Chapter 4 Procaryotic Profiles: The Bacteria and Archaea

Building Your Knowledge

1) What were the first cells on Earth? ARCHAEA BACTERIA

Which modern cells do they most closely resemble (Archaea/Bacteria/Eukarya)?

EUKARYA

When did these first cells appear?

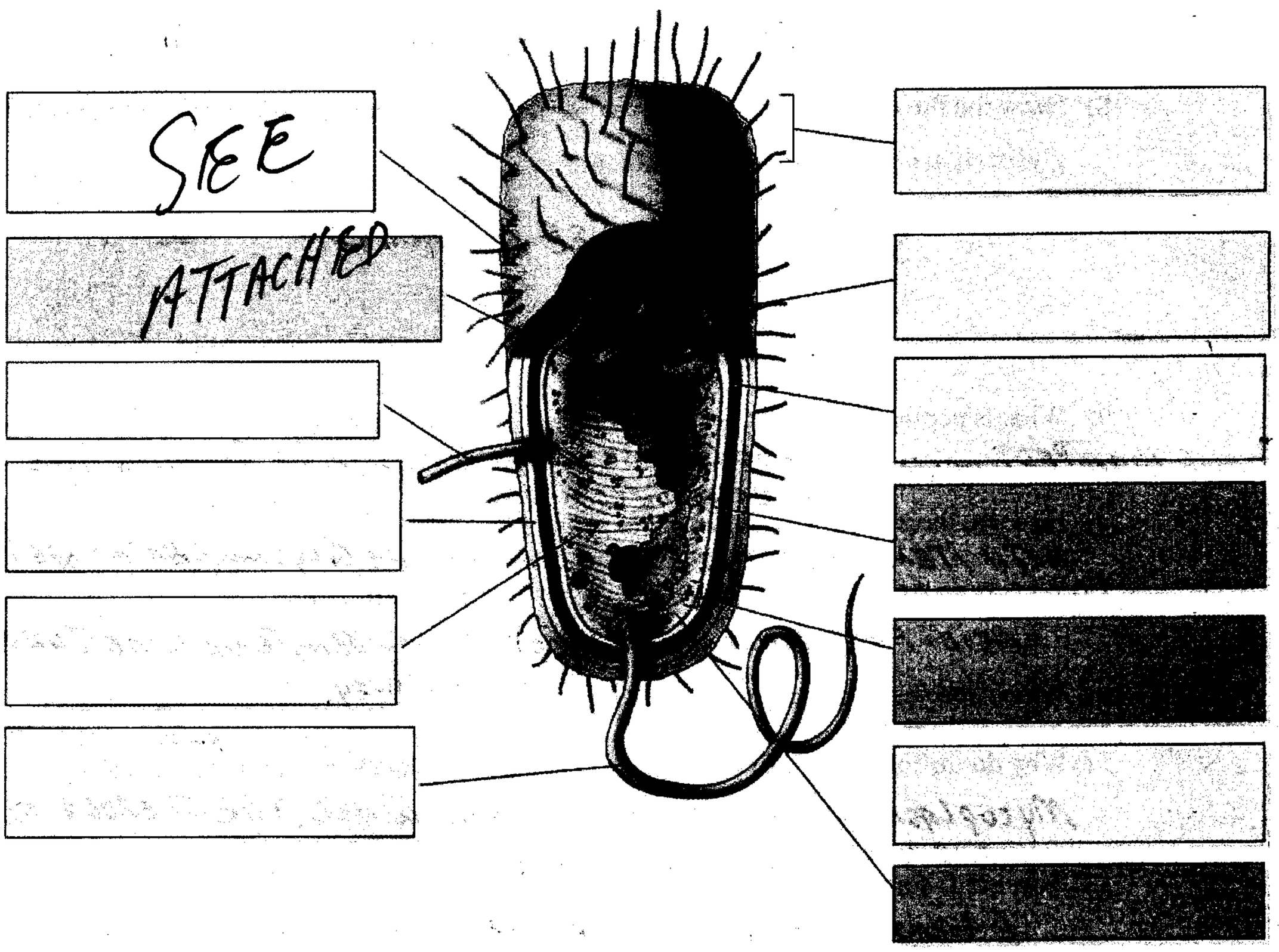
3.8 BILLION YEARS AGO.

