AP Biology **Name:** **P:**

Chapter 15 Reading Guide: Regulation of Gene Expression

How to use this reading guide: Look over the entire reading guide—read each question to prepare yourself for reading the chapter. Read the chapter carefully and thoroughly. Make sure to look at all of the figures and pictures and read their captions. Then…answer the questions posed below.

Individual bacteria respond to environmental change by regulating their gene expression

1. Homeostasis refers to internal changes that take place quite rapidly in response to external environmental changes. How can a bacterium respond to environmental conditions? (what levels?)

2. Describe the basic concept of an operon.
    a. Draw picture which shows the location of the following in relation to each other in an operon: genes A, B and C; operator, promoter, regulatory gene, repressor.
    b. What is the advantage of grouping genes together?

3. In detail, describe the how the trp operon functions. Use a picture of the operon to help illustrate your answer. (LEARN THESE WELL!!!)

4. Using a picture of the lac operon, explain how it works. (LEARN THESE WELL!!!)

5. Repressible and inducible operons are both types of negative regulation. Contrast the differences between these two types of regulation.

6. How does “positive regulation” compare to negative regulation?
    a. How do bacteria use positive regulation in the lac operon?

Eukaryotic gene expression is regulated at many stages

1. What is meant by cell differentiation?

2. What is differential gene expression?
    a. How is this related to cell differentiation?
    b. In general, what relationship can be stated between how differentiated a cell is and the amount of gene expression?

3. Only about 1.5% of eukaryotic genomes code for protein. What else does DNA code for?

4. Study figure 15.6. Briefly summarize the process of gene expression in eukaryotes.

5. What is the most common regulatory method used in most eukaryotes?

6. Heterochromatin is highly condensed and therefore inhibits transcription.
    a. Explain how histone acetylation helps regulate transcription.

    b. Explain how methylation or other functional groups might regulate transcription.

7. How does DNA methylation contribute to gene regulation?
    a. Explain how DNA methylation is involved in cell differentiation during embryonic development.

    b. How does Mitosis and Meiosis affect these methylation patterns? (epigenetic inheritance)

8. STUDY figure 15.8 and read about the organization of eukaryotic DNA. Diagram how a eukaryotic gene is organized and describe what the following elements are and how they are involved in the regulation of this gene.
    a. Control elements (proximal)

b. transcription factors (general and specific)

c. Enhancers (distal control elements)

d. Activators
    i. What structural features seem to be common to the hundreds of activators identifies?

e. mediator proteins

f. repressors

9. How do activators and repressors act indirectly to regulate gene expression? What are the effects of these indirect actions?

10. How do eukaryotes coordinate gene expression without operons? GIVE ALL POSSIBLE METHODS!!!!

11. What advantage(s) does post-transcriptional regulation have?

12. Describe alternative RNA splicing.

13. Prokaryotic mRNA is degraded rapidly. What does this allow?
    a. How does this contrast to eukaryotic mRNA?

14. What may be responsible for the degradation of mRNA?

15. Initiation of translation presents another opportunity to regulate gene expression. Explain each of the following.
    a. Regulatory proteins and UTRs

    b. short poly-A tails
        i. What is so amazing about this?!?!?!?

    c. "global" control

16. Post-translational opportunities for regulation include protein processing and degradation.
    a. In what ways are proteins processed?

    b. Explain "selective degradation."
        i. How are proteins marked for destruction? (include ubiquitin)

Noncoding RNAs play multiple roles in controlling gene expression

17. Study figure 15.13. How are microRNAs and/or small-interfering RNAs involved gene regulation?

Researchers can monitor expression of specific genes

18. How can you use to nucleic acid hybridization to identify whether the bacterial colonies contain the gene of interest?
    a. Briefly explain how the procedure works (study figure 15.14)

19. Explain how reverse transcriptase is used to produce cDNA.

20. What is a genomic library?

21. How can you detect the presence of a gene of interest without using DNA libraries?