

These review questions are for Bio 1 Eukaryotic Genes topic. The questions were adapted from several sources, including the textbook's review questions.

- 1) When a gene is being transcribed, RNA polymerase enzyme is attached to...
 - A) The leading strand
 - B) The lagging strand
 - C) The template strand
 - D) The non-template strand
 - E) Both DNA strands of the gene

- 2) When a gene is being transcribed, the primary RNA transcript contains the same codons as the gene's...
 - A) Leading strand
 - B) Lagging strand
 - C) Template strand
 - D) Non-template strand
 - E) Two DNA strands

- 3) Which of the following statements best describes the termination of transcription in prokaryotes?
 - A) RNA polymerase transcribes through the polyadenylation signal, causing proteins to associate with the transcript and cut it free from the polymerase.
 - B) RNA polymerase transcribes through the terminator sequence, causing the polymerase to separate from the DNA and release the transcript.
 - C) RNA polymerase transcribes through an intron, and the snRNPs cause the polymerase to let go of the transcript.
 - D) Once transcription has initiated, RNA polymerase transcribes until it reaches the end of the chromosome.
 - E) RNA polymerase transcribes through a stop codon, causing the polymerase to stop advancing through the gene and release the mRNA.

- 4) In eukaryotes there are several different types of RNA polymerase. Which type is involved in transcription of mRNAs that encode proteins?
 - A) ligase
 - B) RNA polymerase I
 - C) RNA polymerase II
 - D) RNA polymerase III
 - E) primase

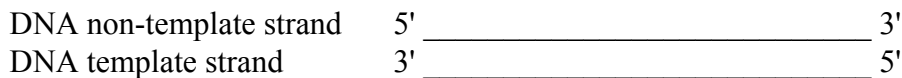
- 5) For transcription of a gene in eukaryotes to begin, which of the following is required (in addition to RNA polymerase)?
 - A) the protein product encoded by the gene

- B) start and stop codons
- C) ribosomes and tRNA
- D) transcription factors
- E) DNA polymerase enzyme

- 6) What exactly do transcription factors do?
- A) Attach RNA polymerase to the promoter
 - B) Change the promoter sequence in response to changing environmental conditions
 - C) Attract ribosomes to the mRNA
 - D) Remove introns from the primary transcript
 - E) Remove exons from the primary transcript

- 7) RNA polymerase becomes attached to the _____ to initiate _____.
- A) mRNA, translation
 - B) Promoter, transcription
 - C) Primer, transcription
 - D) Transcription factor, translation
 - E) Okazaki fragments, DNA replication

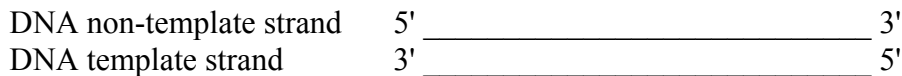
8) The figure below shows a gene.



On the double stranded gene shown above, in which direction does RNA polymerase move?

- A) From the 3' end of the template strand to the 5' end of the template strand.
- B) From the 5' end of the template strand to the 3' end of the template strand.
- C) From the 3' end of the non- template strand to the 5' end of the non-template strand.
- D) From the 5' end of the non- template strand to the 3' end of the non-template strand.
- E) Along both strands of the double-stranded DNA simultaneously.

9) The figure below shows a gene.



In the gene shown above, where would the TATA box sequence (TATAAAA) of the promoter be located?

- A) at the 3' end of the newly made RNA
- B) at the 5' end of the newly made RNA
- C) Near the left side of the non-template strand

- D) Near the right side of the non-template strand
- E) Near the left side of the template strand

10) Which of the following is the best description of the poly-A signal sequence in a gene?

- A) It is a series of T nucleotides that encodes the poly-A tail at the 3' end of the mRNA.
- B) It codes for a sequence in the RNA that signals enzymatic cleavage of the RNA several nucleotides away from the sequence.
- C) It allows the 3' end of the gene to attach to the ribosome.
- D) It is a sequence that codes for binding RNA polymerase to the gene.
- E) It adds a 7-methylguanosine cap to the 3' end of the mRNA.

