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Chapter 17: Gene Expression: From Gene to Protein

1) What is *gene expression*?

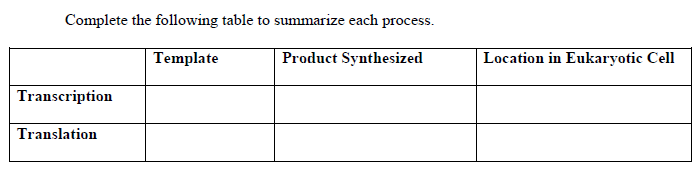
***17.1 Genes specify proteins via transcription and translation***

2) Explain the “one gene-one polypeptide hypothesis”

3) Define each of these processes that are essential to the formation of a protein:

**Transcription:**

**Translation:**



4)

5) How does the protein building process differ in prokaryotes and eukaryotes?

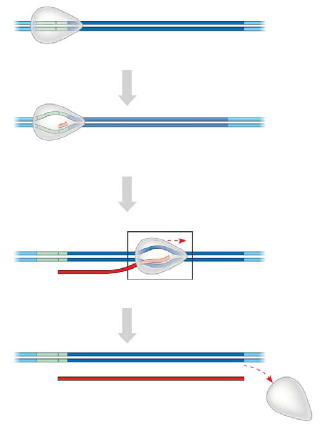
6) Here is a short DNA template. Below it, assemble the complementary mRNA strand. ***Label the codons.***



7) What is the *start codon*? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8) The enzyme which transcribes the DNA is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The strand of DNA that is transcribed is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***17.2 Transcription is the DNA-directed synthesis of RNA: a closer look***

9) Figure 17.7 in your text will require a bit of study. Use it to label the following elements on the figure below: *promoter, RNA polymerase, transcription unit, DNA template, nontemplate DNA,* and *RNA transcript*. Then, below **name the three stages of transcription and briefly describe each stage.**

10) What is the *TATA* box? How do you think it got this name?

***17.3 Eukaryotic cells modify RNA after transcription***

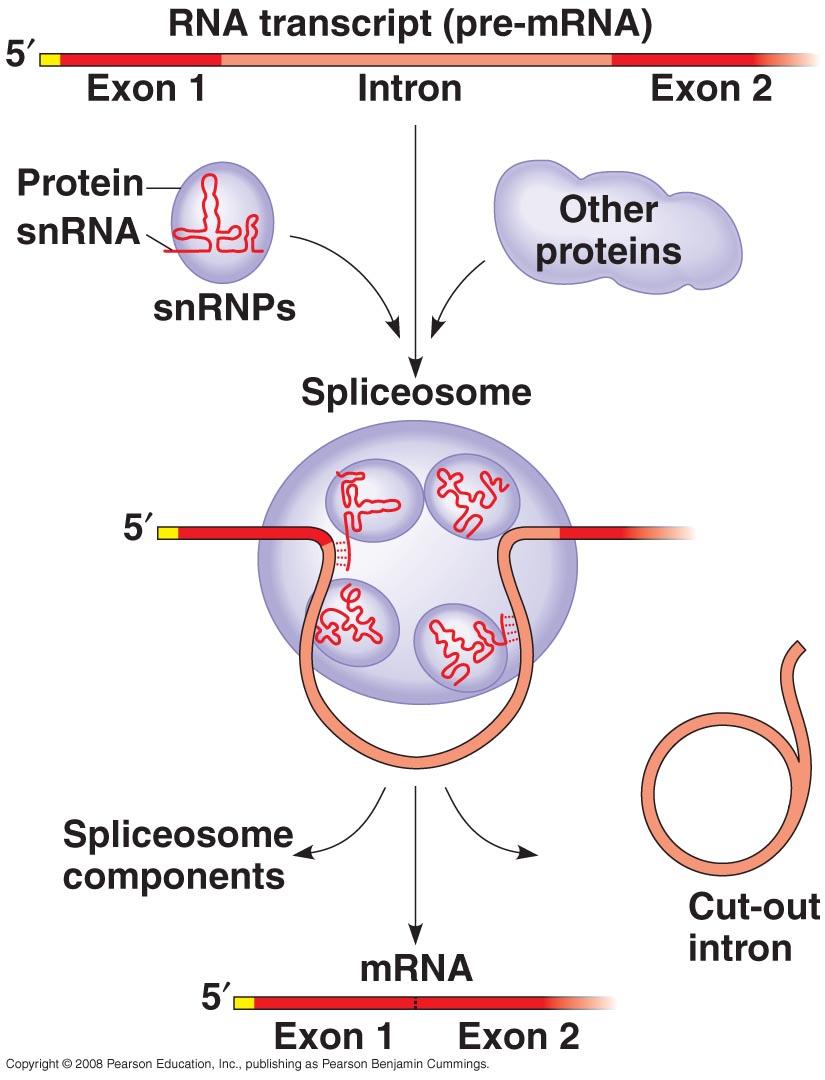
11) *RNA processing* occurs only in eukaryotic cells. The primary transcript is altered at both ends, and sections in the middle are removed.

