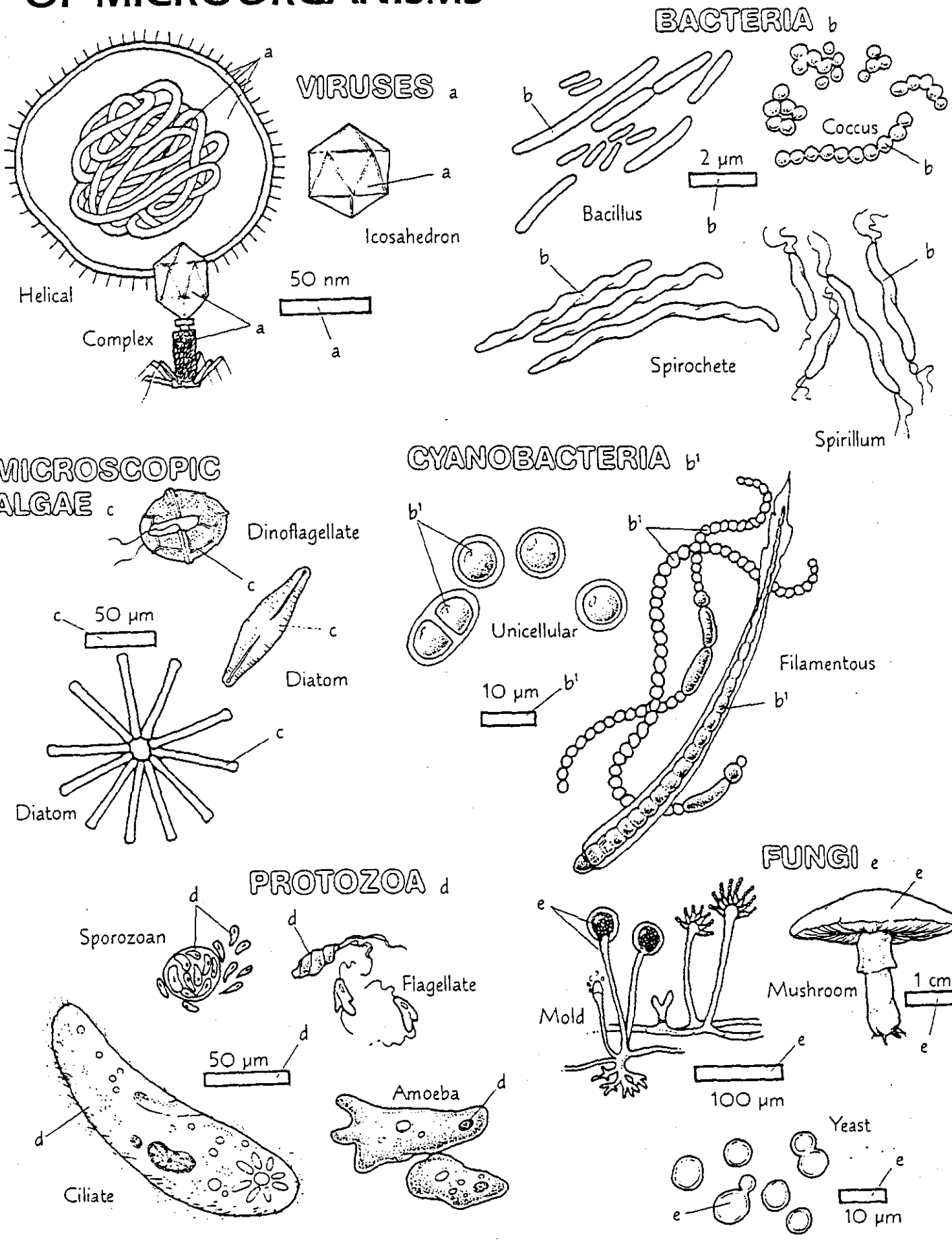
THE SPECTRUM OF MICROORGANISMS



EI

10
THE SPECTRUM OF MICROORGANISMS

The spectrum of microorganisms is very broad, ranging from the ultra-small viruses to the relatively large protozoa. A feature common to most microorganisms is that one may use a microscope to observe their structural details. Their sizes can be compared with the measuring bars as illustrated. Microorganisms are grouped by structural, functional, and biochemical qualities.

