

KEY TERMS

Match the numbered term with the definition that fits it best. Put the corresponding number in front of the appropriate definition.

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|--|---------------------------|---------------------------------|
| 1. nutritional mutants | 18. holoenzyme | 37. alternative splicing |
| 2. one-gene/one-polypeptide hypothesis | 19. promoter | 38. branch point |
| 3. retroviruses | 20. terminator | 39. ribosome |
| 4. central dogma of molecular biology | 21. transcription unit | 40. aminoacyl-tRNA synthetase |
| 5. codons | 22. -35 nt sequence | 41. acceptor stem |
| 6. reading frame | 23. -10 nt sequence | 42. anticodon loop |
| 7. triplet-binding assay | 24. transcription bubble | 43. initiator tRNA |
| 8. degenerate | 25. operon | 44. peptidyl transferase |
| 9. start codon | 26. transcription factors | 45. signal recognition particle |
| 10. stop codon | 27. TATA box | 46. wobble pairing |
| 11. transcription | 28. primary transcript | 47. ribosome binding sequence |
| 12. translation | 29. mature mRNA | 48. A site |
| 13. template strand | 30. 5' cap | 49. P site |
| 14. coding strand | 31. 3' poly-A tail | 50. E site |
| 15. mRNA | 32. introns | 51. nonsense mutation |
| 16. tRNA | 33. exons | 52. frameshift mutation |
| 17. core polymerase | 34. spliceosome | 53. transition mutation |
| | 35. snRNPs | 54. transversion mutation |
| | 36. pre-mRNA splicing | |

- a. ____ Increments of three nts read continuously without spacing where the first codon defines subsequent codons.
- b. ____ The DNA-directed synthesis of RNA that results in a RNA molecule complementary to the template strand.
- c. ____ The DNA strand that is copied when double-stranded DNA is transcribed into single-stranded RNA.
- d. ____ Some amino acids are specified by more than one codon in the genetic code.
- e. ____ Site on the DNA that is required for the recognition and binding of RNA polymerase.
- f. ____ The RNA transcript used to direct the synthesis of polypeptides.
- g. ____ The region of DNA that is located between the promoter of a gene and its terminator sequence.
- h. ____ Formed by addition of the σ subunit to the core polymerase allowing it to properly initiate synthesis.
- i. ____ An enzyme that can synthesize RNA using DNA as a template, but can not initiate synthesis accurately.
- j. ____ Cells with these mutations will grow only on medium that is supplemented with additional nutrients.
- k. ____ A series of three nucleotides read in sequence to direct the incorporation of one amino acid into a protein.
- l. ____ One of the 6-bp sequences common to bacterial promoters that is recognized by RNA pol. holoenzyme.
- m. ____ A ribosomal process in which a mRNA and charged tRNAs base-pair to allow formation of a peptide bond.
- n. ____ The region containing the RNA polymerase, the DNA template, and the growing RNA transcript.
- o. ____ The DNA strand not used as a template for transcription that has the same seq. as the RNA transcript.
- p. ____ DNA seq. found upstream of the start site in eukaryotic promoters, resembles the -10 seq. found in prokaryotes.
- q. ____ One of the 6-bp sequences common to bacterial promoters where the DNA helix is opened.
- r. ____ Beadle and Tatum: a single defect in an enzyme is caused by a mutation at a single site on a chromosome.
- s. ____ A single transcription unit, common to prokaryotes, in which functionally related genes are grouped.
- t. ____ Nirenberg used this to test if defined three-base sequences could bind to the protein synthetic machinery.
- u. ____ The codons UAA, UGA, and UAG that do not specify specific amino acids.
- v. ____ Information passes in one direction from the DNA to an RNA copy, which directs the assembly of a protein.
- w. ____ A class of viruses that can convert their RNA genome into a DNA copy with the enzyme reverse transcriptase.
- x. ____ An adaptor molecule that interacts with mRNA and amino acids and plays a critical role in protein synthesis.
- y. ____ Proteins used to recruit RNA polymerase II to eukaryotic promoters to initiate transcription.
- z. ____ The codon AUG, which encodes the amino acid methionine.
- aa. ____ A DNA sequence that signals RNA polymerase to end transcription.
- bb. ____ More than one mature mRNA produced from a single primary transcript by the inclusion of different exons.
- cc. ____ Activating enzyme that catalyzes the attachment of an amino acid with the appropriate tRNA molecule.
- dd. ____ Sequences in this region of the tRNA cloverleaf structure base-pair with the codons in the mRNA.
- ee. ____ The ability of a single tRNA molecule to "read" more than one codon in the mRNA.
- ff. ____ The class of DNA mutation present if a cytosine nucleotide is substituted for an adenine nucleotide.
- gg. ____ The ribosomal location where the tRNA carrying the next amino acid to be added binds.