a. What happens at the 5' end?

b. What happens at the 3' end?

12) What is the advantage of the 5’ cap and poly A tail?

13) Distinguish between exons and introns.



14) How do spliceosomes work? Study figure 17.12 carefully to **explain** how spliceosomes modify pre-mRNA.

15) What is a *ribozyme*? What commonly held idea was rendered obsolete by the discovery of ribozymes? When a protein and an snRNA are put together, what are they called?

***17.4 Translation is the RNA-directed synthesis of a polypeptide: a closer look***

16) Briefly describe the function of each type of RNA.

a. rRNA

b. mRNA

c. tRNA

17) Identify the roles of the players of the translation process.

a. Transfer RNA

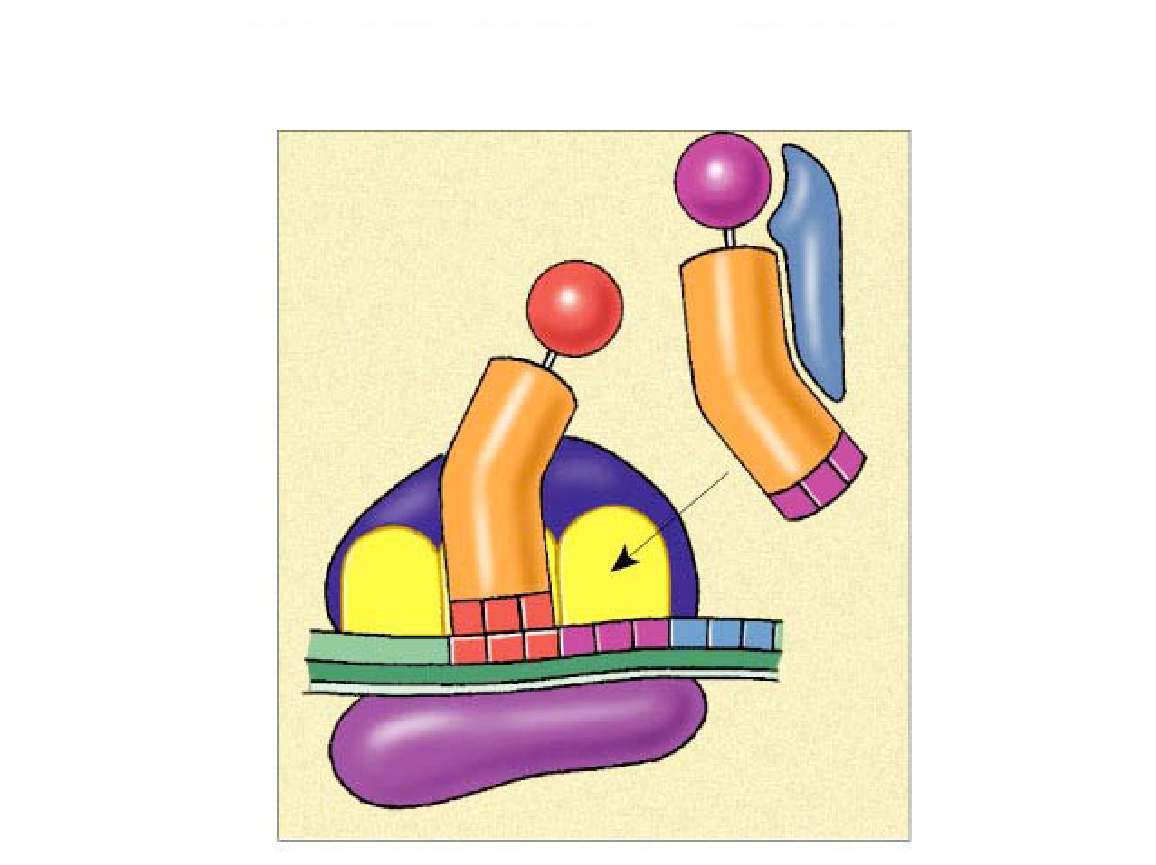
b. anticodon

c. Ribosomes

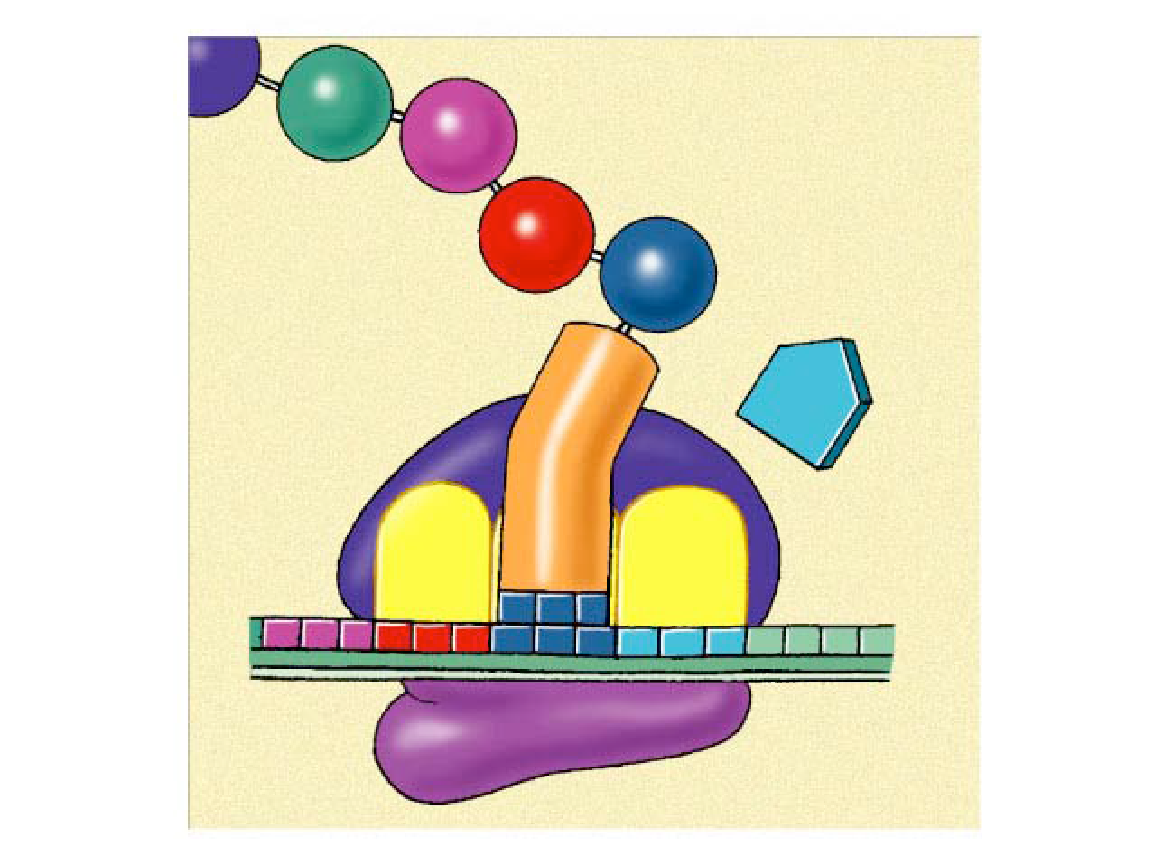
18) On this figure, label the *large subunit, small subunit, A, P,* and *E sites, mRNA binding site.* To the right of the figure, explain the functions of the A, P, and E sites.



19) Summarize the events of *initiation*. Include these components: *small ribosomal subunit, large ribosomal subunit, mRNA, initiator codon, tRNA, Met, initiation complex, P site,* and *GTP*. The figure below may help you.



20) Now, summarize the events of *elongation*. Include these components: *mRNA, A site, tRNA, codon, anticodon, P site,* and *E site.* The figure below may help you.



21) Explain termination (using figure 14.20) and what a **signal peptide** is.

***17.5 Mutations of one or a few nucleotides can affect protein structure and function***

22) Define a *mutation* in terms of molecular genetics. What is a point mutation?

