, MRNA IS ONLY THE LENGTH OF THE GENE THAT CODES FOR THE PROTEIN AND IS SINGLE STRANDED.

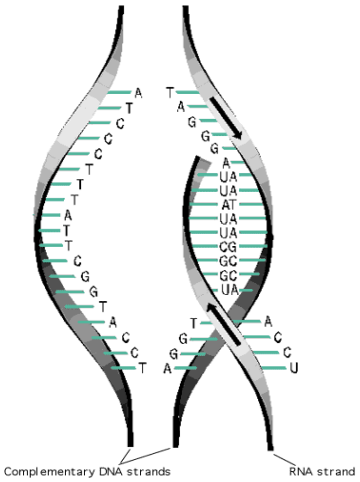
3. Examine the transcription of mRNA from the DNA template at the right; what base is exclusive to RNA? What base from DNA does it replace?

URACIL (U) IS EXCLUSIVE TO RNA AND REPLACES THYMINE (T) IN DNA

*AN "A" ON DNA WILL PAIR WITH A "U" ON MRNA

4. If a gene on DNA reads AGTCCATTGCCA, what would the sequence of the complimentary mRNA strand read?

UCAGGUAACGGU



STEP 3:

5. Now that mRNA has the instructions for a particular protein, where does it go when it leaves the nucleus?

LIKE FAMOUS DAVIS SENT HIS NEPHEW, THE MESSENGER TO THE RIBOSOME COOKIE FACTORY WITH THE RECIPES FOR HIS COOKIES, THE MRNA BRINGS THE INSTRUCTIONS FOR A PROTEIN TO THE RIBOSOME

STEP 4:

6. When mRNA gets to the ribosome, the mRNA is translated in groups of **THREE** bases referred to as **codons**. Record the mRNA sequence you transcribed in question #4 and determine the number of codons found here.

JUST LIKE DAVIS' RECIPES HAD TO BE TRANSLATED AT THE COOKIE FACTORY, THE INSTRUCTIONS FOR THE PROTEIN TO BE MADE MUST BE TRANSLATED AT THE RIBOSOME.

UCA GGU AAC GGU

1 1 1 1 = 4 CODONS

7. Each codon codes for a particular amino acid. Use the codon chart below to determine the amino acid sequence coded for by the mRNA sequence above.

UCA GGU AAC GGU

SER GLY ASN GLY

Universal Genetic Code Chart
Messenger RNA Codons and the Amino Acids They Code For

FIRST BASE	SECOND BASE: U	SECOND BASE: C	SECOND BASE: A	SECOND BASE: G	THIRD BASE
U	UUU, UUC = PHE; UUA, UUG = LEU	UCU, UCC, UCA, UCG = SER	UAU, UAC = TYR; UAA, UAG = STOP	UGU, UGC = CYS; UGA = STOP; UGG = TRP	U C A G
C	CUU, CUC, CUA, CUG = LEU	CCU, CCC, CCA, CCG = PRO	CAU, CAC = HIS; CAA, CAG = GLN	CGU, CGC, CGA, CGG = ARG	U C A G
A	AUU, AUC, AUA = ILE; AUG = MET or START	ACU, ACC, ACA, ACG = THR	AAU, AAC = ASN; AAA, AAG = LYS	AGU, AGC = SER; AGA, AGG = ARG	U C A G
G	GUU, GUC, GUA, GUG = VAL	GCU, GCC, GCA, GCG = ALA	GAU, GAC = ASP; GAA, GAG = GLU	GGU, GGC, GGA, GGG = GLY	U C A G

Record the three-letter abbreviations for the amino acids in the correct order based on the sequence of bases in the mRNA:

SER GLY ASN GLY

8. How many amino acids exist in nature (count the number in the chart above)? How then are there thousands of proteins?

20 (THE ORDER AND NUMBER OF THESE AMINO ACIDS RESULT IN ALL OF THESE DIFFERENT PROTEINS)

