Name_____ Block:___

Protein Synthesis

Part 1 Transcription:

1. Consider the following DNA strand: TAC CGT TCT GCT AAA TAT ACC ACT

Note here we are just looking at one side of the DNA molecule which remember is double stranded!

A. The product of transcription is which one of the following?

a. DNA
b. RNA
b. Protein

B. Write the sequence of bases for the product of transcription here:

AUG GCA AGA CGA UUU AUA UGG UGA

C. Where in eukaryotic cells does transcription take place (cytoplasm or nucleus)?

NUCLEUS

D. To what part of the cell do the products of transcription travel?

a. Lysosome
b. Ribosome in the cytoplasm or in rough ER
c. Nucleolus
d. Smooth ER

E. What enzymes are involved in transcription?

HELICASE AND RNA POLYMERASE

F. What type of bonds need to be broken in order for the mRNA transcript to be made?

HYDROGEN BONDS THAT HOLD TOGETHER THE DNA

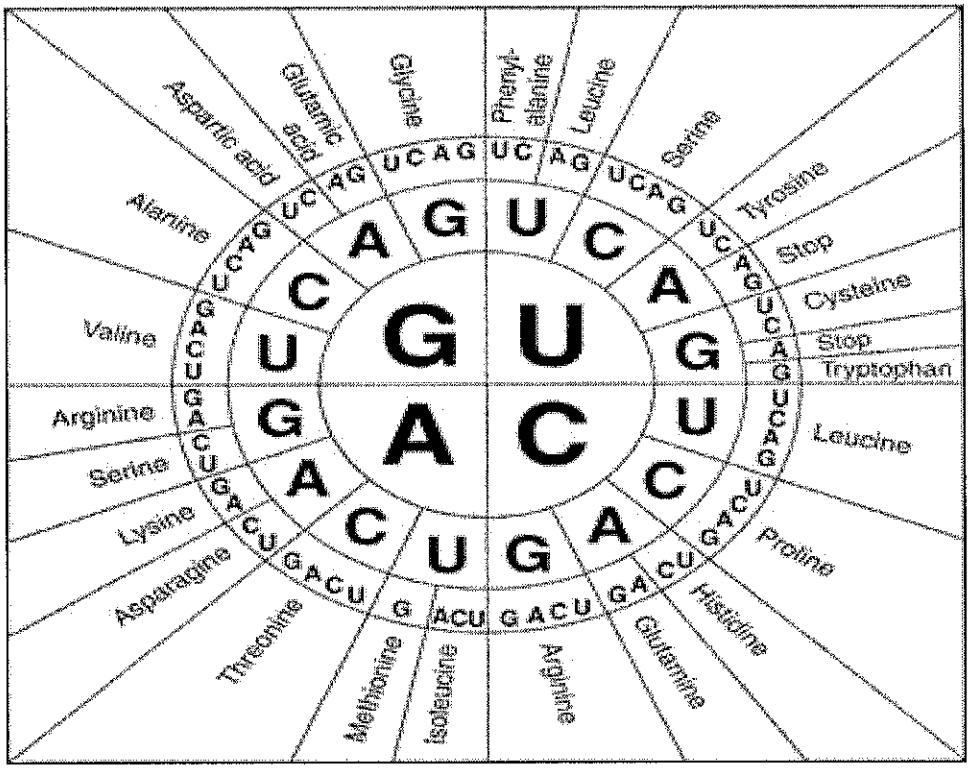
G. How are complimentary base pairing used when creating the RNA transcript?

THE RULES "A MATCHES WITH U" AND "G MATCHES WITH C" ARE USED IN MAKING RNA

Part 2 Translation

2. A. What is the third **codon** in the mRNA you produced in 1. B.?

AGA



2.B. Using the genetic code table above, translate the sequence of codons in the mRNA from 1.B. into the sequence of amino acids in the protein. Write the sequence in the space below:

AUG GCA AGA CGA UUU AUA UGG UGA

Methionine, alanine, arginine, arginine, phenyl-alanine, isoleucine, tryptophan, STOP

2. C. Where in the cell does translation take place? ribosome

2. D. What is the function of the following in translation?

Messenger RNA brings code to ribosome

Ribosomal RNA at the ribosome

Transfer RNA gets the amino acid and anticodon that matches with each codon on the mrNA

2.E. Distinguish between the term codon and anitcodon. Tip Remember that the sequence of codons specifies the sequence of amino acids. Thus always translate the codons which are only on mRNA.