23) Define mutations that are:

a. frameshift

b. Missense

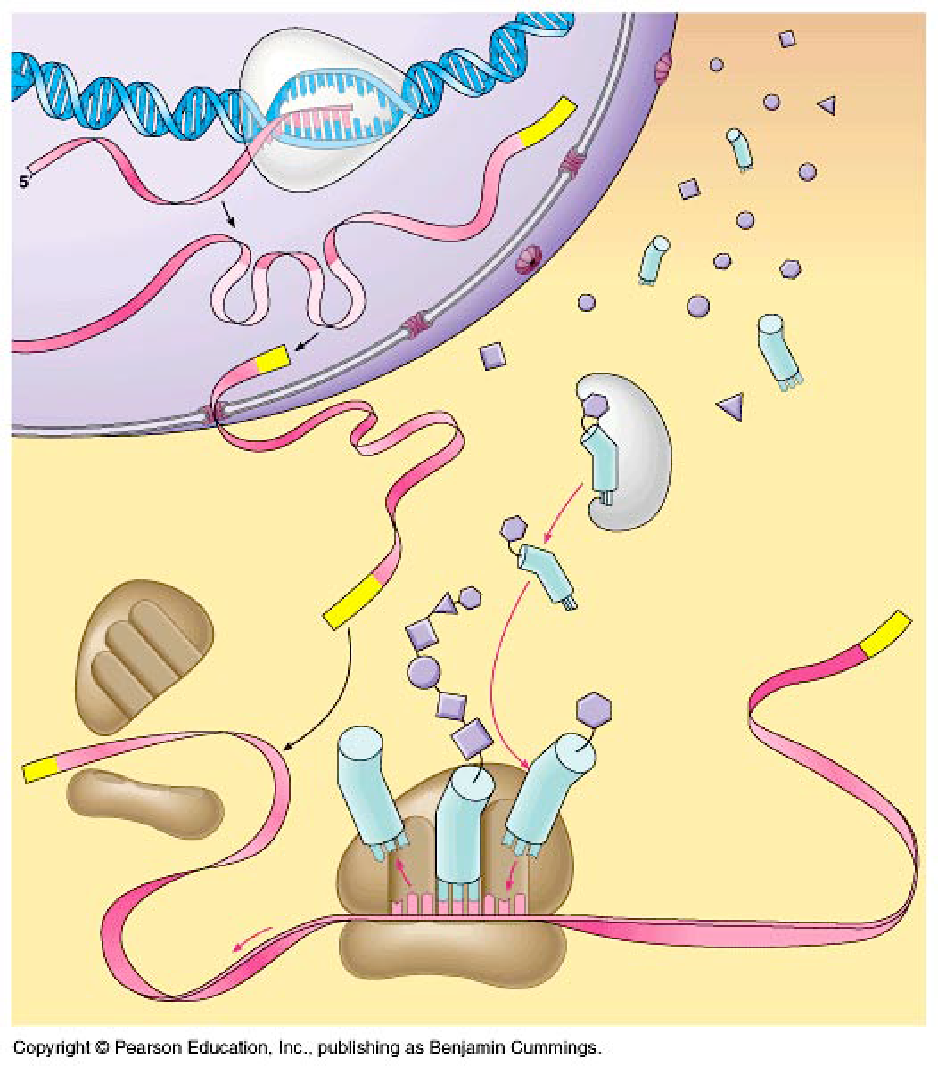
c. Nonsense

d. Insertion or deletion

e. Silent mutation

f. mutagens

24) Use figure 17.26 to trace the flow of chemical information from the gene to the protein product. Make sure you can explain what is going on and all the steps of protein synthesis based on this picture.



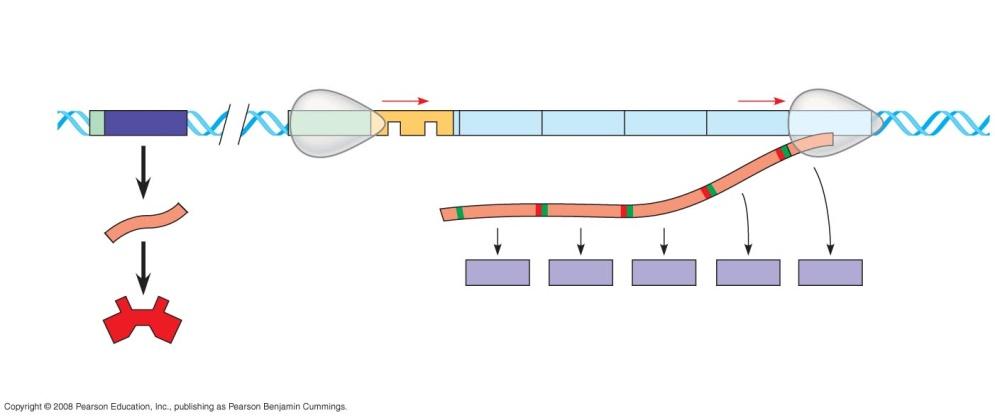
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Chapter 18: Regulation of Gene Expression

***18.1 Bacteria often respond to environmental change by regulating transcription***

1) What is a gene’s promoter? What role does it serve in regulating transcription?

