AP Biology **Name** _____

Chapter 17 Guided Reading: Gene Expression: From Gene to Protein
10ed.

1. What is *gene expression?*

2. What situation did Archibald Garrod suggest caused “inborn errors of metabolism”?

3. Describe one example Garrod used to illustrate his hypothesis.

4. State the hypothesis formulated by George Beadle while studying eye color mutations in *Drosophila.*

5. What strategy did Beadle and Tatum adopt to test this hypothesis?

6. Which organism did Beadle and Tatum use in their research? _____. How did this organism’s nutritional requirements facilitate this research?

7. How were *Neurospora* spores treated to increase the mutation rate?

8. Study figure 17.2 in your text carefully. Summarize the technique used to identify and isolate mutant fungi, the result of the experiment, and the conclusion that ws drawn.

9. What significant findings from the research of Beadle and Tatum resulted in their receiving the Nobel Prize of 1958?

10. What revision of detail (but not of basic principle) did this hypothesis undergo as more information was gained?

11. From the first paragraph in this section, find three ways in which RNA differs from DNA.

12. What are the monomers of DNA and RNA? _____. Of proteins? _____.

13. Define each of these processes that are essential to the formation of a protein:
Transcription

Translation

14. Complete the following table to summarize each process.

	Template	Product Synthesized	Location in Eukaryotic Cell
Transcription			
Translation			

15. In eukaryotes, what is the *pre-mRNA* called?

16. Write the *central dogma* of molecular genetics, as proclaimed by Francis Crick.

17. How many nucleotide bases are there?_____ How many amino acids?_____

18. How many nucleotides are required to code for these 20 amino acids?

19. The language if DNA is a *triplet code.* How many unique triplets exist?_____

20. DNA is double stranded; however, for each protein, only one of these two strands is used to produce an mRNA transcript. What is the strand called?

21. Here is a short DNA *template.* Below it, assemble the complementary mRNA strand.

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

22. How many *codons* are there? _____ Label one codon.

23. Describe *Nirenberg's* experiment in which he identified the first codon. What codon/amino acid pair did he identify?

24. Of the 64 possible codons, how many code for amino acids?

25. What event is coded for UAA, UAG, and UGA?

26. What is the *start codon?*_____

27. Why is the genetic code said to be *redundant* but not *ambiguous?*

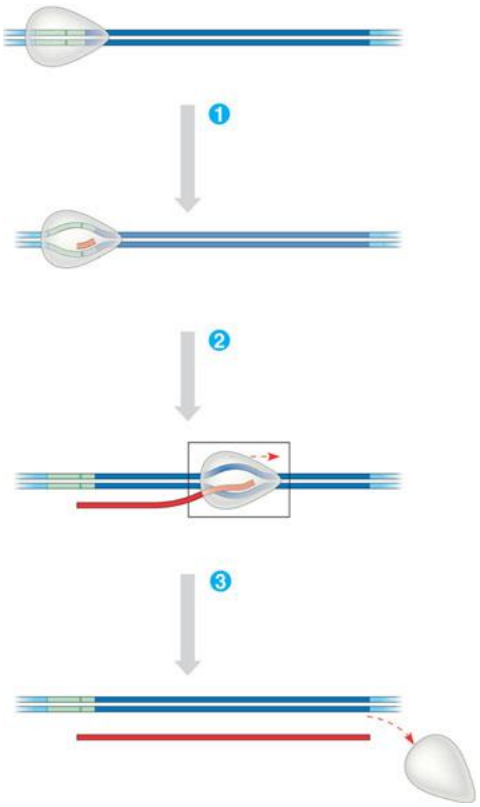
28. Explain the concept of *reading frame.*