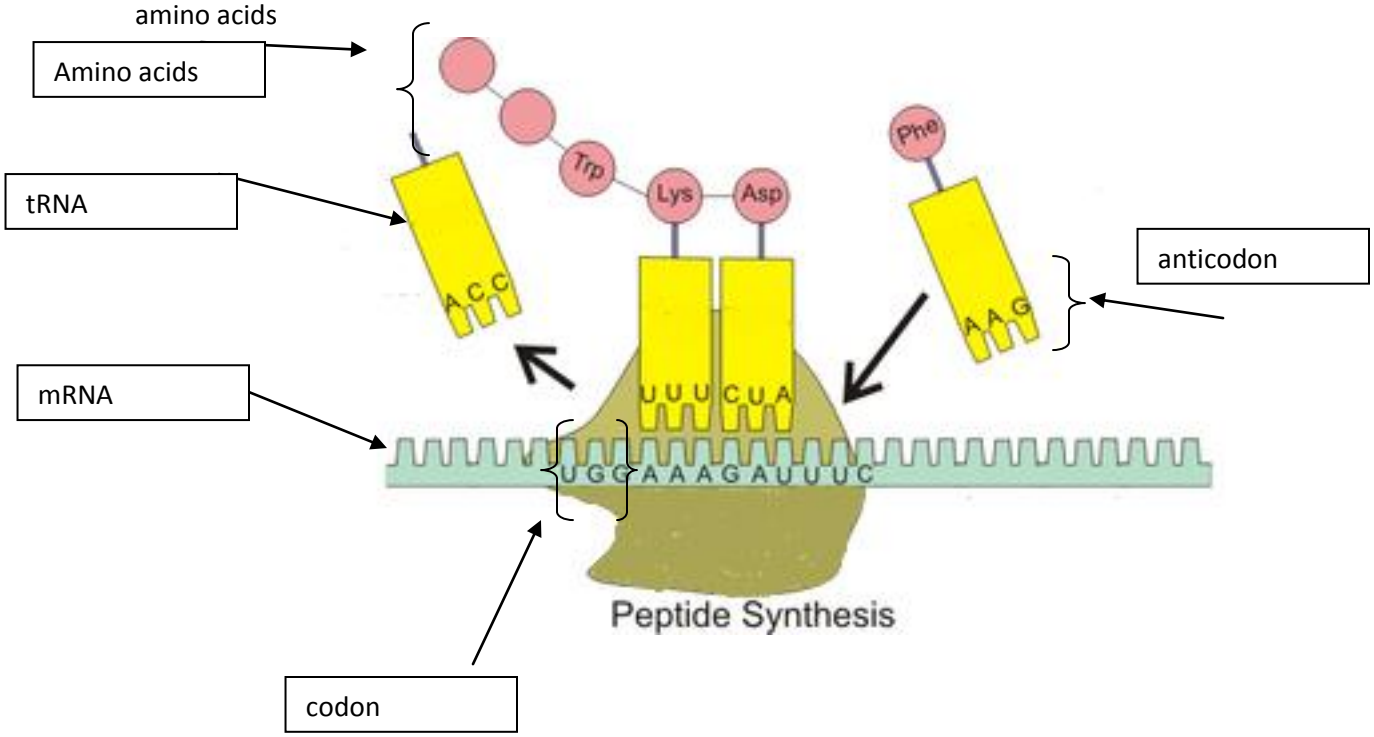
STEP 5:

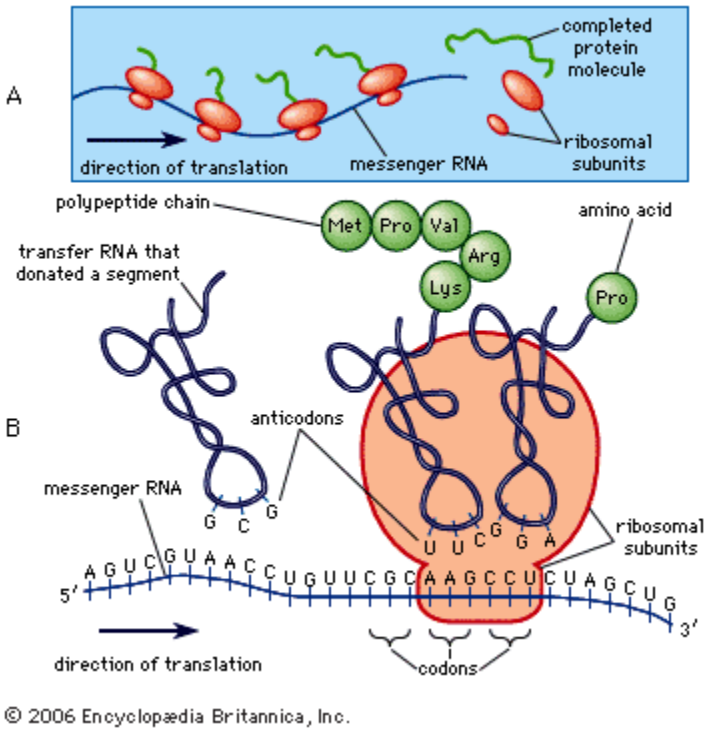
- Once the type and order of amino acids in a protein have been translated by the ribosome, the amino acids need to be transported over to the correct location to join together to create a protein.
- Another type of RNA helps transport a specific amino acid over to a specific mRNA codon at the ribosome.
- This RNA is referred to as **transfer RNA (tRNA)** and has an **anticodon** sequence that compliments the codon on mRNA at the ribosome.

9.If a codon on mRNA reads CCG, what would the anticodon on tRNA have to read in order to stop at this codon and drop off an amino acid?

GGC

10.Examine the diagram below and label the following: ribosome, mRNA, tRNA, codon, anticodon, amino acids





11.In order for tRNA to deliver the amino acid proline to the correct location in the diagram above, what must its anticodon read?

THE TRNA CARRYING THE AMINO ACID PROLINE (PRO) HAS THE ANTICODON OF GGA, MAKING IT ABLE TO STOP AT THE CODON ON MRNA READING CCU

STEP 6:

- The ribosome continues translating the codons on mRNA until it translates a codon that reads STOP.
- This informs the ribosome that the protein is completed and ready to be transported by the endoplasmic reticulum and packaged into its final, correct shape at the golgi complex.

12. Examine the Universal genetic code chart and provide an example of a STOP codon.

UGA, UAA, UAG

STEP 7: Neighboring amino acids are connected by bonds known as **peptide bonds**, creating a protein or **polypeptide**.

*What would happen to the protein if the first triplet on DNA changed from AGT to CGT?THE MRNA WOULD NOW READ GCA INSTEAD OF UCA AND THE AMINO ACID SER WOULD BE REPLACED BY THE AMINO ACID ALA (THE WRONG AMINO ACID WOULD BE BROUGHT OVER)