2) Prokaryotes use a regulatory system called an operon. Explain what an operon is:



3) Label figure 18.3, and identify the function of the following components:

promoter:

operator:

repressor:

(Also label: RNA polymerase, operon, regulatory gene, start and stop codons)

4) How does a *repressor* protein work?

5) What are *regulatory genes*?

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

***18.2 Eukaryotic gene expression is regulated at many stages***

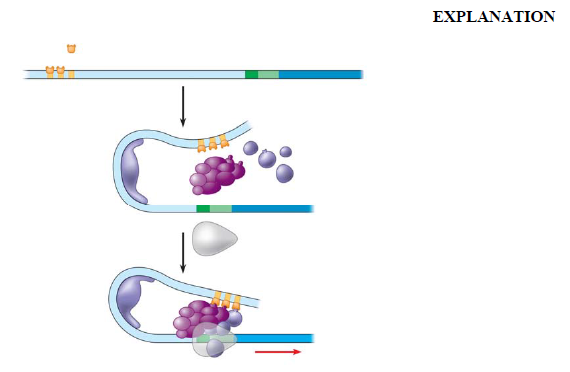
7) Even though all cells of an organism have the same genes, there is *differential gene expression*. What does this mean?

8) What occurs in *histone acetylation*? How does it affect gene expression?

9) What is *DNA methylation*? What role may it play in gene expression?

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

11) Use figure 18.10 below to explain how enhancers and activators interact with transcription factors to affect gene expression. Label the following elements: *TATA box, promoter, gene, enhancer, activators, transcription factors, transcription initiation complex, RNA polymerase II,* and *DNA.* Then place your explanation to the right of the figure.



12) 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*?

***18.3 Noncoding RNAs play multiple roles in controlling gene expression***

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

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Chapter 18 & 20: Development, Stem Cells, and Cancer

***18.4 A program of differential gene expression leads to the different cell types in a multicellular organism***

1) Explain what occurs in *cell differentiation* and *morphogenesis*.

2) 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. different *inductive signals*

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

b. What is **apoptosis** and how does it play a role in development?

4) 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?

5) What is controlled by *homeotic genes*?

***18.5 Cancer results from genetic changes that affect cell cycle control***

6) What mechanism is involved in the beginning of tumor growth? Discuss *oncogenes* and proto*- oncogenes* and how they are converted. What mechanism is involved in the beginning of tumor growth?

7) *Tumor-suppressor genes* help prevent uncontrolled cell growth. One that is found mutated (and therefore nonfunctional) in more than 50% of human cancer is *p53*. So important is the *p53 gene* that it is sometimes called the “guardian angel of the genome.” Describe the double whammy that results from mutation of *p53*.

11) Explain the *multistep model of cancer development* and compare it to embryonic development.

***20.3 Cloned organisms and stem cells are useful for basic research and other applications***

6) How is *nuclear transplantation* performed in animals?

7) What are *stem cells*? What is the major difference between *embryonic stem cells* (*ES*) and *adult stem cells*?

8) How might *induced pluripotent stem cells* (iPS) resolve the debate about using stem cells for medical treatments?

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Chapter 19 & 27: Viruses

***Overview***

*Experimental work with viruses has provided important evidence that genes are made of nucleic acids. Viruses were also important in working out the molecular mechanisms of DNA replication, transcription, and translation. Viruses have been important in the development of techniques of manipulating and transferring genes. As you learn about viruses in this chapter, you will build on the foundation necessary for an understanding of the molecular techniques of biotechnology.*

***19.1 A virus consists of a nucleic acid surrounded by a protein coat***

1) List several characteristics of viruses.

2) What is a *capsid*?

3) What is the role of an *envelope* in animal viruses?