2) Appendages serve two generalized functions for bacteria. What are they?

a. MOTILITY

b. ATTACHMENT & DNA EXCHANGE

3) Label the following diagram of a procaryotic cell. Circle the structures found in ALL bacteria and underline those found in MOST bacteria.



4) Draw a bacillus with the following flagellar arrangements.

a. peritrichous 	c. monotrichous 
b. lophotrichous 	d. amphitrichous 

5) How do chemical attractants affect the tumble/run cycle of a motile bacterial cell?

THROUGH THE PROCESS OF CHEMOTAXIS A CHEMICAL SIGNAL IS SENT TO THE FLAGELLUM TO ROTATE THE FLAGELLUM IN A COUNTER CLOCKWISE ROTATION TOWARDS

6) In what way are the spirochete flagella unusual? How do spirochetes move? THE SUBSTANCE HAS A "RUN."

SPIROCHETE HAVE PERIPLASMIC FLAGELLA. LOCOMOTION IS BY TWISTING ACTION.

7) What is the difference between pili and fimbriae? Both are used for ATTACHMENT

Pili may be used for DNA (PLASMID) EXCHANGE.

8) Draw the three layers of the cell envelope, labeling the interior and exterior of the cell, the glycocalyx, cell wall and cell membrane.

SEE ATTACHED

9) What is peptidoglycan and where is it found in bacterial cells?

ss-LINKED PEPTIDOGLYCANS ARE GLUCOSE AMINO ACID POLYMERS forming THE BACTERIAL CELL WALL.

How are the actions of lysozyme and penicillin similar?

BOTH ITEMS HYDROLYZE THE BONDS OF THE GLYCAN CHAINS OPENING UP THE CELL WALL.

10) What is an Acid-fast stain used for?

ACID-FAST STAIN IS USED FOR WAXY BACTERIA LIKE TUBERCULOSIS AND LEPROSY.

Which species of bacteria are Acid-fast?

11) Why do mycoplasmal cell membranes contain higher levels of sterol molecules?

MYCOPLASM DO NOT CONTAIN A CELL WALL. THE STEROLS STABILIZE THE MEMBRANE AGAINST BURSTING

12) How are L-forms and mycoplasmas similar?

L-forms BACTERIA CAN LOOSE THEIR CELL WALL AND BECOME A PROTOPLAST.

What is the difference between a spheroplast and a protoplast?

A GRAM (-) BACTERIA CAN LOOSE ITS CELL WALL RETAINING ITS OUTER CELL MEMBRANE. PROTOPLASTS ARE GRAM (+) BACTERIA THAT LOST THEIR ENTIRE CELLWALL.

13) List and describe four separate functions of bacterial cell membranes.

a. ENERGY TRANSDUCTION, NUTRIENT PROCESSING . . .

b. COORDINATION FOR DNA SYNTHESIS

c. SEMI-PERMEATABLE MEMBRANE (OSMOSIS)

d. MACROMOLECULE TRANSPORT

14) There are two structures made of DNA in the bacterial cell. Which is larger and contains essential genes? GENOME (CHROMOSOME)

Which genes are commonly found on plasmids? ANTIBIOTIC RESISTANT GENES & "SEX" PILLUS GENE

15) What are the functions of ribosomes and where are ribosomes found?

RIBOSOMES FUNCTION AS THE SYNTHESIS CATALYST SITE FOR POLYPEPTIDE SYNTHESIS. THESE SUBCELLULAR BODIES ARE FOUND THROUGH OUT

16) What are inclusion bodies? THE CYTOPLASM

INCLUSION BODIES ARE STORAGE VESSICLES

17) What is an endospore? ENDOSPORE ARE DORMANT RESTING BODIES.

Why is it an advantage for bacteria to have them? THEY RESIST HARSH ENVIRONMENTS

Name 2 bacteria that form endospores. CLOSTRIDIUM BACILLUS

Are endospores used for reproduction? Explain your answer.

