

Review Sheet Gene to Protein (Transcription & Translation)

Lester BIOL 150

General things to do to prepare for the exam:

- study the PowerPoints
- write out the answers to the learning objectives found with each PowerPoint
- listen to my lecture recordings

Chapter 17

Explain the one gene-one polypeptide hypothesis. How is this different from the one gene-enzyme and one gene-one protein hypotheses?

Describe: mRNA, tRNA, and rRNA.

Which type of cell can synthesize a protein faster, prokaryote or eukaryote? Why?

What is the central dogma of biology?

In general, describe the process of transcription and translation.

What is a triplet codon?

Be able to write a complementary mRNA sequence and then use the genetic code chart to write the sequence of amino acids corresponding to that mRNA.

Explain why the genetic code is redundant.

All polypeptides start with which codon?

What are the three stop codons?

Which enzyme synthesizes RNA? How many are there in eukaryotes? Prokaryotes?

How does the above enzyme know where a gene starts and stops? In which direction is RNA synthesized?

Describe the three stages of transcription?

Why are transcription factors required? What is the TATA box?

Describe the different modifications that happen to the mRNA in a eukaryote. What is the function of these modifications? Do prokaryotes modify mRNA?

What are introns and exons? How are the introns removed? Do bacteria have introns?

What is RNA splicing and how does it occur?

What is the spliceosome? Ribozyme?

Describe alternative RNA splicing.

What is meant by the "wobble" of a codon?

What does tRNA do? What is an anticodon? Be able to write the anticodon from an mRNA.

What does aminoacyl-tRNA synthetase do? How many of them are there? Why?

Don't worry about E, P, and A sites on the ribosome.

Describe the three stages of translation.

What are polyribosomes? How do they benefit a cell?

Describe the post-translational modification of proteins.

How do proteins know where to be delivered inside of a cell?

List and describe the major types of RNA's.

Compare and contrast prokaryotes and eukaryotes with regard to transcription and translation.

What is a mutation?

What are the possible consequences of a mutation?

What is a point mutation? Missense mutation? Nonsense mutation?

What is/are the possible consequence(s) of a missense mutation?

What is the likely consequence of a nonsense mutation?

What is a frameshift mutation? What is the likely consequence of this mutation?

What are spontaneous mutations? What do we call those things that increase the rate of mutation? Give examples.

If you want to clone a eukaryotic gene into a prokaryotic cell, is there any problem with doing this? Explain.

Sample Test Questions

A particular triplet of bases in the template strand of DNA is 5'-AGT-3'. What would be the corresponding codon for the mRNA that is transcribed?

- A) 3'-UCA-5' B) 3'-UGA-5' C) 5'-TCA-3' D) 3'-ACU-5'

The genetic code is essentially the same for all organisms. From this, one can logically assume which of the following statements to be true?

- A) A gene from an organism can theoretically be expressed by any other organism.
B) DNA was the first genetic material.
C) The same codons in different organisms translate into different amino acids.
D) Different organisms have different types of amino acids.

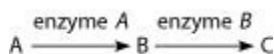
Which of the following processes occurs during transcription?

- A) DNA is replicated B) RNA is synthesized
C) proteins are synthesized D) mRNA attaches to ribosomes

The genetic code is redundant. What is meant by this statement?

- A) A single codon can specify the addition of more than one amino acid.
- B) The genetic code is different for different domains of organisms.
- C) The genetic code is universal (the same for all organisms).
- D) More than one codon can specify the addition of the same amino acid.

Use the figure to answer the question.



Refer to the metabolic pathway illustrated. If A, B, and C are all required for growth, a strain mutant for the gene encoding enzyme B would be able to grow on medium supplemented with which of the following nutrient(s)?

- A) nutrient A only
- B) nutrient B only
- C) nutrient C only
- D) nutrients A and C

According to the central dogma, what is the intermediate molecule involved in the flow of information in a cell that should go in the blank?

DNA → _____ → Proteins

- A) mtDNA
- B) rRNA
- C) mRNA
- D) tRNA

Which of the following processes occurs in prokaryotes but not in eukaryotes?