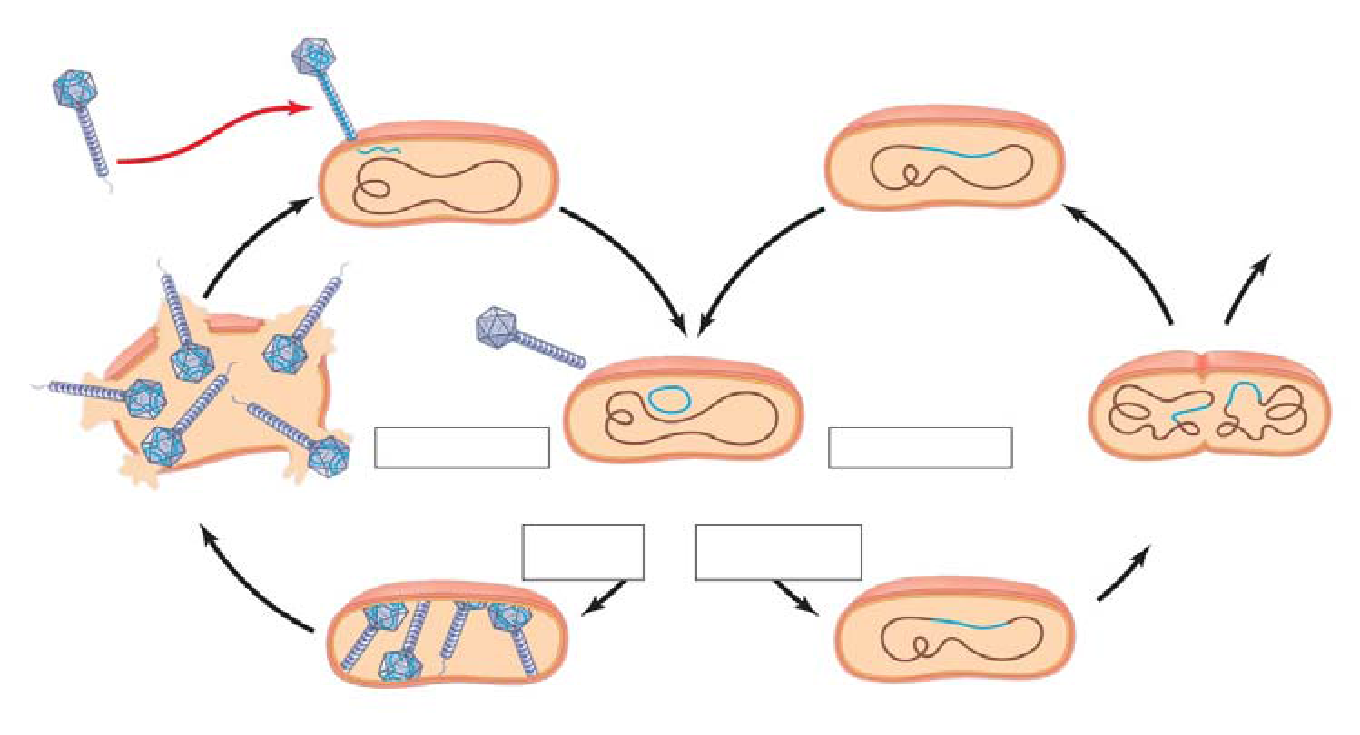
***19.2 Viruses replicate only in host cells***

4) What is meant by *host range*? Distinguish between a virus with a broad host range and one with an extremely limited host range, and give an example of each.

5) What are *bacteriophage*s? Distinguish between *lytic and lysogenic* phages.

6) What portion of a phage enters the host cell? How does it do this?

7) Label the following elements of figure 19.6 below: *phage, lysogenic cycle, lytic cycle, prophage, phage DNA, bacterial chromosome,* and *self assembly*.



8) Compare the lytic and lysogenic cycles.

9) What is a *retrovirus*? How do retroviruses, such as HIV, replicate their genome?

***19.3 Viruses and prions are formidable pathogens in animals and plants***

10) *Prions* strike fear into carnivores everywhere. What are they? How are they transmitted? What do they do?

***Note: 27.2*** ***Rapid reproduction, mutation, and genetic recombination in prokaryotes*** *p.561*

11) Describe transduction.

12) Explain why viruses may mutate so quickly.