11) Which of the following experimental procedures is most likely to make an mRNA in the cytoplasm become degraded faster than usual?

- A) shortening of the poly-A tail and removal of the 5' cap
- B) removal of the 5' cap and methylation of C nucleotides
- C) methylation of C nucleotides and methylation of histones
- D) methylation of histones and removal of one or more exons
- E) removal of one or more exons and shortening of the poly-A tail

12) In an experimental situation, a student researcher inserts an mRNA molecule into the cytoplasm of a eukaryotic cell after he has removed its 5' cap and poly-A tail. Which of the following would you expect him to find?

- A) Delayed but normal translation because the mRNA would first return to the nucleus to be properly processed.
- B) Delayed but normal translation because the missing parts of the mRNA will be added by enzymes in the cytoplasm.
- C) Little translation because the molecule will be digested by enzymes in the cytoplasm.
- D) Increased translation because the ribosome is not blocked by the 5' cap.
- E) Normal translation because the 5' cap and poly-A tail do not encode protein.

13) The 5' cap makes the mRNA resistant to digestive enzymes in the cytoplasm. What are other functions of the 5' cap?

- A) elongation of the polypeptide and base pairing of methionine-tRNA to AUG at the start of the messenger RNA
- B) base pairing of methionine-tRNA to AUG at the start of the messenger RNA and binding of the ribosome to the mRNA
- C) binding of the ribosome to the mRNA and exporting of the mRNA from the nucleus
- D) forming covalent peptide bonds between the first two amino acids and exporting of the mRNA from the nucleus
- E) exporting of the mRNA from the nucleus and elongation of the polypeptide

14) A pre-mRNA 8,000 nucleotides long may contain only 1,200 nucleotides that encode amino acids. The difference between the total number of nucleotides and the number of nucleotides needed to encode the protein is best explained by the fact that...

- A) introns are present in the pre-mRNA.
- B) there is redundancy and ambiguity in the genetic code.
- C) many nucleotides are needed to code for each amino acid.
- D) RNA polymerase enzyme can break off and lose nucleotides during the transcription process.
- E) there are termination sequences near the beginning of each mRNA.

15) The structures that remove the introns from a pre-mRNA are called...

- A) snRNPs
- B) Introns
- C) Exons
- D) RNA polymerases
- E) restriction enzymes

16) A cluster of snRNPs (the particles in the nucleus that remove introns from the pre-mRNA) is known as a...

- A) Intron
- B) Poly adenylation enzyme
- C) Exons
- D) Spliceosome
- E) Ligase body

17) snRNPs are made of ...

- A) Lipid and Carbohydrate
- B) Carbohydrate and RNA
- C) RNA and DNA
- D) DNA and Protein
- E) Protein and RNA

18) Which of the following is *not* true of RNA processing?

- A) Exons are cut out from the RNA before it leaves the nucleus.
- B) One or more nucleotides are added to both ends of the RNA.
- C) snRNPs function in RNA splicing.
- D) RNA splicing is carried out by spliceosomes.
- E) A primary transcript is often much longer than the final mRNA molecule that leaves the nucleus.

19) Use the following model of a eukaryotic pre-mRNA transcript to answer the question below. UTR = untranslated region, E = exon, I = intron.

5' UTR E₁ I₁ E₂ I₂ E₃ I₃ E₄ UTR 3'

After the mature mRNA is made from the pre-mRNA, the mature mRNA will have which parts of the pre-mRNA shown above?

- A) 5' UTR I₁ I₂ I₃ UTR 3'
- B) 5' E₁ E₂ E₃ E₄ 3'
- C) 5' UTR E₁ E₂ E₃ E₄ UTR 3'
- D) 5' I₁ I₂ I₃ 3'
- E) 5' E₁ I₁ E₂ I₂ E₃ I₃ E₄ 3'

20) Use the following model of a eukaryotic pre-mRNA transcript to answer the question below. UTR = untranslated region, E = exon, I = intron.