NO — ENDOSPORES FORM FROM A PARENT VEGETATIVE CELL

18) What two factors most determine a bacterial cell's shape?

(1) CELL WALL; (2) CYTOSKELETON SYSTEM

19) List the three most commonly seen bacterial cell shapes.

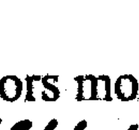
a. ROD SHAPE - BACCILLUS

b. ROUND - COCCI

c. CURVED - SPIRAL

d. SPIRILLUM

20) Draw the following arrangements of bacterial cells.

diplococci 	streptococci 
staphylococci 	palisades 

21) Why are classification schemes important to microbiologists? Give two reasons.

22) Why are descriptive traits like Gram stain characteristic and cell shape alone not enough to classify microbes?

BOTH STAPHYLOCCOCUS AUREUS & STAPHYLOCCOCUS EPIDERMIDIS V GRAM STAIN POSITIVE. HOWEVER, ONLY S. AUREUS PRODUCE LYTIC ENYZMES TO BREAK HUMAN RED BLOOD CELLS APART.

23) What gene sequences are used to compare and classify different species? Why are these sequences used?

RIBOSOMAL RNA GENES CODING FOR rRNA INDICATE RELATENESS IN ANCESTRY BETWEEN AND WITHIN BACTERIAL SPECIES. RIBOSOME TEND TO BE MORE STABLE OVER LONG TIME PERIODS THAN DNA ALONE.

24) What is the definitive published source for bacterial classification? BERGEY'S MANUAL

25) The current edition of Bergeys's Manual of Determinative Bacteriology separates bacteria based on differences in PHENOTYPIC TRAITS. The four major divisions listed are:

a. SHAPE

b. CULTURAL BEHAVIOUR

c. BECHEMICAL REACTION

d. rRNA SEQUENCING

26) Which system (phenotype or phylogeny-based) to medical microbiologists commonly use to identify bacteria in clinical samples? Why?

PHENOTYPIC TRAITS ARE USED DUE TO THEIR EASY CHARACTERIZATION OF MICROBES BY THEIR RIELATENESS.

27) What is a strain of bacteria?

A STRAIN OF BACTERIA ARE a CLONAL DESCENDANTS FROM A COMMON ANCESTOR.

Are two strains of *E.coli* of the same species? DEVIATION FROM A COMMON ANCESTOR WILL RESULT IN DIFFERENT STAINS OF E.coli

28) Can you grow obligate intracellular parasites on general media agar plate? Why or why not?

INTRACELLULAR PARASITES LIKE VIRUS REQUIRE A HOST CELL AND CAN NOT BE GROWN ON AGAR.

29) Name 2 bacterial obligate intracellular parasites and the diseases they cause.

a. VIRUS - SMALL POX

b. RICKETTSIAS - Rocky MOUNTAIN SPOTTED FEVER.

30) How are cyanobacteria and Green & Purple sulfur bacteria similar?

BOTH ARE PHOTOSYNTHETIC BACTERIA

Which group produces oxygen?

CYANOBACTERIA PRODUCE O_2

31) What are myxobacteria and why are they different from most bacteria?

THESE ARE GLIDING BACTERIA THAT SWARM TOGETHER FORMING REPRODUCTIVE FRUITING BODIES – MAKING SPORES

32) Of the three domains, which two are procaryotic?

a. ARCHAEA

b. EUKARYA

Which procaryotic domain is most closely related to eucaryotes?

ARCHAEA

Which members of Domain Archaea would you expect to see in the Dead Sea?

ARCHAEA

33) What are the 3 major groups of Archaea, as determined by rRNA sequences?

a. METHANOGENS

b. HALOPHILES

c. PSYCHROPLILES

Organizing Your Knowledge

Please make an X corresponding to the nature of each trait listed below.