- hh. ____ A base substitution mutation that changes a transcribed codon to stop codon and results in a truncated protein.
- ii. ____ Seq. in the 5' end of a prokaryotic mRNA that is complementary to the 3' end of the small subunit rRNA.
- jj. ____ The ribosomal location where the tRNA that carried the previous amino acid added binds.
- kk. ____ Forms a bond between the amino group of 1 amino acid and the carboxyl group of the growing chain.
- ll. ____ Small nuclear ribonucleoprotein particles that recognize the intron-exon junction.
- mm. ____ Coding sequences of a gene that are joined together to form the mature mRNA transcript.
- nn. ____ Added to the 3' end of a transcript by poly-A polymerase to protect the mRNA from degradation.
- oo. ____ The final processed form of the mRNA after 5' capping, 3' polyadenylation, and splicing.
- pp. ____ A conserved adenine nucleotide within introns that base-pairs with snRNA and is important for intron removal.
- qq. ____ The ribosomal location where the tRNA attached to the growing polypeptide chain is bound.
- rr. ____ The class of DNA mutation present if one pyrimidine is substituted for a different pyrimidine.
- ss. ____ The 3' end of a tRNA molecule ending in 5'-CCA-3' where an amino acid is attached.
- tt. ____ A large complex, consisting of snRNPs and other proteins, responsible for the removal of introns.
- uu. ____ An insertion, or deletion, of a single base in the DNA that causes an alteration in the reading frame.
- vv. ____ Modification of the 5' end of a transcript by the addition of methylated GTP to the 5' PO₄ group.
- ww. ____ Noncoding DNA sequences that interrupt the coding sequence of a gene.
- xx. ____ The cellular organelle that has two subunits and three tRNA binding sites where protein synthesis takes place.
- yy. ____ A cytoplasmic protein complex that binds polypeptides with a signal sequence and targets them to the ER.
- zz. ____ The process of removing the introns from a primary transcript to form a mature mRNA.
- aaa. ____ In prokaryotes, this tRNA is charged with a chemically modified methionine, N-formylmethionine.
- bbb. ____ The original RNA synthesized by RNA polymerase before it undergoes processing.

LEARNING BY EXPERIENCE

1. Refer to table 15.1. To the right of each triplet below, write the associated amino acid. If none, describe the effect of the triplet.

- | | |
|------------------|--------------------|
| a. codon UUG | f. codon AUG |
| b. codon CCG | g. DNA triplet AAA |
| c. codon GGA | h. codon AUG |
| d. anticodon GCC | i. codon UGG |
| e. codon GUC | j. anticodon UCA |

2. For the following exercise, refer to the figure, or to table 15.1 to answer the questions below.

DNA:

Strand A 5' TTA GGA CCC TCT GGG GTT CAC CAG CGA CAT TCC GAT AGC 3'
Strand B 3' AAT CCT GGG AGA CCC CAA GTG GTC GCT GTA AGG CTA TCG 5'

mRNA:

5' GCU AUC GGA AUG UCG CUG GUG AAC CCC AGA GGG UCC UAA 3'

- a. Consider the DNA molecule and the mRNA molecule that is transcribed from it depicted above. Which strand of the DNA is the coding strand?
- b. What is the amino acid sequence of the protein that would be translated from this mRNA?

3. For the following exercise, refer to the DNA sequence shown below and answer the questions that follow by figuring out the amino acid sequence of each of the DNA strands shown.

DNA (coding strand): A-T-G-C-C-A-G-C-A-C-T-G-G-T-A-A-A-A-C-A-C-T-G-A

- a. Compared to the DNA sequence shown, the following DNA sequence has what type of mutation present?
A-T-G-C-C-A-G-C-A-C-T-G-A-T-A-A-A-A-C-A-C-T-G-A
- b. Compared to the DNA sequence shown, the following DNA sequence has what type of mutation present?
A-T-G-C-C-A-G-C-A-G-C-T-G-G-T-A-A-A-A-C-A-C-T-G-A
- c. Compared to the DNA sequence shown, the following DNA sequence has what type of mutation present?
A-T-G-C-C-A-G-C-A-C-T-A-G-T-A-A-A-A-C-A-C-T-G-A
- d. Compared to the DNA sequence shown, the following DNA sequence has what type of mutation present?
A-T-G-C-C-A-G-C-A-C-T-G-G-T-A-T-A-A-C-A-C-T-G-A

EXERCISING YOUR KNOWLEDGE

Briefly answer the following questions in the space provided.