29. Name the enzyme that uses the DNA template strand to transcribe a new mRNA strand.

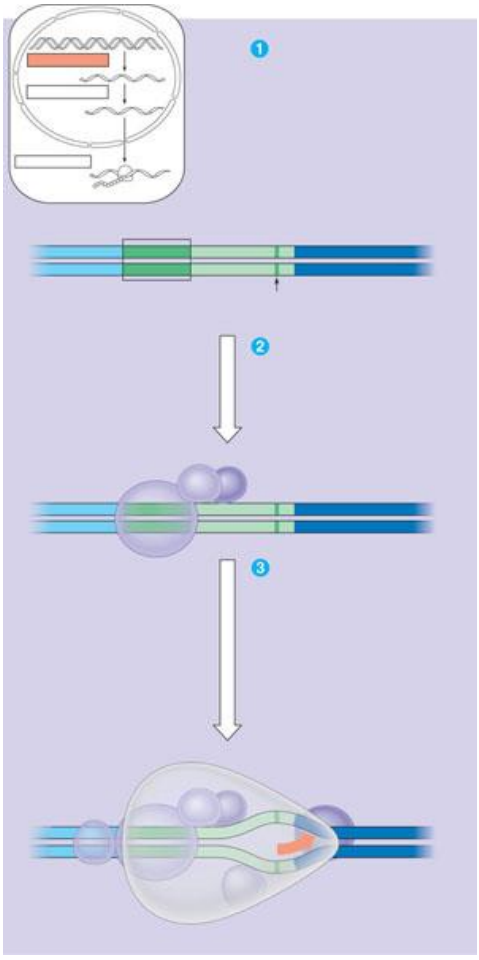
30. Which enzymes, *DNA polymerase III* or *RNA polymerase,* does **not** require a primer to begin synthesis?

31. What is a *transcription unit?*

32. Label these elements on the following figure: *promoter, RNA polymerase, start point, transcription unit, DNA template, nontemplate DNA, 5' and 3' ends* of all the strands, and *RNA transcript.* Then, to the right of the figure, name the three stages of transcription and briefly describe each stage.



33. Label these elements of the following figure: *promoter, TATA box, RNA polymerase II, transcription factors, template DNA strand, start point, 5' and 3', transcription initiation complex, and mRNA transcript.* To the right of the figure, explain the three stages of initiation in a eukaryotic promoter.



34. What is the *TATA* box? How do you think it got this name?

35. Write a <u>paragraph</u> to describe the process by which mRNA is formed. Use these terms correctly in your essay, and highlight (or underline) each one: *TATA box, gene, terminator, promoter, elongation, 5' to 3', termination,* ignition RNA, polymerase RNA nucleotides, template, start point, termination *signal, and transcription factors.*

36. *RNA processing,* sometimes also called mRNA editing, occurs only in eukaryotic cells. Prokaryotic cells lack the enzymes to edit mRNA. The primary transcript is altered at both ends, and sections in the middle are removed.

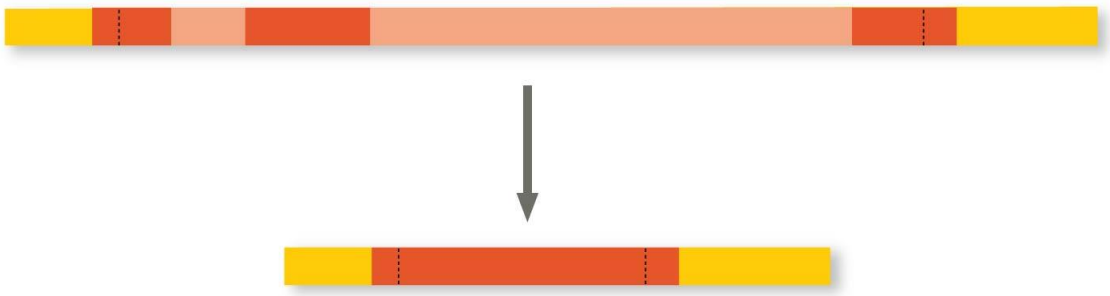
    a. What happens at the 5' end?

    b. What happens at the 3' end?