- A) post-transcriptional splicing
- B) transcription and translation occur simultaneously
- C) translation in the absence of a ribosome
- D) gene splicing

The following question refers to this table of codons.

		Second Base				
		U	C	A	G	
First Base	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } Ser UCC } UCA } UCG }	UAU } Tyr UAC } UAA } Stop UAG } Stop	UGU } Cys UGC } UGA } Stop UGG } Trp	U C A G
	C	CUU } Leu CUC } CUA } CUG }	CCU } Pro CCC } CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } Arg CGC } CGA } CGG }	U C A G
	A	AUU } Ile AUC } AUA } AUG } Met or Start	ACU } Thr ACC } ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
	G	GUU } Val GUC } GUA } GUG }	GCU } Ala GCC } GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } Gly GGC } GGA } GGG }	U C A G

Which of the following sequences of nucleotides are possible in the template strand of DNA that would code for the polypeptide sequence Phe-Leu-Ile-Val?

- A) 5'-TTG-CTA-CAG-TAG-3' B) 5'-AUG-CTG-CAG-TAT-3'
C) 3'-AAA-AAT-ATA-ACA-5' D) 3'-AAA-GAA-TAA-CAA-5'

Transcription in eukaryotes requires which of the following molecules in addition to RNA polymerase?

- A) anticodons B) ribosomes and tRNA
C) several transcription factors D) aminoacyl-tRNA synthetase

Which of the following processes occurs in eukaryotic gene expression?

- A) mRNA, tRNA, and rRNA are translated.
B) RNA polymerase binds to the terminator sequence.
C) A cap is added to the 5' end of the mRNA.
D) RNA polymerase requires tRNA to elongate the molecule.

In an experimental situation, a student researcher inserts an mRNA molecule into a eukaryotic cell after she has removed its 5' cap and poly-A tail. Which of the following processes would you expect her to find to have occurred?

- A) The mRNA is quickly converted into a ribosomal subunit.
B) The cell adds a new poly-A tail to the mRNA.
C) The mRNA attaches to a ribosome and is translated, but more slowly.
D) The molecule is digested by enzymes because it is not protected at the 5' end.

Which one of the following statements about RNA processing is correct?

- A) Exons are cut out before mRNA leaves the nucleus. B) Ribozymes may function in RNA splicing.
C) RNA splicing can be catalyzed by tRNA.
D) A primary transcript is often much shorter than the final RNA molecule that leaves the nucleus.

How does the primary transcript in the nucleus of a prokaryotic cell compare to the functional mRNA?

- A) the primary transcript is larger than the mRNA
B) the primary transcript is smaller than the mRNA
C) the primary transcript and the mRNA both contain introns
D) the primary transcript is the same size as the mRNA

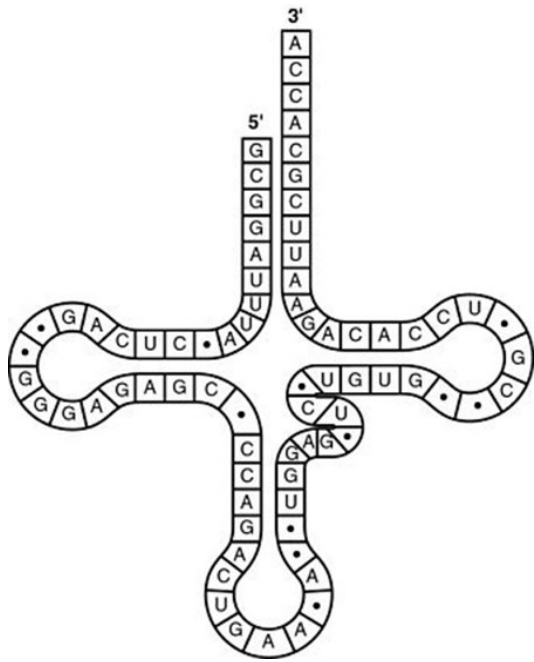
A particular triplet of bases in the coding sequence of DNA is AAA. The anticodon on the tRNA that binds the mRNA codon is _____.

- A) TTT B) UUA C) UUU D) AAA

In bacteria, there are 61 mRNA codons that specify an amino acid, but only 45 tRNAs. Which of the following statements explains this fact?

