AP Biology **Name** _____

Chapter 18.1-18.4 Guided Reading: Regulation of Gene Expression 10ed.

1. All genes are not "on" all the time. Using the metabolic needs of *E. coli,* explain why no?

2. What are the two main ways of controlling metabolism in bacterial cells?

3. *Feedback inhibition* is a recurring mechanism throughout biological systems. In the case of *E. coli* regulating tryptophan synthesis, is it *positive* or *negative inhibition*? Explain your choice.

4. Enzymatic pathways involve a series of different enzymes that catalyze reactions in sequence. In order for this to occur, the genes that code for these enzymes are *coordinately controlled* by being clustered in units known as *operons.* To better understand how an operon functions, begin by explaining the role of each of the following:

   a. *Promoter*

   b. *Operator*

   c. *Repressor*

   d. *Regulatory genes*

5. Distinguish between *inducible* and *repressible operons,* and describe one example of each type.

6. **Label this sketch** of the *lac* operon with the following terms <u>AND</u> **State the function** of each structure.

   operon genes

   operon

   RNA polymerase

   mRNA

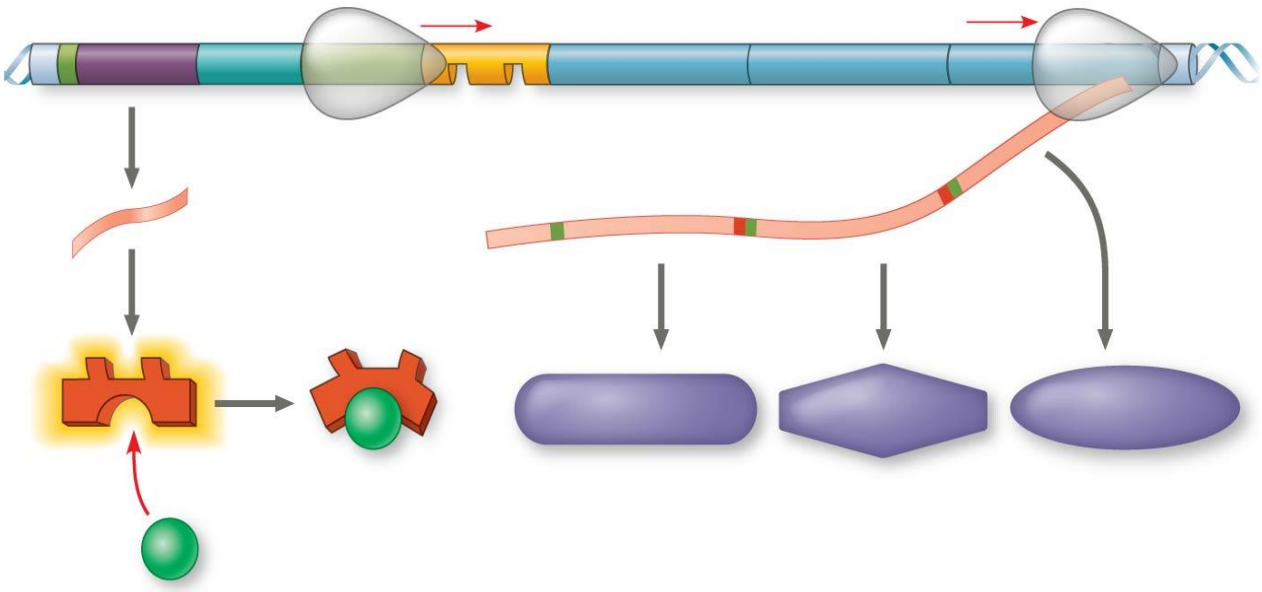
   repressor protein

   operator

   repressor

   regulatory gene

   inducer



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7. Compare and contrast the *lac* operon and the *trp* operon.

8. When a repressor is bound to the operator of the lac operon, is the operon off or on?

9. To demonstrate you understand how the *lac* and *trp* operon work, let's assume a human host has had a meal of turkey (rich in the amino acid tryptophan) and washed it down with milk. Explain your answer to each of the following:

   a. Will the *trp* operon be active?

   b. Will the *lac* operon be active?

10. Given access to both glucose and lactose, *E. coli* will use the glucose. Describe the relationship between glucose supply, cAMP, and CAP.

11. Explain why CAP binding and stimulation of gene expression is *positive regulation.*

12. How can both repressible and inducible operons be *negative regulators*?

13. Even though all cells of an organism have the same genes, there is *differential gene expression.* What does that mean?

14. What percentage of the genes of a typical human cell is expressed at any given time?

15. The common control point of gene expression for all organisms is at transcription, although for eukaryotes gene expression can be regulated at other points, to be discussed later. Refer to the diagrams on the left side of Figures 18.7,18.8, and 18.10 to list the three points at which control of transcription occurs.
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16. Gene expression can be regulated by modifications of the chromatins that affect transcription. Distinguish between *heterochromatin* and *euchromatin* as their structure and activity.