Structure	Location	Function
Capsule	External	
Flagella		
	Entire Cell	Environmentally Resistant Form
Actin cytoskeleton		
	External	Adhesion
Inclusions		
		Translation (protein synthesis)
Cell wall		

Trait	Microscopic (Requires microscope)	Macroscopic (Naked Eye)
bacterial cell shape	X	
colony size		X
colony shape		X
speed of colony growth		X
Gram stain	X	
cell arrangement	X	
flagellar arrangement	X	
capsule	X	
endospores	X	
slime layers	X	
colony color	X	

Practicing Your Knowledge

1. A capsule is used by bacterial cells for all of the following EXCEPT:
   a. conjugation
   b. protection against phagocytes
   c. adhering to surfaces
   d. formation of biofilms

2. Which of the following statements is FALSE, concerning bacterial cell walls?
   a. they have peptidoglycan
   b. they give cells their shape
   c. they protect the cell from hypertonic lysis
   d. they are the target of penicillin action

3. A flagellum is used by a bacterial cell for:
   a. adhesion
   b. structural support
   c. protein synthesis
   d. motility

4. Archaeabacteria include ___.
   a. many human pathogens
   b. mostly flagellated bacteria
   c. extremophiles
   d. all of the Gram negative bacterial species

5. A flagellated bacterial cell moving toward a food source will ___.
   a. make a straight line right for the food.
   b. tumble more than it runs.
   c. run more than tumble
   d. shed its flagella and move with its slime layer

6. If you gram-stain a culture and see purple circles arranged in chains, you would call them:
   a. Gram negative bacilli
   b. Gram positive staphylococci
   c. Gram negative staphylococci
   d. Gram positive streptococci

7. Bacteria are taxonomically classified by___.
   a. cell shape
   b. rRNA sequence similarity
   c. mechanism of mobility
   d. colony morphology

8. Bacterial plasmids will likely carry all of the following genes EXCEPT:

a. the gene to use a different sugar source
b. antibiotic resistance genes
c. genes for the proteins required in metabolism
d. all of these are commonly seen on plasmids

9. Which of the following structures is NOT found in the cell envelope of a bacterial cell?

a. cell wall
b. ribosomes
c. capsule
d. glycocalyx

10. If a bacterial cell lost its ribosomes, it would no longer be able to ___.

a. produce proteins
b. produce DNA
c. produce lipids
d. produce a flagella

11. Which of the following bacteria are photosynthetic?

a. Cyanobacteria
b. Chlamydia
c. Pseudomonas
d. Treponema

12. Gram positive cell walls ___.

a. contain LPS
b. have a thick layer of peptidoglycan
c. have porins
d. have an outer membrane

