

Chapter 14 Reading Guide: Gene Expression – From Gene to Protein

Concept 14.1: Genes specify proteins via transcription and translation

1. What is *gene expression*?

2. The research of Beadle and Tatum resulted in their Nobel Prize award in 1958. Describe their scientific contribution.

3. What is the *one gene-one enzyme hypothesis*?

4. How has this hypothesis been modified?

5. What are three ways in which RNA differs from DNA?

6. Define the following terms:
 - a. *Transcription*

 - b. *Translation*

7. **Complete** the following table to summarize each process.

	Template	Product Synthesized	Location in Eukaryotic Cell
Transcription			
Translation			

8. **Label** the diagram of the *Central Dogma* below.



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9. Here is a short DNA template strand. Below it, **assemble** the complimentary RNA strand.

3' A C G A C C A G T A A A 5'

10. In the above RNA strand in #9, how many **codons** are there? _____ **Label** the codons above.

11. For each of codons in the mRNA strand in #9 above, **specify** the **amino acids** that would be added to a growing polypeptide chain during translation.

12. Contrast the **template strand** vs. the **coding strand** in DNA.

13. Briefly explain how Marshall Nirenberg “cracked the genetic code”.

14. Examine Figure 14.6.

- a. How many codons are possible? _____
- b. How many codons actually code for amino acids? _____
- c. Which amino acid can function as the “start” codon? _____
- d. What do the codons UAA, UAG, or UGA represent?

15. Explain the concept of the **reading frame**.

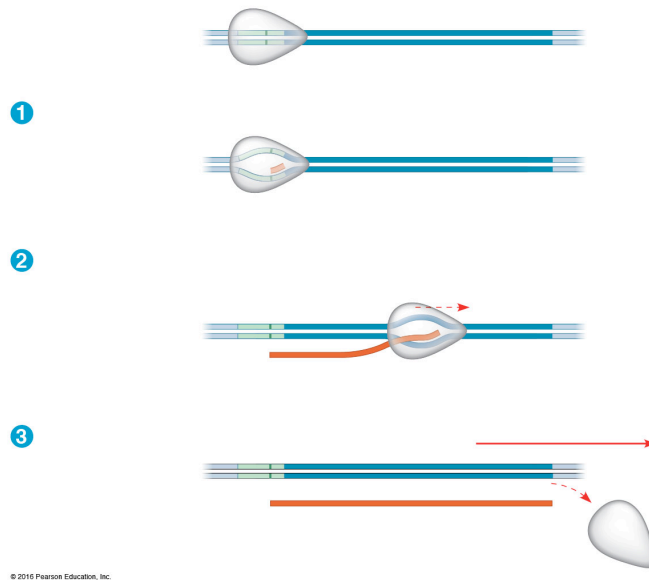
16. What can happen if the reading frame is altered?

Concept 14.2: Transcription is the DNA-directed synthesis of RNA

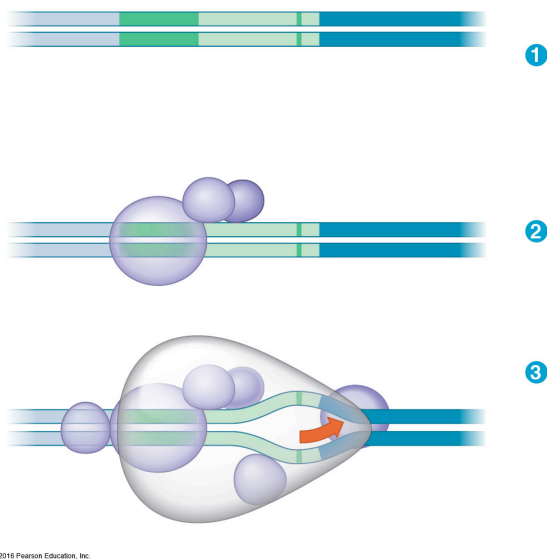
17. Name the enzyme involved in transcription.