17. What occurs in histone acetylation? How does it affect gene expression?

18. What is *DNA methylations?* What role may it play in gene expression?

19. The inactive mammalian X chromosome is heavily methylated. What is the result of this methylation?

20. What is *genomic imprinting,* and how is it maintained? Give an example discussed earlier in human genetics.

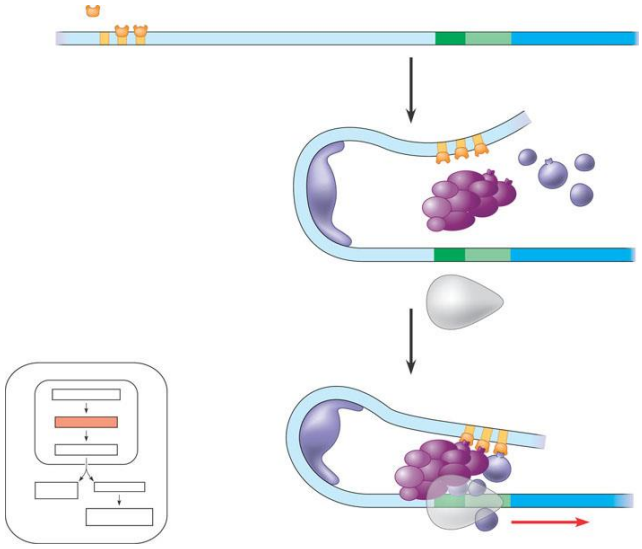
21. Explain what is meant by *epigenetic inheritance,* and give an example of epigenetic changes discusses in the text or in class.

10. Figure 18.8 reviews some material you are already familiar with by showing what occurs in transcription and RNA processing. However, focus on what is new in this figure. Note the *Enhancer (distal control elements)* and *Proximal control elements,* What is the role of each of these?

11. What are *general transcription factors,* and how do they function?

12. How can the rate of gene expression be modified by *specific transcription factors*?

13.Use the following sketch to explain how enhancers and activators interact with transcription factors to affect gene expression. Label the following elements: *TATA box, promoter, gene, enhancer, activators, mediator proteins, general transcription factors, transcription initiation complex, DNA-bending protein, RNA polymerase II,* and *DNA*. Then place your explanation to the left of the figure.



14. In prokaryotes, functionally related genes are usually clustered in a single operon. What has been found to be the case in eukaryotes?

15. With rare exceptions, operons have not been found in eukaryotic cells, and the genes coding for the enzymes of a particular metabolic pathway are often scattered over different chromosomes. What is a *plausible mechanism for* the coordination of gene expression?

16. How can *alternative RNA splicing* result in different proteins derived from the same initial RNA transcript?

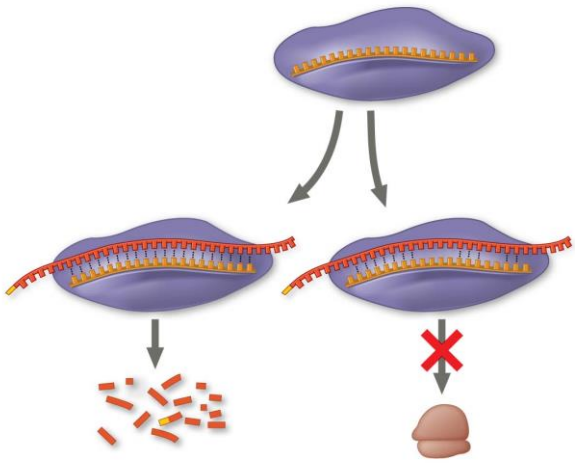
17. *Post-transcriptional control* includes regulation of *mRNA degradation.* Explain how this affects translation.

18. How can proteins be activated, processed, and degraded? Give an example or describe each process.

19. An article in *Scientific American* about *proteasomes* was entitled “Little Chamber of Horrors.” Explain how proteins are targeted for degradation, and give a specific example of when this might occur.

20. It is now known that much of the RNA that is transcribed is not translated into protein. These RNAs are called *noncoding* RNAs. Read carefully to discern a crucial role played by these RNAs. What is the role?

21. One of the *noncoding RNAs* that regulate gene expression is *microRNA (miRNA).* Use the following sketch to explain the two modes of action of *microRNAs.*



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22. Other classes of small RNAs continue to be discovered. Give an associated function for each:

a. Small interfering RNA (siRNA)

b. Piwi-interacting RNA (piRNA)

23. What three processes lead to the transformation of a zygote into the organism?

24. Explain what occurs in *cell differentiation* and *morphogenesis.*

25. Differential gene expression results from different activators in different cells. How do different sets of activators come to be present in two cells? Explain how each of these occurs:

a. distribution of *cytoplasmic determinants*

b. *induction*

26. What is meant by *determination?* Explain what this means within an embryonic cell.

27. What process ensures that all the tissues and organs of an organism are in their characteristic places? Where do the molecular cues that control this process arise?

28. What is controlled by *homeotic genes*?

29. What are *maternal effect genes?* Describe some effects they may control.

30. *Bicoid* is a gene that produces a *morphogen.* What results when there is a high concentration of the *bicoid* protein in a developing embryo?

31. What important understandings about embryonic development resulted from the research into *bicoid?*