37. What are three important functions of the *5' cap* and *poly-A tail?*

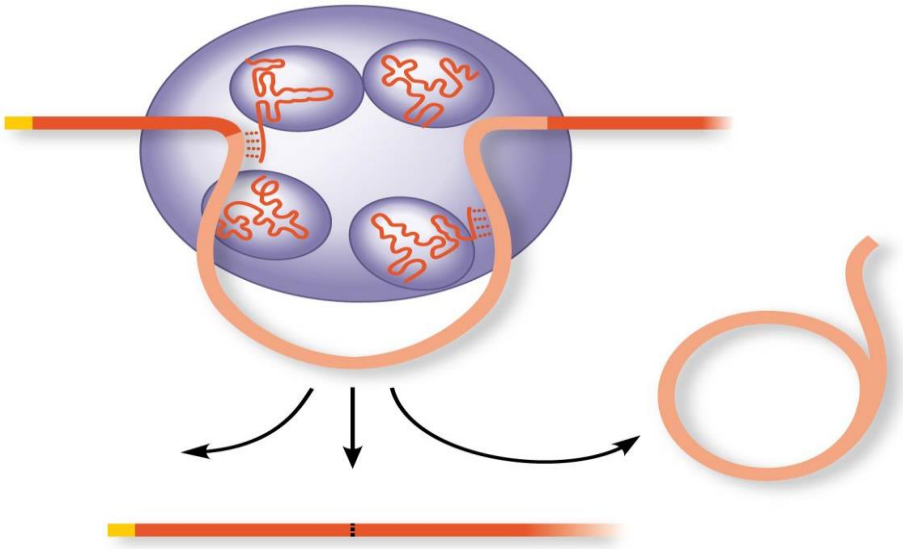
38. Distinguish between *introns* and *exons.*

39. On both the pre-mRNA and the mRNA strand, label: *pre-mRNA, 5' cap, poly-A tail, introns,* and *exons.*



40. What are the two components of *spliceosomes?* How do spliceosomes work?

41. On the following figure, label these terms: *pre-mRNA, small RNAs, protein, spliceosomes, intron, exon,* and *edited mRNA.*



42. Explain how the splice sites are recognized.

43. What is a *ribozyme?*

44. What commonly held idea was rendered obsolete by the discovery of ribozymes?

45. What are three properties of RNA that allow it to function as an enzyme?

    a.

    b.

    c.