1. What are the roles of the three forms of RNA?
 2. Why is the phenomenon symbolized by DNA → RNA → Protein referred to as the Central Dogma?
 3. Why are the terms *transcription* and *translation* appropriate for their respective processes?
 4. (a) What is meant by the “reading frame”?
(b) Why is it important?
 5. What is the function of the TATA box?
 6. What is the function of 5' caps and 3' poly-A tails?
 7. Why do some activating enzymes need to recognize only one anticodon while others need to recognize several?
 8. (a) What is a GC hairpin, and (b) how does it work?
 9. In the initiation of transcription, what does RNA polymerase do?
 10. How are introns dealt with before translation?
- Circle the letter of the one best answer in each of the following questions.
11. RNA polymerase adds nucleotide triphosphates to a new RNA chain that are complementary to
 - a. the template strand.
 - b. the mRNA.
 - c. the coding strand.
 - d. the anticodon.
 - e. the promoter sequence.
 12. The function of tRNA is to
 - a. provide a place for polypeptide synthesis.
 - b. transport amino acids to the ribosome.
 - c. travel to the ribosome to direct the assembly of polypeptides.
 - d. transcribe DNA.
 - e. translate DNA.
 13. The work of H. Gobind Khorana used organic synthesis to produce which of the following
 - a. mutated DNA molecules.
 - b. amino acids.
 - c. RNA molecules of defined sequence.
 - d. RNA polymers with more than 1 nucleotide.
 - e. DNA molecules of defined sequence.
 14. In Beadle and Tatum's experiments, if the *argE* gene contained a mutation that inactivated the E enzyme, the *Neurospora* would fail to grow on
 - a. ornithine.
 - b. arginòsuccinate.
 - c. arginine.
 - d. citrulline.
 - e. glutamate.
 15. A molecule of tRNA with the anticodon AAA will transport the amino acid
 - a. phenylalanine.
 - b. lysine.
 - c. proline.
 - d. glycine.
 - e. arginine.

16. Which of the following must take place in eukaryotes, before a primary transcript can be translated?
- 5' capping
 - 3' poly-A tail addition
 - mRNA transport to the cytoplasm
 - pre-mRNA splicing
 - all of the above
17. In eukaryotes, ____ codons specify amino acids.
- 21
 - 24
 - 61
 - 64
 - 60
18. Peptidyl transferase activity of the ribosome resides in which of the following?
- the small subunit
 - the rRNA
 - the amino acids
 - the large subunit
 - the tRNA
19. Relative to the mRNA, how are the ribosome sites arranged 5' to 3'?
- A, P, E
 - P, E, A
 - A, E, P
 - E, P, A
 - E, A, P
20. A mutation that changes a thymine nucleotide to a guanine nucleotide is what type of mutation?
- frameshift
 - transversion
 - inversion
 - translocation
 - transition
21. A mutation occurring when one chromosome is broken and is attached to another chromosome is
- inversion.
 - transversion.
 - translocation.
 - reversion.
 - duplication.
22. In mitochondrial genomes, ____ is a "stop" codon.
- UGA
 - UUU
 - AUA
 - UAA
 - AGA
23. In the process of transcription,
- the base sequence of DNA is copied into RNA.
 - a polypeptide is formed as specified by the genes in chromosomes.
 - rRNA is specified by exons in DNA.
 - a strand of mRNA is formed with base sequences complementary to those of DNA.
 - mRNA is formed as coded by introns.
24. After a peptide bond is formed during translation, which of the following occurs?
- The ribosome moves relative to the mRNA.
 - The mRNA dissociates.
 - The tRNA in the P site is ejected.
 - The large subunit dissociates.
 - EF-Tu factor binds to the charged tRNA.
25. The 5' cap plays a key role in eukaryotic translation because of which of the following?
- It binds the initiator tRNA.
 - It binds initiation factors.
 - It binds to the ribosome-binding sequence.
 - It has enzymatic activities.
 - It binds the small ribosomal subunit.
26. In the process of translation,
- a strand of mRNA is formed with nucleotide sequences complementary to those of DNA.
 - nucleotide sequences of tRNA are established.
 - a polypeptide is formed in response to the rRNA nucleotide sequences.
 - rRNA is synthesized with sequences complementary to those of tRNA.
 - a polypeptide is formed as dictated by the nucleotide sequences in mRNA.
27. In prokaryotic transcription, the -35 sequence and the -10 sequence are
- coding strands.
 - promoters.
 - RNA polymerase.
 - terminators.
 - part of the template strand.
28. As polypeptides are formed at the ribosome, elongation continues until ____ is exposed.
- a release factor
 - an intron
 - a stop codon
 - an exon
 - polypeptidase

29. A spliceosome is formed from a cluster of
- spRNAs.
 - smRNAs.
 - ribosomes.
 - nucleosomes.
 - snRNPs.
30. For the process of pre-mRNA splicing to occur accurately, the spliceosome must recognize
- the 5' cap.
 - the tRNA molecule.
 - the DNA template.
 - the intron-exon junctions.
 - the DNA-mRNA hybrid.