18. What is a **transcription unit**?

19. Use Figure 14.8 in your textbook to **label** the following diagram of transcription. **Include** the following terms: *promoter*, *RNA polymerase*, *transcription unit*, *DNA template*, *nontemplate DNA*, *RNA transcript*, and *5' and 3' ends*. To the left of the figure, briefly **explain** the three stages of transcription.



20. Use Figure 14.9 in your textbook to **label** the following diagram of transcription in **eukaryotes**. Include the following terms: *TATA box*, *RNA polymerase II*, *transcription factors*, *template DNA strand*, *nontemplate DNA strand*, *start point*, *5' and 3' ends*, *promoter*, *mRNA transcript*. To the right of the figure, briefly **explain** the three stages of transcription.



21. What makes up the **transcription initiation complex**?

Concept 14.3: Eukaryotic cells modify RNA after transcription

22. RNA processing only occurs in eukaryotic cells. The primary transcript is altered at both ends, and sections in the middle are removed.

a) What happens at the 5' end?

b) What happens at the 3' end?

23. What are 3 important functions of these modifications to the 5' and 3' ends?

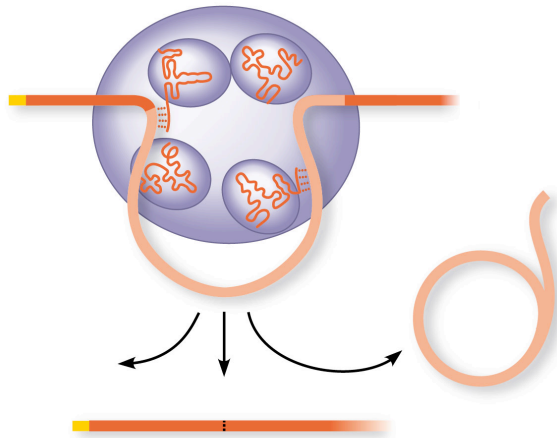
1.

2.

3.

24. Distinguish between *introns* and *exons*. (Hint: "Exons" are *expressed*.)

25. Label the diagram below.



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26. What is a *spliceosome* made of?

27. What is *alternative RNA splicing*? What are the benefits?

28. What is a *ribozyme*?

29. What 3 properties of RNA enable some RNA molecules to function as enzymes?

- 1.
- 2.
- 3.

Concept 14.4: Translation is the RNA-directed synthesis of a polypeptide

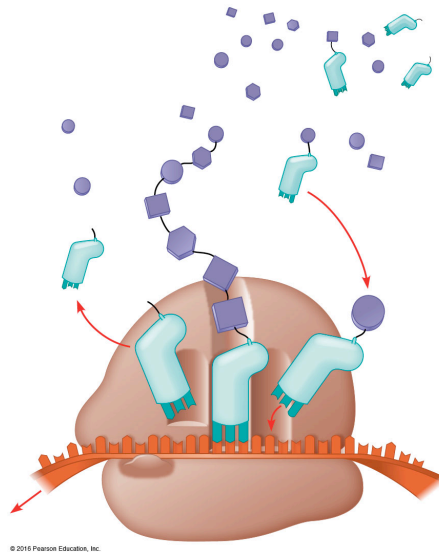
30. Complete the chart below.

Type of RNA	Description	Function
mRNA		
tRNA		
rRNA		

31. What is an **anticodon**?

32. What are the function of **aminoacyl-tRNA synthetases**?

33. Label the following diagram. Include the following terms: mRNA, tRNA, codon, anticodon, amino acid, polypeptide, A site, P site, E site, small ribosomal subunit, large ribosomal subunit.



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34. What does **wobble** in base pairing mean?