46. What is the consequence of *alternative splicing* of identical mRNA transcripts?

47. Three types of RNA are needed for proteins synthesis. Complete the following chart.

Type of RNA	**Description**	**Function**
mRNA		
tRNA		
rRNA		

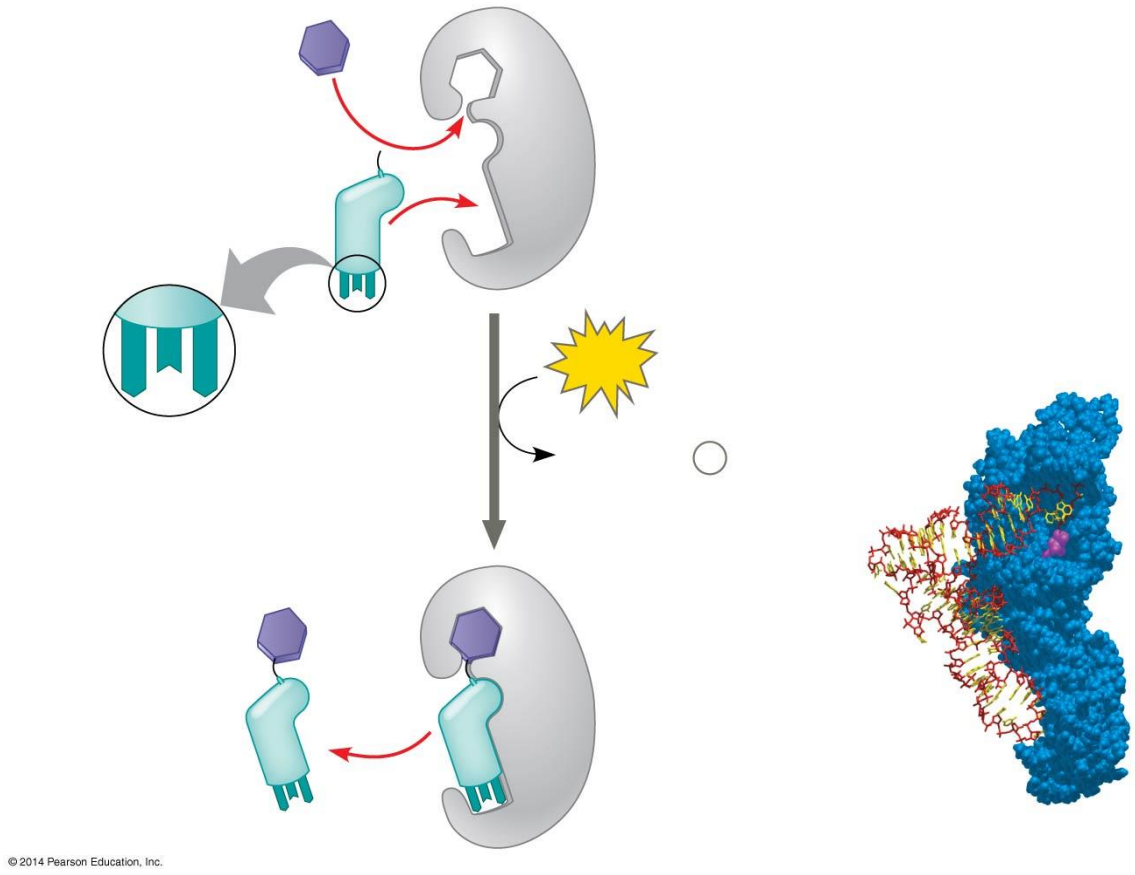
48. What is an *anticodon?*

49. *Transfer RNA* has two attachment sites. What binds at each site? Sketch tRNA to indicate the two attached sites, and not where complementary base pairing and hydrogen bonding occur to give it shape.

50. How many different *aminoacyl-tRNA synthetases* are there?_____

51. Scientists expected to find one aminoacyl-tRNA synthetase per codon, but far fewer have been discover. How does *wobble* explain this?

52. Use the following figure to explain the process of a specific amino acid being joined to a tRNA. Also add these labels: *aminoacyl-tRNA synthetase, ATP, amino acid, and tRNA.*



53. Describe the structure of a eukaryotic *ribosome.*

54. How does a prokaryotic ribosome differ from a eukaryotic ribosome? What is the medical significance of this difference?

55. On the following figure, label the *large subunit; small subunit; A, P, and E sites;* and *mRNA binding site.* To the right of the figure, explain the functions of the A,P, and E sites.

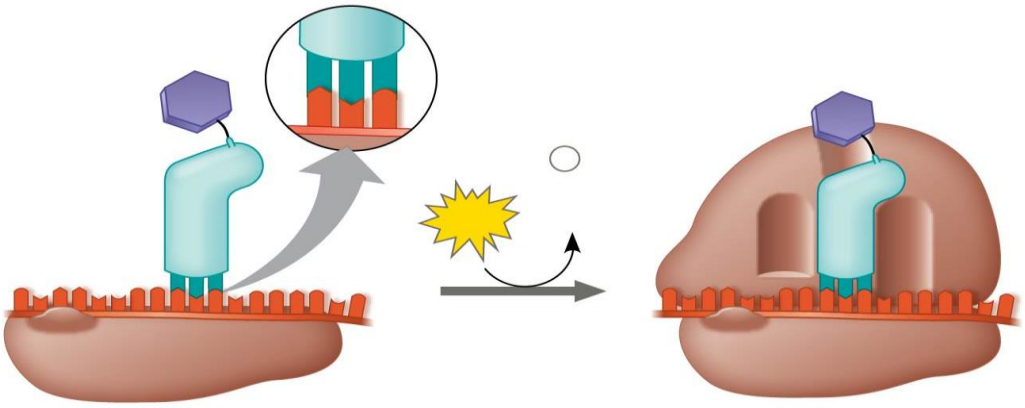
56. Much like with transcription, we can divide translation into three stage. List them.

    a.

    b.