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AP Biology

Plant Form and Function (Chapters 36-39)

***36.2 Different mechanisms transport substances over short or long distances***

1) Define these terms:

**flaccid**

**turgid**

**plasmolysis**

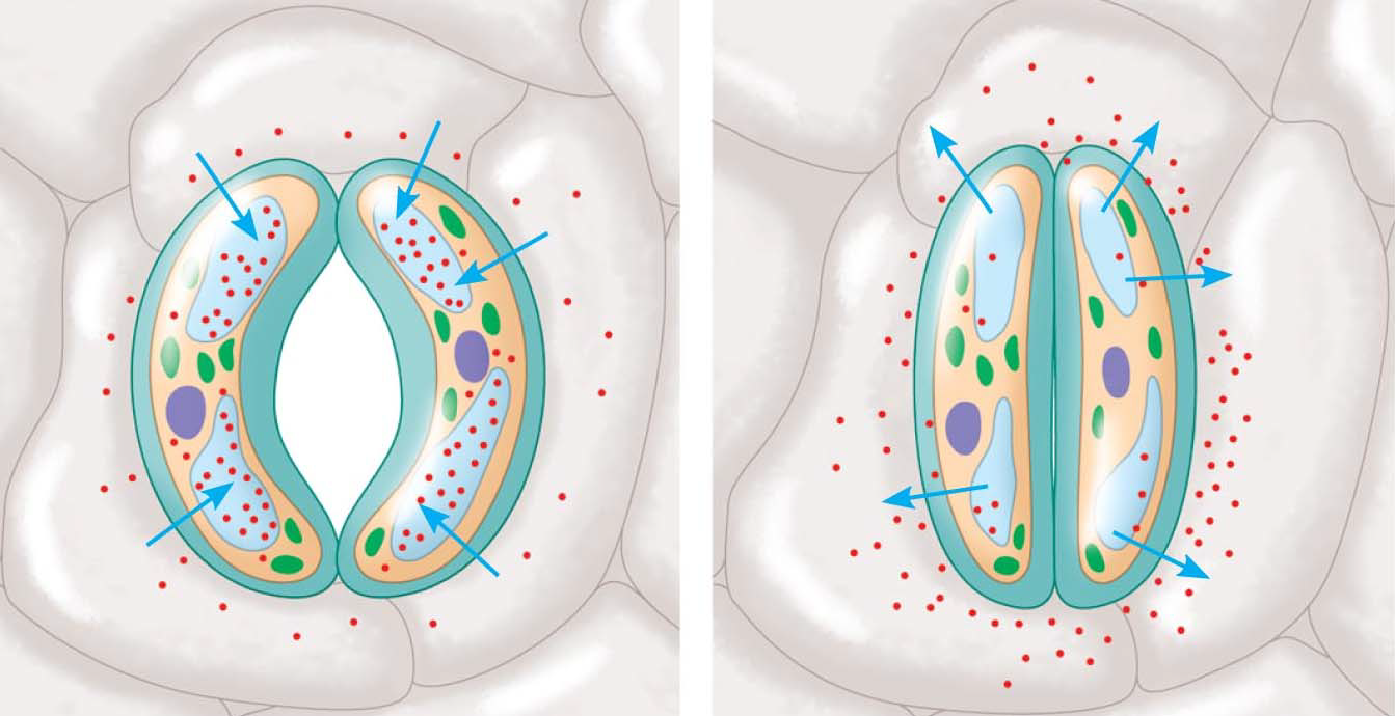
***Concept 36.5 Transpiration drives the transport of water and minerals from roots to shoots via the xylem***

3) Explain the cohesion-tension hypothesis.

***Concept 36.4 The rate of transpiration is regulated by stomata***

4) Leaves generally have large surface areas and high surface-to-volume ratios. Give an advantage and disadvantage of these traits.

**advantage**

**disadvantage**

5) On the sketches, label the *guard cell, stomata, K+*, and *H2O*. Explain why the stoma opens when K+ accumulates in the guard cells.