13. Smooth, encapsulated bacteria are generally less pathogenic than are rough bacterial strains.

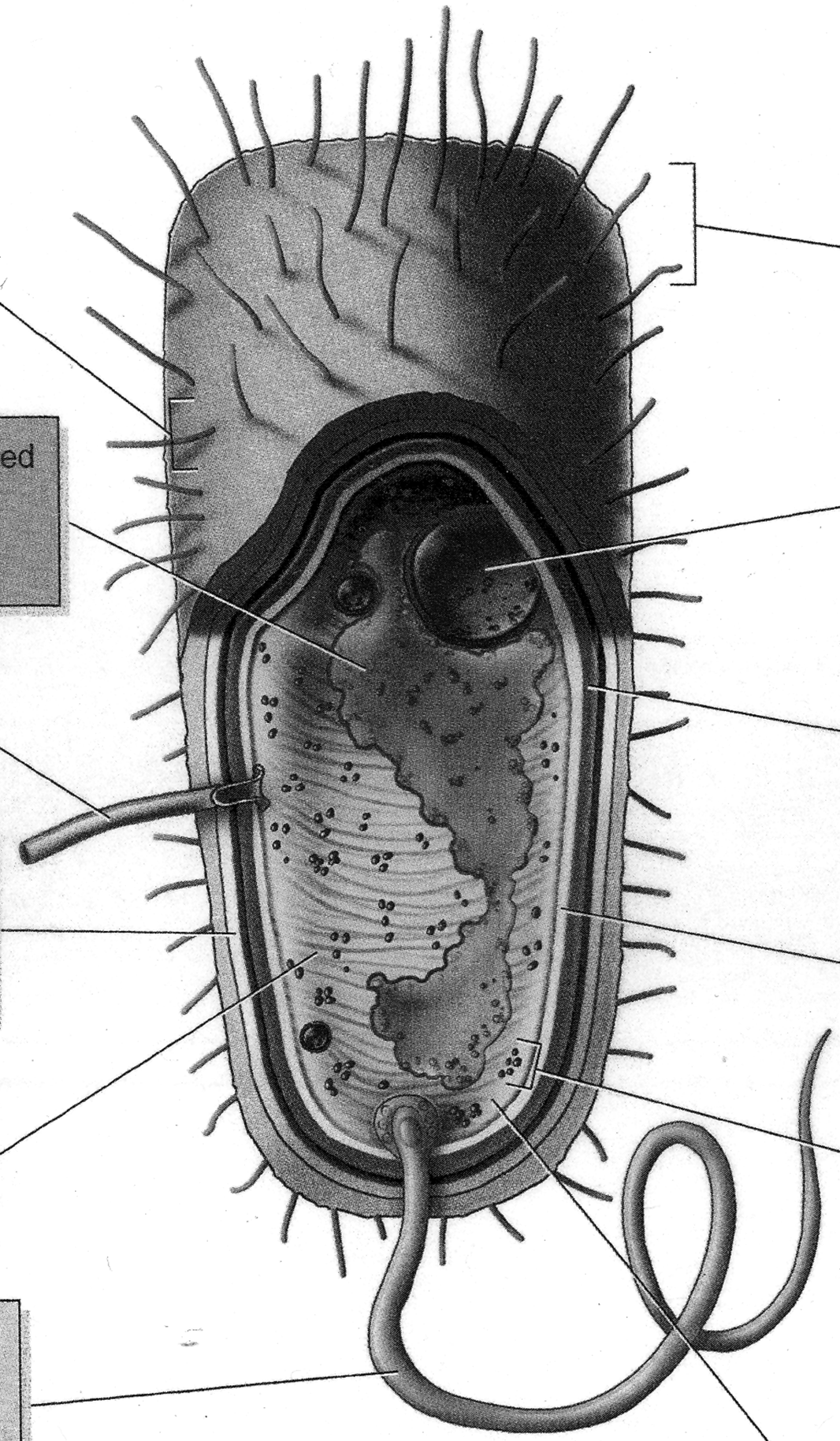
a. True
b. False

14. Which group of bacteria have periplasmic flagella?

a. bacilli
b. cocci
c. vibrio
d. spirochetes

15. Endospores are used by some bacterial species to reproduce.

a. True
b. False



Glycocalyx—A coating or layer of molecules external to the cell wall. It serves protective, adhesive, and receptor functions. It may fit tightly or be very loose and diffuse.

Bacterial chromosome or nucleoid—Composed of condensed DNA molecules. DNA directs all genetics and heredity of the cell and codes for all proteins.

Pilus—An elongate, hollow appendage used in transfers of DNA to other cells.

Outer membrane—Extra membrane similar to cell membrane but also containing lipopolysaccharide. Controls flow of materials and is toxic to mammals when released.

Actin cytoskeleton—Long fibers of proteins that encircle the cell just inside the cell membrane and contribute to the shape of the cell.

Flagellum—Specialized appendage attached to the cell by a basal body that holds a long, rotating filament. The movement pushes the cell forward and provides motility.

Fimbriae—Fine, hairlike bristles extending from the cell surface that help in adhesion to other cells and surfaces.

Inclusion/Granule—Stored nutrients such as fat, phosphate, or glycogen deposited in dense crystals or particles that can be tapped into when needed.

Cell wall—A semi-rigid casing that provides structural support and shape for the cell.

Cell membrane—A thin sheet of lipid and protein that surrounds the cytoplasm and controls the flow of materials into and out of the cell pool.

Ribosomes—Tiny particles composed of protein and RNA that are the sites of protein synthesis.

Endospore—Dormant body formed within some bacteria that allows for their survival in adverse conditions (not shown).

Cytoplasm—Water-based solution filling the entire cell.

42 **Structure of a Procaryotic Cell**
Figure 4.1

Figure 4.6: A prokaryotic cell showing typical structures.