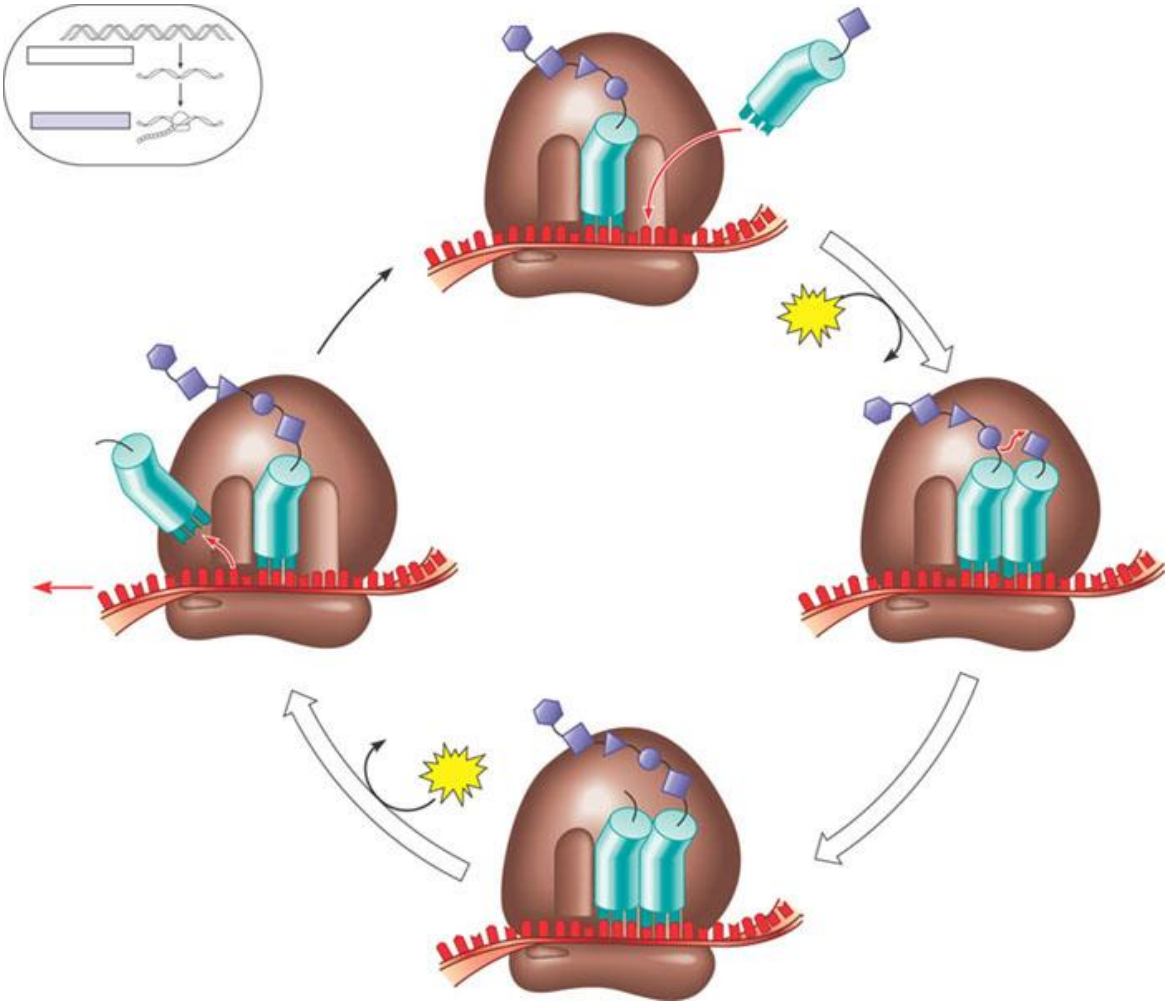
    c.

