I. PROTEIN SYNTHESIS =

Why is protein synthesis so important?

Some important roles of proteins in the body:

1) 

2) 

3) 

4) 

5) 

Which organelles will be involved in protein synthesis?

What role does DNA play in protein synthesis? What is a “gene”?

II. THE BIG PICTURE OF PROTEIN SYNTHESIS

a) 

b) 

c)
III. A “SIMPLE” 9-STEP PROCESS:

Step 1: Some signal occurs that asks for a specific protein to be produced

   What are some examples of this signal?

Step 2: Acetylation: The section of DNA with the needed gene is unwound so that it is accessible.

   ![Acetylation diagram]

   Question: Why aren’t DNA genes always easily accessible?

Step 3: The two DNA strands are separated so that its nucleotide BASES are accessible.

   ![DNA separation diagram]

   DNA bases = guanine (G), cytosine (C), adenine (A), and thymine (T)

   DNA base pairings:
III. A “SIMPLE” 9-STEP PROCESS: (cont.)

Step 4: TRANSCRIPTION: DNA bases are matched with their complementary RNA bases.

In this step a “copy” is made from the “original”. This copy is similar, but not identical. You can use the analogy of PARAPHRASING. Paraphrasing means saying the same general thing in a different way. RNA is coding for the same protein using slightly different “words” than DNA used.

RNA bases = guanine (G), cytosine (C), adenine (A), and uracil (U)

DNA to RNA pairings:

<table>
<thead>
<tr>
<th>DNA Base</th>
<th>RNA Base</th>
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<tbody>
<tr>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>T</td>
<td>U</td>
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<tr>
<td>A</td>
<td>A</td>
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</tbody>
</table>

Question: Why can’t RNA use thymine as a base?

The result of gene transcription is a strand of ____________________________________.

Each group of three bases form a CODON representing an AMINO ACID (or a start or stop code).
III. A “SIMPLE” 9-STEP PROCESS: (cont.)

Step 5: The strand of mRNA leaves the nucleus.

Step 6: A ribosome links to the mRNA strand and starts “reading” it.

Step 7: TRANSLATION: A TRANSFER RNA (tRNA) molecule whose ANTICODON fits with the mRNA CODON brings the matching amino acid to the ribosome.

Matching Codons and Anticodons

<table>
<thead>
<tr>
<th>First Position</th>
<th>Second Position</th>
<th>Third Position</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>U</td>
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<tr>
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<td>met</td>
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<td>CAA</td>
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<td>met</td>
</tr>
</tbody>
</table>

Phe = Phenylalanine; Leu = Leucine; Ile = Isoleucine; Met = Methionine; Val = Valine; Ser = Serine; Pro = Proline; Thr = Threonine; Ala = Alanine; Tyr = Tyrosine; His = Histidine; Gln = Glutamine; Asn = Asparagine; Lys = Lysine; Asp = Aspartic Acid; Glu = Glutamic Acid; Cys = Cysteine; Trp = Tryptophan; Arg = Arginine; Gly = Glycine
III. A “SIMPLE” 9-STEP PROCESS: (cont.)

**Step 8:** Repeat Step 7 with the next mRNA codon. The ribosome then binds the two amino acids together with a peptide bond.

![Diagram showing the ribosome binding two amino acids](image)

**Step 9:** Repeat Steps 7 & 8 until the “stop code” is reached and the entire strand of mRNA has been translated.

![Diagram showing the ribosome translating mRNA](image)

**NET RESULT:**

**Protein synthesis practice:**
IV. POST-TRANSLATIONAL PROCESSING AND PACKAGING

Which organelles will be involved in processing and packaging new proteins?

V. WHAT CAN GO WRONG & CAN IT BE FIXED?

Some sources of errors and examples:

1. 

2. 

3. 

[Gene Therapy diagram]
We're about to build a small protein - pretty much like a cell builds proteins. First, we'll begin with a nucleic acid. Here is a short sequence of bases in one strand of a nuclear DNA.

The gene for our protein located in this strand. The bases for this gene are enclosed in the box.

... T A T T A C A G G C A A C G T A C C A T T C G G A ...

The sequence of bases in this gene are a blueprint for the order of amino acids in a protein. Two processes - transcription and translation - are needed to produce copies of this protein.

Process #1: Transcription

Transcription takes place in the nuclei of cells. Bases in a DNA gene pair with bases in nucleotides. Transcription produces messenger RNAs (mRNAs) by adding one nucleotide after another. The sequence of bases in the gene provides a template for the sequence of bases in the messenger RNA.

The bases in the gene shown above are repeated here. Based on the sequence of bases in the gene, what is the order of bases in the mRNA produced during TRANSCRIPTION of the gene in the box above? Write the letter for a base in mRNA on each line. (Note: remember that an RNA is being produced.)

DNA gene T A C A G G C A A C G T A C C A T T
mRNA

Cells form multiple copies of mRNA from a single gene in the nucleus. Following their production during Transcription, mRNAs leave the nucleus through pores in the nuclear envelope and enter the cytoplasm where Translation occurs.

There are six codons in this strand of mRNA. Transfer the mRNA codons from above to these blanks:

mRNA codon #1 mRNA codon #2 mRNA codon #3 mRNA codon #4 mRNA codon #5 mRNA codon #6

Process #2: Translation

Translation takes place in the cytoplasm of cells. Copies of mRNA join ribosomes and transfer RNAs (tRNAs) bring in certain amino acids in the proper order as the proteins are built amino acid by amino acid.

The job here is to pair codons in mRNA with anticodons in tRNA. What are the tRNA anticodons for the mRNA codons listed above?

tRNA anticodon #1 tRNA anticodon #2 tRNA anticodon #3 tRNA anticodon #4 tRNA anticodon #5 tRNA anticodon #6

Finally... the key question... what is the order of amino acids in this polypeptide chain? Using the Anticodon Chart in your lecture notes, pair up the tRNA anticodons with their associated amino acids (AA).

AA #1 AA #2 AA #3 AA #4 AA #5

Why are only five amino acids listed when there are six anticodons?

Can we call our final product a functional protein? What else will probably happen to this polypeptide chain?