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Protein Synthesis Problems

Use the same DNA kits as we did for DNA Replication to complete this page. You will also need to use the mRNA codon chart on this page to determine which amino acids correspond to which codon sequence.

mRNA Codon Chart:

A A U Asparagine A A C	C A U Histadine C A C	G A U Aspartic acid G A C	U A U Tryosine U A C
A A A Lysine A A G	C A A Glutamine C A G	G A A Glutamic acid G A G	U A A Stop U A G
A C U A C C Threonine A C A A C G	C C U C C C Proline C C A C C G	G C U G C C Alanine G C A G C G	U C U U C C Serine U C A U C G
A G U Serine A G C	C G U C G C Arginine	G G U G G C Glycine	U G U Cysteine U G C
A G A Arginine A G G	C G A C G G	G G A G G G	U G A Stop U G G Tryptophan
A U U A U C Isoleucine	C U U C U C Leucine	G U U G U C Valine	U U U Phenylalanine U U C
A U A A U G Methionine	C U A C U G	G U A G U G	U U A Leucine U U G

PART A: Transcription (this takes place in the nucleus)

1. Build the following DNA molecule using your DNA kits just like we did last time:

left rail (blue) T T C G C G C T A C G A A T T A C G T A T C C C T A A
right rail (yellow) A A G C G C G A T G C T T A A T G C A T A G G G A T T

2. Act as the enzyme DNA Transcriptase, and "unzip" your DNA molecule (i.e. prepare it like you did for DNA replication).
3. Use the RNA nucleotides (pink – phosphate, ribose sugar, base) to transcribe an mRNA molecule using the right (yellow) rail of DNA.

Record the sequence of bases in this mRNA below:

4. Carefully slide your mRNA (pink) away from the DNA (i.e. out of the nucleus and to a ribosome) and reform your original DNA molecule. Keep this DNA for future use.

PART B: Translation (this takes place at the ribosome)

5. Your role will be to act as a ribosome, translating mRNA from left to right. Use your table of mRNA codons and prepare the appropriate tRNA molecules (either blue or green, but labeled tRNA), and the amino acid they will carry (using the mRNA codon chart). Continue to build the amino acid sequence.

Record the amino acid sequence below:

Try to complete this section without your DNA kits, as you will not have them for the quiz. You will never have to memorize the mRNA codon chart.

mRNA Codon Chart:

A A U Asparagine A A C	C A U Histadine C A C	G A U Aspartic acid G A C	U A U Tryosine U A C
A A A Lysine A A G	C A A Glutamine C A G	G A A Glutamic acid G A G	U A A Stop U A G
A C U A C C Threonine A C A A C G	C C U C C C Proline C C A C C G	G C U G C C Alanine G C A G C G	U C U U C C Serine U C A U C G
A G U Serine A G C	C G U C G C Arginine	G G U G G C Glycine	U G U Cysteine U G C
A G A Arginine A G G	C G A C G G	G G A G G G	U G A Stop U G G Tryptophan
A U U A U C Isoleucine	C U U C U C Leucine	G U U G U C Valine	U U U Phenylalanine U U C
A U A A U G Methionine	C U A C U G	G U A G U G	U U A Leucine U U G

6. Try an example without your DNA model:

DNA *left* C G T A A C G C G C G A A T C G C G A T C
 right G C A T T G C G C G C T T A G C G C T A G

a. Transcribe the left rail of DNA and record the mRNA that is produced.

b. Translate the mRNA (using the table of mRNA codons & amino acids) and record the amino acid sequence that this gene codes for.

c. Use the mRNA and amino acid sequence from above (6. b) and determine the tRNA anticodons that would be used to transport the amino acids.

DNA – left rail	C G T	A A C	G C G	C G A	A T C	G C G	A T C
mRNA codons							
Amino acid							
tRNA anticodons							

PART C: Mutation – Use your DNA kit to help with this question

1. A mutation is defined as any change in the base pairs of a gene.
 - a. Use the DNA molecule from question 6 above. Reading from left to right, mutate the gene by removing the first T - A base pair that you find.
Record the new DNA sequence below:
 - b. Acting as the enzyme DNA transcriptase, "unzip" your DNA molecule.
 - c. Use the RNA nucleotides to transcribe a mRNA to the left rail of DNA.
Record the mutated sequence of bases in this mRNA below:
 - d. Carefully slide your mRNA away from the DNA (out of the nucleus) and reform your original DNA molecule.
 - e. Your role will be to act as a ribosome, translating mRNA from left to right. Use your table of mRNA codons and prepare the appropriate tRNA molecules and the amino acid they will carry.
Continue to build the amino acid sequence and record this sequence below:
2. Describe (in general terms) how a mutation may affect the amino acid sequence of a protein being synthesized.
3. Do you think that all mutations will alter the amino acid sequences of the protein being synthesized (Hint: Look at the mRNA codon chart...)? Why?

PART D: Mapping Genes

Geneticists are often claiming that they have found the gene for a particular trait or disease. These geneticists can determine the base pairs of a gene if they know the amino acid sequence of the protein it codes for (i.e. they work backwards using the codon charts to map DNA).

Given the amino acid sequence for a portion of a protein, determine the DNA or portion of the gene that codes for this protein.

phenylalanine - glutamine - arginine - arginine - leucine - threonine - arginine - glycine

mRNA U U C C A G C G G C G U C U C A C A C G A G G G

DNA