- A) Some tRNAs have anticodons that recognize four or more different codons.
B) The rules for base pairing between the third base of a codon and tRNA are flexible.
C) Many codons are never used, so the tRNAs that recognize them are dispensable.
D) The DNA codes for all 61 tRNAs, but some are then destroyed.

Use the figure to answer the next two questions.



What type of bonding is responsible for maintaining the shape of the tRNA molecule shown in the figure?

- A) ionic bonding between phosphates
- B) hydrogen bonding between base pairs
- C) van der Waals interactions between hydrogen atoms
- D) peptide bonding between amino acids

The figure represents tRNA that recognizes and binds a particular amino acid (in this instance, phenylalanine). Which codon on the mRNA strand codes for this amino acid?

- A) 5'-UGG-3'
- B) 3'-GUG-5'
- C) 5'-GUA-3'
- D) 5'-UUC-3'

Which of the following properties is associated with a protein that will be secreted from a eukaryotic cell?

- A) It must be translated by a ribosome that remains free within the cytosol.
- B) Its signal sequence must target it to the ER, after which it goes to the Golgi.
- C) Its signal sequence must be cleaved off before the polypeptide can enter the ER.
- D) Its signal sequence must target it to the plasma membrane, where it causes exocytosis.

Which of the following molecules are required for the process of translation?

- A) mRNA, tRNA, DNA, and rRNA
- B) mRNA, DNA, and rRNA
- C) mRNA, tRNA, and rRNA
- D) mRNA, tRNA, and DNA

Which one of the following structures, if missing, would usually prevent translation from starting?

- A) exon
- B) 5' cap
- C) AUG codon
- D) poly-A tail

Post-translational modifications of proteins may include which of the following processes?

- A) removal of introns
- B) addition of a 5' cap
- C) addition of a poly-A tail
- D) addition of carbohydrates to form a glycoprotein

Which of the following statements is true about protein synthesis in prokaryotes?

- A) Extensive RNA processing is required before prokaryotic transcripts can be translated.
- B) Translation can begin while transcription is still in progress.
- C) Prokaryotic cells have complicated mechanisms for targeting proteins to the appropriate cellular organelles.
- D) Unlike eukaryotes, prokaryotes require no initiation or elongation factors.

Which of the following statements correctly describes the effect a nonsense mutation would have on a gene?

- A) It changes an amino acid in the encoded protein.
- B) It has no effect on the amino acid sequence of the encoded protein.
- C) It introduces a premature stop codon into the mRNA.
- D) It alters the reading frame of the mRNA.

Which of the following statements is the most current description of a gene?

- A) a unit of heredity that causes formation of a phenotypic characteristic
- B) a DNA subunit that codes for a single complete protein
- C) a DNA sequence that is expressed to form a functional product: either RNA or polypeptide
- D) a discrete unit of hereditary information that consists of a sequence of amino acids

How might a single base substitution in the sequence of a gene affect the amino acid sequence of a protein encoded by the gene?

- A) Only a single amino acid could change, because the reading frame would be unaffected.
- B) The amino acid sequence would be substantially altered, because the reading frame would change with a single base substitution.
- C) All amino acids following the substitution would be affected, because the reading frame would be shifted.
- D) It is not possible for a single base substitution to affect protein structure, because each codon is three bases long.

Which of the following is *not* true of a codon?

- A) It may code for the same amino acid as another codon.
- B) It never codes for more than one amino acid.
- C) It extends from one end of a tRNA molecule.
- D) It is the basic unit of the genetic code.

Rank the following one-base point mutations with respect to their likelihood of affecting the structure of the corresponding polypeptide (from most likely to least likely).

1. insertion mutation deep within an intron
2. substitution mutation at the third position of a codon in an exon
3. substitution mutation at the second position of a codon in an exon
4. deletion mutation within the first exon of the gene

- A) 1, 2, 3, 4 B) 4, 3, 2, 1 C) 2, 1, 4, 3 D) 3, 1, 4, 2

Which component is *not* directly involved in translation?

- A) GTP B) DNA C) tRNA D) ribosomes