I love your enthusiasm!

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Name Leonie Hoeher Period _____

Chapter 27: Bacteria and Archaea

Overview

1. The chapter opens with amazing tales of life at the extreme edge. What are the "masters of adaptation"? Describe the one case you thought most dramatic.

totally! Prokaryotes ~~(bacteria specifically)~~ are the masters! They are so versatile! *Halobacterium* can live in water w/ 32% salt concentration!

Concept 27.1 Structural and functional adaptations contribute to prokaryotic success ahhhhh

2. Which two domains include *prokaryotes*?

Bacteria and Archaea

3. Let's focus on some general details about *prokaryotes*.

a. Are they multicellular or unicellular?

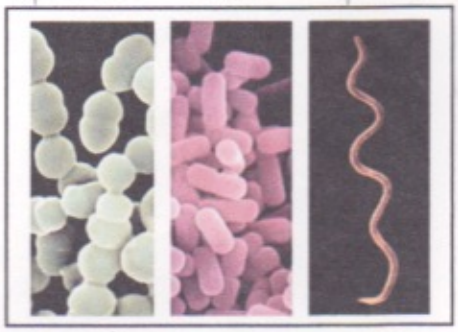
(Mostly) unicellular

b. Compare their size relative to eukaryotic cells.

Prokaryotes are much smaller

c. What three shapes are most common? Label them on the figure.

sphere rod spiral



Cocci Bacilli spirilla

d. What is the composition of the typical bacterial cell wall?

Peptidoglycan (sugar + peptides)
Polysaccharides and proteins are generally found

4. A key feature of prokaryotic cells is the *cell wall*. What three functions does it provide for the cell?

- prevents dehydration (protects cell)
- maintains shape of cell
- prevents bursting in hypotonic environment

5. Quick review! What material comprises the cell wall of plants? of fungi?

Wall of plants: cellulose
Wall of fungi: chitin

6. The cell walls of Archaeans are different. They lack peptido glycan but contain proteins and polysaccharides.

7. Explain the difference between *Gram-positive* and *Gram-negative bacteria*.
Gram + bacteria contains more peptidoglycan and has a less complex outer layer than Gram −. Gram − bacteria has less peptidoglycan and ~~more~~ another carb & lipid layer on the outside. These features also make Gram − more resistant to antibiotics.

8. What is a bacterial *capsule*? What functions may it serve?
A capsule is a dense layer of polysaccharides and proteins outside of the bacterium. It helps with the bacterium's adherence and protection.

9. Many prokaryotes are capable of directional movement. What is this called?
Taxis

10. What bacterial feature makes this possible?
Flagella 

11. Under ideal conditions, how quickly can *E. coli* divide? What conditions check prokaryotic reproduction?
They can divide every 20min (whaaaat!).
Short nutrient supply, competition, consumption by other organisms, and poison by their own wastes are all factors that can inhibit reproduction.

12. What three key features allow prokaryotic populations to consist of trillions of individuals?
They are tiny, reproduce fast, and have short generations.

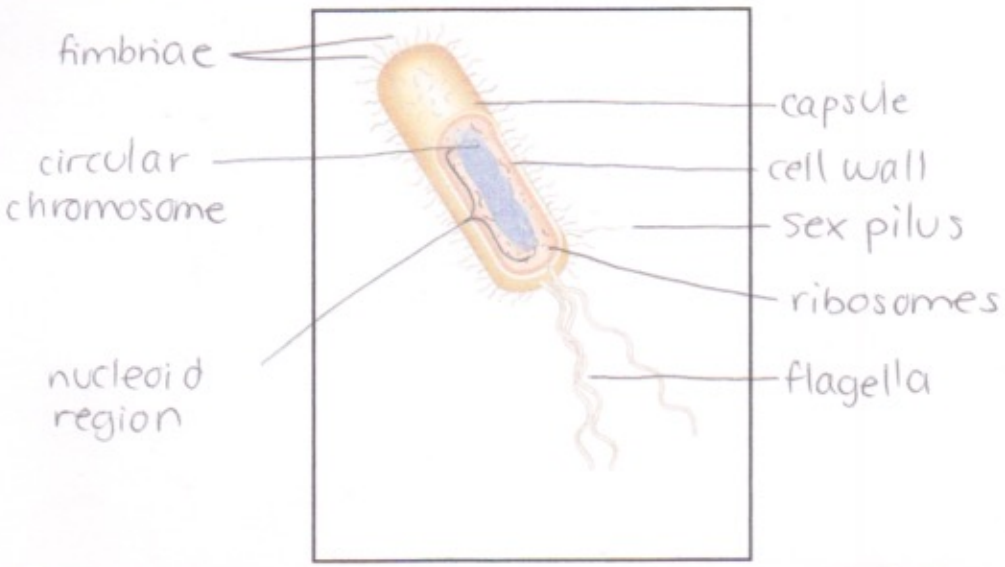
13. Compare prokaryotes to eukaryotes in terms of the following characteristics:

	Prokaryotes	**Eukaryotes**
Size	small	large
Genome	circular + less info	linear + more info
Membranes	cell walls have peptidoglycan, lipids, carbs	cell walls have cellulose or chitin
Location of genome	nucleoid	nucleus
Plasmids	existent	nonexistent
Ribosomes	smaller	larger (different RNA + protein content)

14. What are the small, circular, self-replicating pieces of DNA found in bacteria called?

Plasmids

15. Label the following structures of a typical prokaryote seen here: *cell wall*, *sex pilus*, *circular chromosome*, *nucleoid region*, *ribosomes*, *flagella*, *capsule*, and *fimbriae*. Sketch in a plasmid or two, and label them. For each structure, know the function. (Go to the end of the chapter, p. 573, for help with this figure.)



16. When conditions for survival are difficult, some species produce *endospores*. What are these? Can you name any species that form *endospores*? As a hint, consider what causes botulism or tetanus.

Endospores are resistant cells bacteria can form when lacking an important nutrient. Bacteria can copy their DNA and make a dehydrated cell that can survive in bad conditions for a very long time. *Clostridium tetani* (tetanus) can form endospores.

Concept 27.2 Rapid reproduction, mutation, and genetic recombination promote genetic diversity in prokaryotes

17. You should now have some idea why there is so much potential for genetic diversity with bacterial populations. Although mutation is the major source of genetic variation in prokaryotes, listed below are the other three ways variation is introduced. Explain each one.

Source of Variation	Summary Explanation
Transformation	prokaryote takes up DNA from its surroundings → genotype/phenotype could change
Transduction	bacteriophage injects other cell's DNA into recipient → errors in phage assembly cause this
Recombination	prokaryotes may exchange DNA with each other due to the F factor (homologous regions of DNA can align and recombine)

18. Define *transformation*. This idea was first described by *Frederick Griffith*. (You read about his work in Concept 16.1.)

Transformation occurs when a prokaryote takes up DNA from its environment and accepts the functions/qualities of that DNA sequence. A pathogenic strand can therefore "infect" a nonpathogenic strand and elicit transformation.

19. What is *transduction*? What is the vector for this process?

The vector for transduction, a process in which DNA from another prokaryote is injected into a different prokaryote, is a bacteriophage.

20. Compare and contrast *transduction* and *transformation*.

Both processes allow for genetic recombination within a prokaryote, however in transformation, the cell simply takes up genetic material from its environment, whereas in transduction, a phage injects prokaryotic DNA into a host.

21. What is a *sex pilus*? What is the *F factor*? And how are the two related?

The F factor is a DNA sequence that results in the "fertility" of a certain cell. The genes can code for a sex pilus, which is a medium through which prokaryotes can donate DNA.

22. The F factor is an *episome*. This is a piece of DNA that can be integrated within the main chromosome of the bacterium, or able to exist as an independent plasmid. What is the bacterial cell called:

when the F factor is in plasmid form?

F^+ cell

when it lacks an F plasmid?

F^- cell

when it is integrated within the chromosome?

Hfr cell

23. What occurs in bacterial *conjugation*?

In conjugation, two (prokaryotic) cells temporarily join and one of the individual cells accepts DNA and the other one donates DNA (usually through sex pili...)

24. When a mating bridge forms between an *F+* cell and an *F–* cell and the *F plasmid* is replicated and transferred, what is the status of the *F–* cell afterward?

The F^- cell goes to F^+ ! way to go F^- cell ☺

25. What is an *Hfr* cell?

An Hfr cell has the fertility factor built into its chromosomal DNA (high frequency of recombination)

26. How are *Hfr* cells created?

Hfr cells can be created when the donor cell's F factor is integrated into the chromosome after conjugation.

27. Summarize the transfer of genetic information from an *Hfr* cell to an *F–* cell.

The Hfr cell plays the donor during conjugation with an F⁻ cell. The chromosomal DNA from the Hfr cell may align with homologous regions of the F⁻ DNA and exchange information.

28. An understanding of *R plasmids* and antibiotic resistance will be important when you do a bacterial transformation lab. What are *R plasmids*?

R plasmids have resistance genes that can code for enzymes that may inhibit the function of antibiotics.

Concept 27.3 A great diversity of nutritional and metabolic adaptations have evolved in prokaryotes

29. Prokaryotes can be placed in four groups according to their mode of nutrition, which is how they take in carbon and how they obtain energy. List each group below, and summarize how each of them obtains energy. Place an ** by the heterotrophs.

Mode of Nutrition	Energy Source	Examples

30. Compare the metabolic requirements of each group with respect to oxygen:

obligate aerobes

obligate anaerobes

facultative anaerobes

31. To which of the above groups do you think the bacterium *Clostridium tetani*, the causative agent of tetanus, belongs?