35. Briefly **describe** these stages of translation.

1. Initiation:

2. Elongation:

3. Termination:

36. What is a **release factor**? By what mechanism is termination accomplished?

37. Describe at least three types of **post-translational processing**.

38. What determines whether a ribosome is free in the cytosol or bound to rough ER?

39. What is the advantage of **polyribosomes**?

40. How does protein synthesis differ between prokaryotes and eukaryotes?

Concept 14.5: Mutations of one or a few nucleotides can affect protein structure and function

41. Define **point mutations**.

42. Describe the effect of mutations that are:

a) Silent:

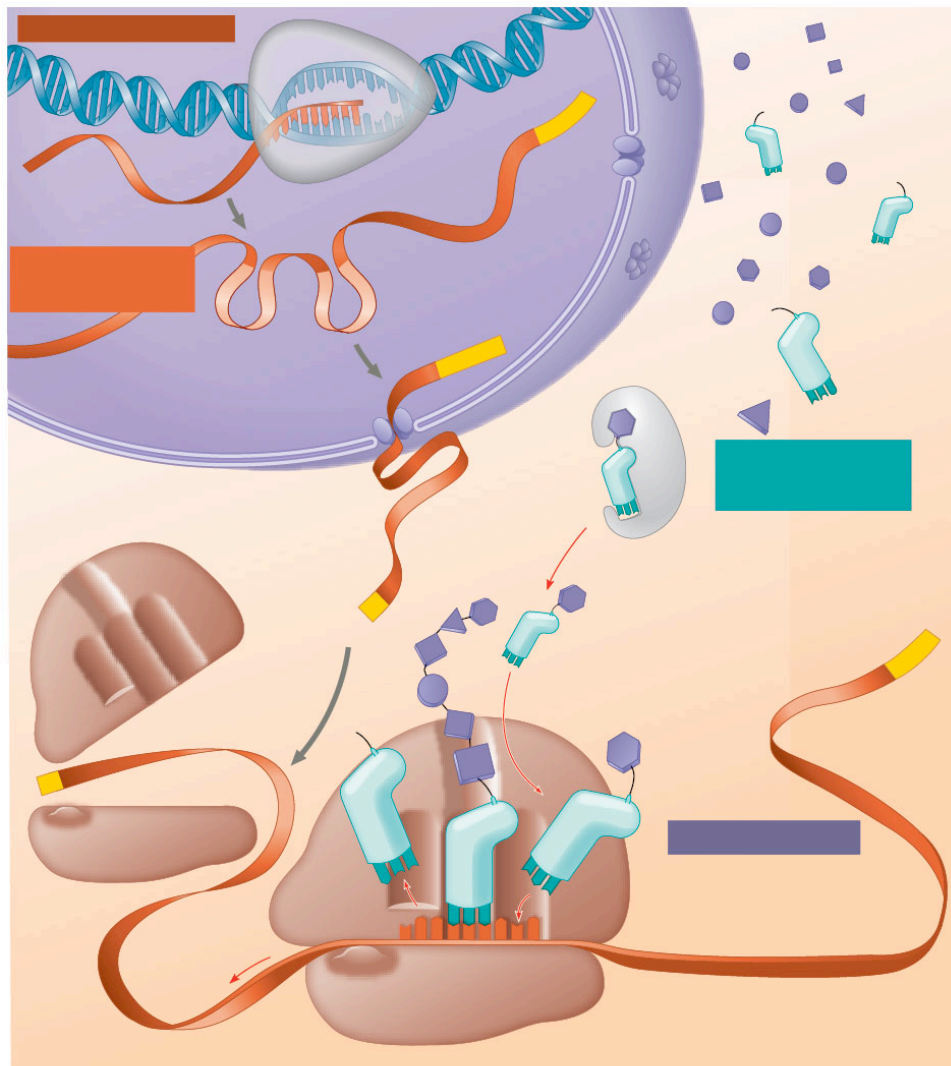
b) Missense:

c) Nonsense:

43. What causes **frameshift mutations**? What are the possible effects of these types of mutations?

44. What is a **mutagen**? Give 3 examples of mutagens.

45. **Label** the summary diagram of transcription and translation in a eukaryotic cell.



46. What is a gene? It used to be simply stated that one gene codes for one polypeptide. That definition has now been modified. **Write** below the broader molecular definition in use today.