57. Summarize the events of *initiation.* Include these components: *small ribosomal subunit, large ribosomal subunit, mRNA, start codon, initiator tRNA, Met, translation initiation complex, P site, and GTP.*



58. What is always the first amino acid in the new polypeptide? _____

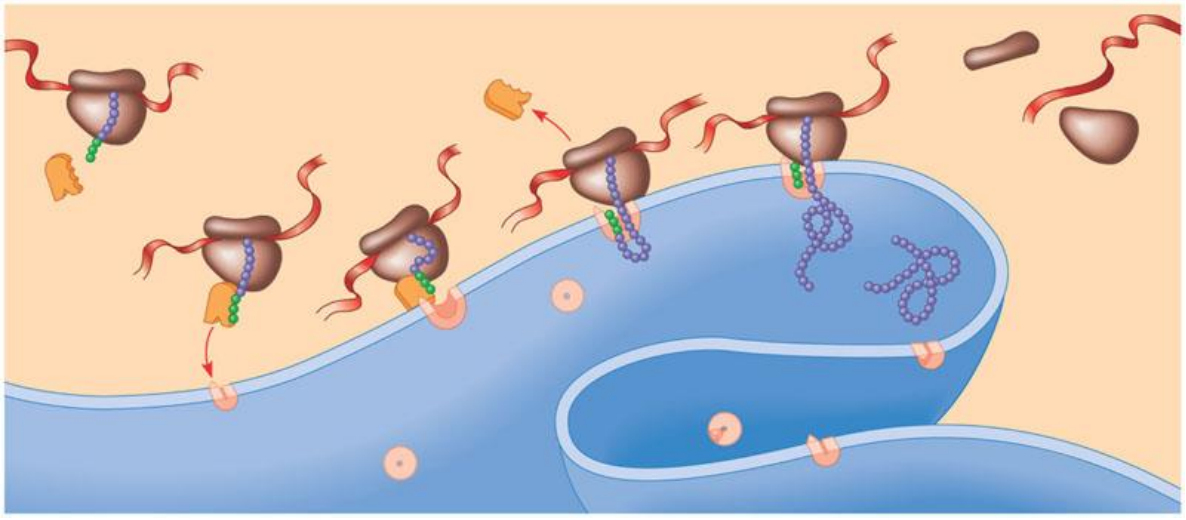
59. Now, summarize the events of *elongation.* Include these components in the figure: *mRNA, A site, tRNA, codon, anticodon, ribozyme, P site, E site, codon recognition, peptide bond formation, translocation, 3' and 5', polypeptide chain.*



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

61. Describe at least three types of *post-translational modifications.*

62. Use the following figure to explain how proteins are targeted for the ER.



1.

2.

3.

4.