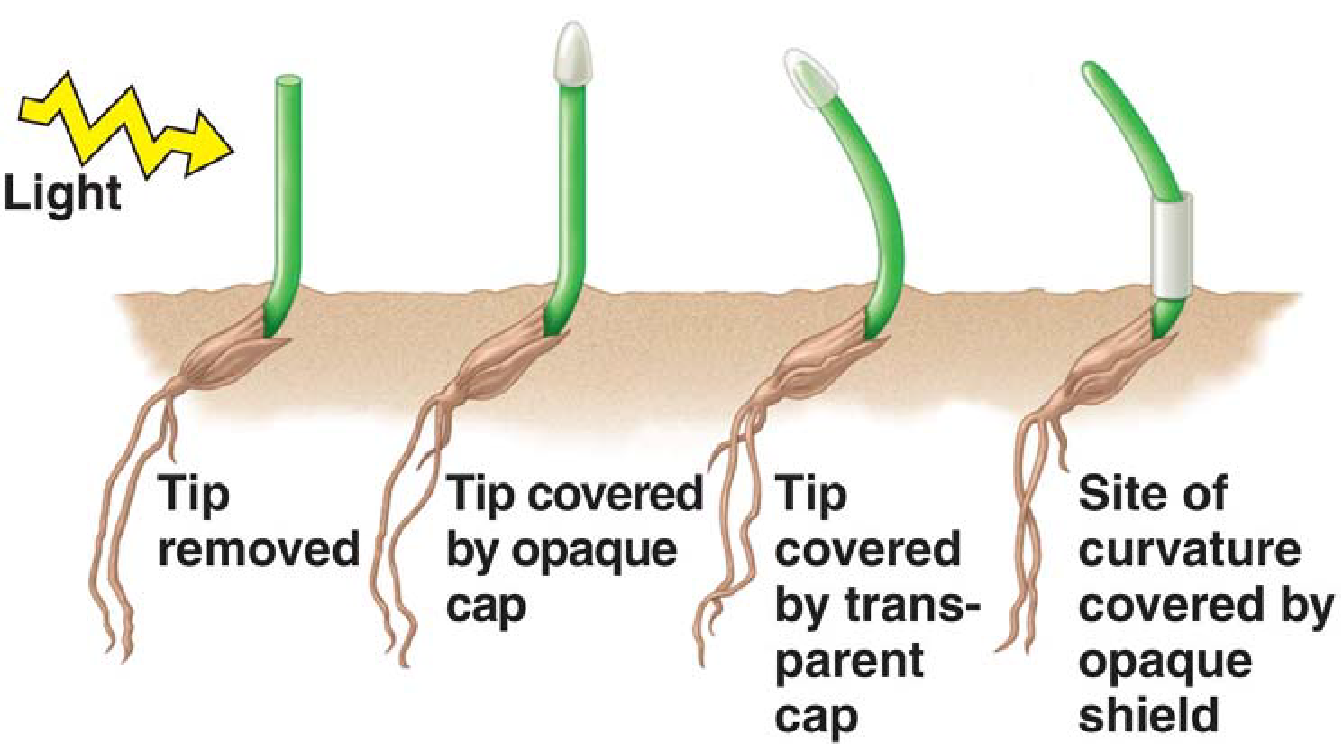
6) Three types of stimuli can cause guard cells to open. Name and explain how each one works.

|  |  |
| --- | --- |
| Stimulus for Stomatal Opening and Closing | Explanation |
|  |  |
|  |  |
|  |  |

***Concept 39.2 Plant hormones help coordinate growth, development, and responses to stimuli***

7) Both plants and animals have *hormones*. The definition of a hormone has three parts. What are they, and how do they fit into the signal transduction pathway model?

8) What is a *tropism*?



9) Figure 31.2 describes early experiments on *phototropism* conducted by Charles and Francis Darwin. What can be concluded from these experiments?

10) In jest, we tell our students that when in doubt about which plant hormone causes which plant response, just answer *auxin*. Auxin has so many functions, this answer often works. List and describe two functions of auxin.

|  |  |
| --- | --- |
| Auxin Functions | Description |
|  |  |
|  |  |

***39.3 Responses to light are critical for plant success***

11) What color light is absorbed by *phytochromes*?

12) What are two different responses initiated by blue light?

13) What is a *circadian rhythm*? Give one plant example and one human example.

14) Plants detect photoperiod, and in many species it affects their time of flowering. Explain each of the following, and give an example of a plant that is in the group.

**short-day plant**

**long-day plant**

**day-neutral plant**

***39.4 Plants respond to a wide variety of stimuli other than light***

15) What is *gravitropism*? How may a plant detect gravity?

16) What is *thigmotropism*? How is it adaptive?

**Watch these videos and take notes as needed.**

AP Bio Chapter 16, Development, Stem Cells and Cancer by Alison Dolan (there is also a recap in a related video AP Biology Chapter 15 Regulation of Gene Expression that goes with your Chapter 18 questions)

Bozeman Science: (some of these may only be in YouTube not the Bozeman Science site)

DNA Replication

Transcription Translation

Gene Regulation

Viruses

AP Bio Lab 3 Mitosis & Meiosis

AP Bio Lab 6 Molecular Biology

Plants

Plant Structure

Plant Nutrition and Transport

Plant Control

Crash Course Biology:

Evolutionary Development: Chicken Teeth