Color the title (a) and the three related viruses at upper left. Also color the measuring bar at upper left, noting the length of the bar (in nm) in relation to the viruses shown. Light pastel colors are recommended for the viruses.

Viruses (a) are among the smallest microorganisms, and require electron microscopes for visualization. Composed of fragments of nucleic acid surrounded by protein coats, viruses occur in three major shapes: the icosahedron (a 20-sided figure), the helix (or coil), and the complex form. Lacking synthetic "machinery," viruses do not grow or show any observable activity except replication, which can be accomplished only within living cells. Despite their structural simplicity, viruses are responsible for several important human diseases including influenza, hepatitis, chicken pox, and acquired immune deficiency syndrome (AIDS). In each of these cases, disease virulence is related to the viral capacity for replication, which alters cellular function and structure in the host.

Color the title (b) and the four different bacteria. Color the measuring bar at upper right, noting the difference in size between bacteria and viruses. Consult Plate 8 for review of comparison of linear dimensions.

Bacteria (b) are perhaps the most abundant organisms on Earth. Most species of bacteria are hundreds of times larger than viruses, and the great majority of species can be seen with an ordinary light microscope at a magnification of 1000 times (1000 X). Bacteria occur in three major shapes: the rod-shaped bacillus, the spherical coccus, and the spiral-shaped spirochete and spirillum. The vast majority of bacteria play positive, non-pathogenic roles in nature, such as digesting the remains of dead animals and plants. They also recycle the elements, extracting nitrogen from the air for protein production in plants. Moreover, they manufacture foods for human consumption. Bacteria that cause disease do so by growing in the body tissues, digesting healthy cells, and producing toxins that interfere with cellular functions. Such pathogenic activity can produce serious sickness or death in the host. Biologists estimate that the mass of bacteria on Earth outweighs the mass of all plants and animals.

Color the title (b^1) and the two members of this bacterial subgroup. Color the measuring bar and compare.

Cyanobacteria (b^1; formerly called blue-green algae but now called cyanobacteria to reflect their place as bacteria) are microorganisms that possess pigments which function in the solar energy-trapping process of photosynthesis. Their microscopic size and chemical features are typical of microorganisms. Cyanobacteria may occur in one-celled (unicellular) or multicellular filamentous forms. They inhabit fresh water and marine environments, sometimes giving a "pea soup" color to the water.

Color the title (c) and the three members of the group, and the related 50 μm measuring bar. Note these organisms are significantly larger than those microorganisms just colored.

Microscopic algae (c), like cyanobacteria, have pigments within their cells and are considered microorganisms. The pigments of these algae are more like those of plants, however, and have a complexity typical of plant cells. Two types of microscopic algae are important in microbiology: the diatoms, which serve as major sources of food in the oceans; and the dinoflagellates, which cause the red tides that occur periodically in ocean waters and coastal regions.

Color the title (d) and the four members of the group, and the related 50 μm measuring bar.

Protozoa (d) are microorganisms with complex cellular features. Means of locomotion is an important criterion in the classification of protozoa. Amoebas move by thrusting out portions of their cell membranes (pseudopods) then moving into the projections. Flagellates move as one or more whiplike flagella push or pull the organism along. Ciliates, covered with rows of hairlike cilia, move by synchronized beating of the cilia. Sporozoans have no method of locomotion in the adult form, but move with the flow of their external environment. Most species of protozoa are harmless, but certain ones cause malaria and sleeping sickness, among other diseases.

Color the title (e) and the three members of the group, and the three measuring bars (10 μm, 100 μm, and 1 cm).