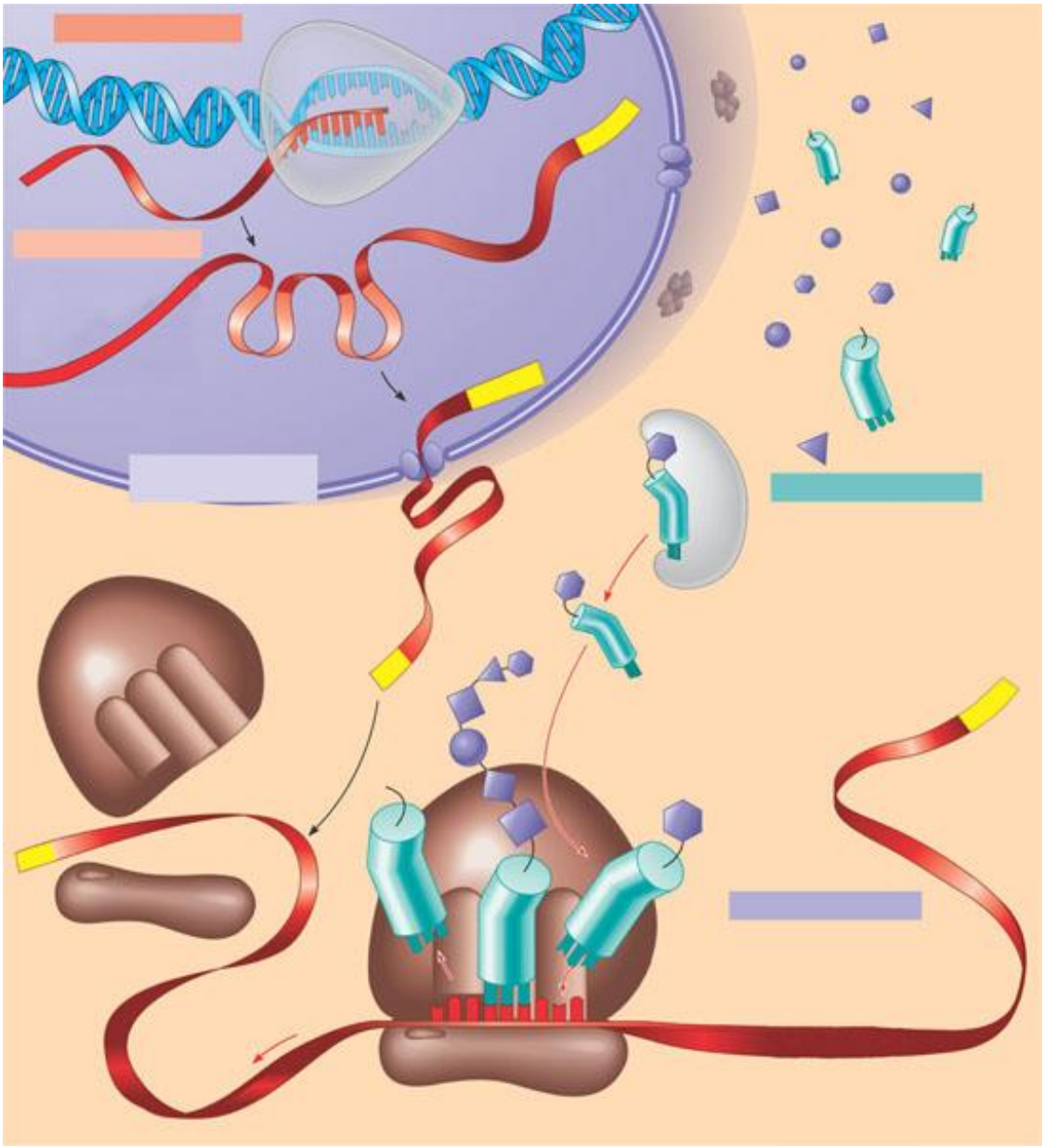
5.

6.

63. What is a *polyribosome?*

64. Beside lacking enzymes for RNA editing, describe how the lack of compartments in a prokaryotic cell results in a difference in gene expression from what was described in eukaryotic cells.

65. Use this summary figure to explain the five major events in transcription and translation.



66. Mutations provide the raw material of evolution. Define a *mutation* in terms of molecular genetics.

67. Chromosomal rearrangements are considered large-scale mutations. Point mutations are considered small-scale mutations, and are of two general types. The first is a *single nucleotide-pair substitution.* What occurs here?

68. How can a *nucleotide-pair substitution* result in a *silent mutation?*

69. What is the difference between a *nonsense* and *missense mutation?*

70. The second category of point mutations includes nucleotide-pair insertions or deletions. These can result in *frameshift mutations*. What does this mean*?*

71. What are the two categories of *mutagens*?

72. What is a gene? Write in the following space the broader molecular definition in use today.