5' UTR E₁ I₁ E₂ I₂ E₃ I₃ E₄ UTR 3'

Suppose that exposure to a chemical mutagen results in a change in the sequence that alters the 5' end of intron 1. Which of the following is most likely to occur?

- A) No protein will be produced from the mRNA
- B) loss of E₁ from the mRNA
- C) Translation of the mRNA will stop after E₁
- D) inclusion of I₁ in the mRNA
- E) exclusion of E₂ in the mRNA

21) Use the following model of a eukaryotic pre-mRNA transcript to answer the question below. UTR = untranslated region, E = exon, I = intron.

5' UTR E₁ I₁ E₂ I₂ E₃ I₃ E₄ UTR 3'

Suppose that, after processing of the RNA in the nucleus is complete, most of the 5' end of the 5' UTR was somehow removed. What might result?

- A) Removal of the 5' UTR has no effect because the exons are still maintained.
- B) Removal of the 5' UTR also removes the 5' cap and the mRNA will quickly degrade.
- C) The 3' UTR will duplicate and one copy will replace the 5' end.
- D) The first exon will not be read because I₁ will now serve as the UTR.
- E) Removal of the 5' UTR will result in the strand not binding to tRNAs.

22) When a spliceosome binds to a pre-mRNA, where does it attach?

- A) to the exons only
- B) to the 5' UTR
- C) to the 3' UTR
- D) to an intron/exon junction
- E) to introns only

23) Alternative RNA splicing...

- A) is a mechanism for increasing the rate of transcription.
- B) can allow the production of proteins of different sizes from a single mRNA in the cytoplasm.
- C) can allow the production of similar proteins from the one gene.
- D) increases the rate of translation.
- E) Occurs if snRNPs are present. If no snRNPs are present, only normal exon/intron splicing occurs.

24) In the structural organization of many eukaryotic genes, individual exons are often related to which of the following?

- A) the sequence of the intron that immediately precedes each exon
- B) the number of polypeptides making up the functional protein
- C) the various domains of the polypeptide product
- D) the number of restriction enzyme cutting sites
- E) the number of start sites for transcription

25) If a protein is coded for by a single gene and this protein has six clearly defined domains, which number below is closest to the number of exons that the gene is most likely to have?

- A) 1
- B) 3
- C) 6
- D) 12
- E) 14

26) A molecular biologist inserts a eukaryotic gene into a bacteria. The bacteria produces a protein from the gene but the protein's amino acid sequence is very different from the amino acid sequence when the gene is expressed in eukaryotic cells. What is the best explanation of why the sequence of the protein is different in bacteria?

- A) The bacteria doesn't splice out the intron sequences of the mRNA
- B) The bacteria's DNA polymerase has a much higher mutation rate than eukaryotic DNA polymerase
- C) The genetic code (the amino acid encoded by each codon sequence) is different in bacteria compared to the genetic code in eukaryotes
- D) Bacteria ribosome's read mRNAs from 3' to 5' instead of 5' to 3'

27) The pre-mRNA splicing process...

- A) Occurs in prokaryotes
- B) Makes an mRNA from the joined together introns
- C) Can produce different mRNAs by alternative splicing
- D) Always joins each exon to the next exon that follows it
- E) Always joins each intron to the next intron that follows it

28) In eukaryotic cells, transcription cannot begin until...

- A) the gene's two DNA strands break off from the chromosome.
- B) several transcription factors have bound to the promoter.
- C) the 5' caps are removed from the mRNA.
- D) the DNA introns are removed from the template DNA strand.
- E) the DNA introns are removed from the non-template DNA strand.

Answers to review questions:

- 1) C
- 2) D
- 3) B
- 4) C
- 5) D
- 6) A
- 7) B
- 8) A
- 9) C
- 10) B
- 11) A
- 12) C
- 13) C
- 14) A
- 15) A
- 16) D
- 17) E
- 18) A
- 19) C
- 20) D
- 21) B
- 22) D
- 23) C
- 24) C

- 25) C
- 26) A
- 27) C
- 28) B