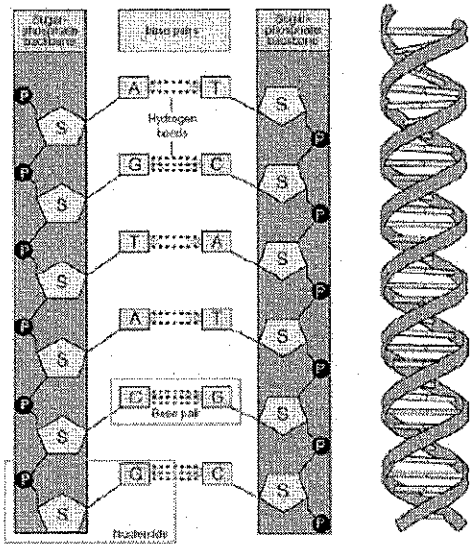
Part 3: Protein Synthesis: Look at the DNA helix below. Write an essay to the right of the figure that explains how the code in the DNA can be used to make a protein. Use the following terms in your answer: nucleus, dna, rna, translation, transcription, codon, peptide bond, genetic expression

Part 4. Point Mutations.

A mutation is a change in the genetic material. Mutations are important because they provide new genetic variation required for evolution. Mutations may involve a change in a single nucleotide in the DNA or they may involves large scale changes in chromosome structure. Here we will consider only one type of mutation, a point mutation.

A **point mutation** is a change in a single nucleotide in a gene's DNA . Three types of mutations are deletions, insertions and substitutions. In **deletions**, a nucleotide is left out when the DNA is duplicated, while **insertions** involve an addition of a nucleotide between two others. In **substitutions** one nucleotide is mistakenly replaced by another, T for A for example.

Fig. 1



Proteins are crucial to life. They carry out the functions of our genes. Proteins are synthesized during G1 phase of interphase. They are synthesized in two steps: transcription and translation.

Transcription is the first step in protein synthesis. This step occurs in nucleus of the cell. A specific segment of the DNA is unwound. Helicase, an enzyme capable of breaking the bonds between the nitrogen bases in DNA, splits apart the double helix. The exposed DNA template is then read by RNA polymerase and transcribed into mRNA (messenger). In fig. 1, the sequence "AGTACG" could be the DNA template. The mRNA transcript made from this template would be "UCAUGC". Messenger RNA leaves the nucleus and the DNA returns to is original twisted state.

The mRNA travels to a ribosome in the cytoplasm, this is the site of protein synthesis. Here transfer the codons on the mRNA are translated into amino acids. Transfer RNA (tRNA) goes and gets the matching anticodon and amino acid that matches up with each triplet base-pair sequence on the mRNA. The tRNA continues reading each triplet base-pair until all codons are translated or a "Stop" codon is reached. Once completed, a polypeptide chain of amino acids is the product. This protein chain folds up and moves throughout the cell to carry out its particular function.

Proteins carry out a number of functions in our cells and in our bodies. They are enzymes that speed up chemical reactions. They are antibodies that help us to fight infections and they are involved in muscle movement. Most importantly, enzymes carry out the functions of our genetic code, in DNA.

Insertions and deletions are often called **frame-shift** mutations. We will consider these first.

Frameshift Mutations

4. Consider the original DNA strand from 1. A: TAC CGT TCT GCT AAA TAT ACC ACT

A. Delete the 10th nucleotide in the original DNA strand and write the resulting DNA strand here:

TAC CGT TCT GCT AAA TAT ACC ACT

TAC CGT TCT CTA AAT ATA CCA CT (MUTATED STRAND)

B. Transcribe the mutated DNA

AUG GCA AGA GAU UUA UAU GGU

C. Write the sequence of amino acids in the polypeptide resulting from translating the molecule produced in 2B:

Methionine, alanine, arginine, aspartic acid, Leucine, Tyrosine, Glycine (the two bases at the end are useless here)

D. Do you think the resulting polypeptide will work well for whatever function the original protein is used for? No, the amino acid sequence has changed. This will most likely result in a new protein (different phenotype)

Substitution mutations:

A **base substitution** is simply a replacement of one base in the original DNA for another, for instance T for A.

Consider the original DNA strand from 1.A: TAC CGT TCT GCT AAA TAT ACC ACT

5A. Replace the 10th nucleotide (G) in the original DNA strand with T. Write the mutated DNA here:

TAC CGT TCT TCT AAA TAT ACC ACT

AUG GCA AGA AGA UUU AUA UGG UGA

5B. Transcribe the mutated DNA from 4.A and write the resulting molecule here:

Methionine, alanine, arginine, arginine, phenyl-alanine, isoleucine, tryptophan, STOP

It is the same sequence! So this mutation would not result in any major changes. The protein expressed would be the same ☺