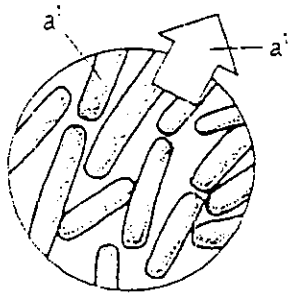
Fungi (e) are complex microorganisms subdivided into two groups: the molds and yeasts. Molds, which include mushrooms, are long, branching chains of cells called hyphae. With vigorous growth, hyphae may result in a visible mass, called a mycelium. Fungi commonly employ spores as a means of reproduction. Many molds prefer acidic environments such as citrus fruits, cheeses, and bread. Yeasts are single-celled fungi, about the size of large bacteria. They are important in bread production and fermentation of juices to produce wine. Together with bacteria, the fungi are the prime decomposers of the world's organic matter.

1. Microorganisms are grouped according to?
2. Viruses are _____ in size.
3. Viruses are composed of?
4. How do viruses use living cells?
5. Examples of pathogenic viruses include?
6. Bacteria are the most?
7. List the roles bacteria can play.
8. Cyanobacteria possess?
9. Where and in what forms is Cyanobacteria found?
10. Protozoa are classified by?
11. List and explain 3 ways protozoans move.
12. What are the 2 groups fungi are placed in?
13. Molds consist of?
14. What do Fungi utilize to reproduce?
15. Yeasts are?
16. Which 2 of the microorganisms are decomposers?

FORMS OF BACTERIA

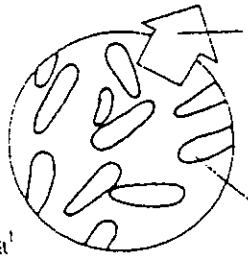
BACILLUS (a)

ANTHRAX a^1



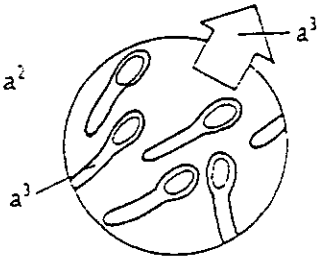
RECTANGULAR a^1

DIPHTHERIA a^2



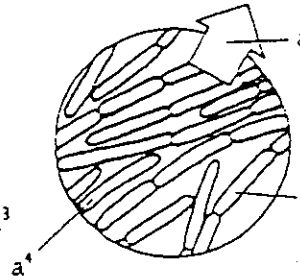
CLUB a^2

TETANUS a^3



SWOLLEN a^3

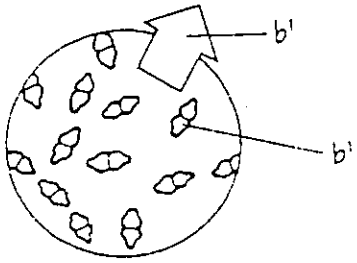
RAT BITE FEVER a^4



CHAIN a^4

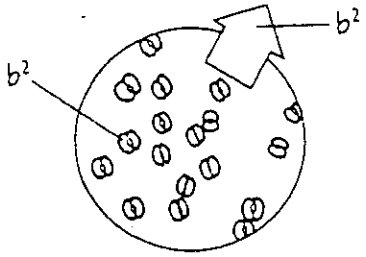
COCCUS (b)

PNEUMONIA b^1



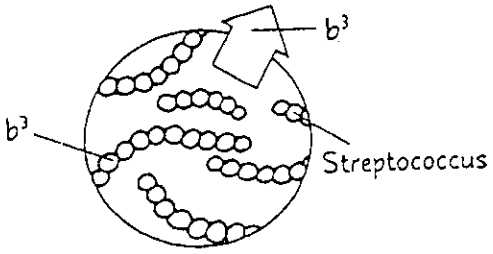
DIPLOCOCCUS b^1

GONORRHEA b^2



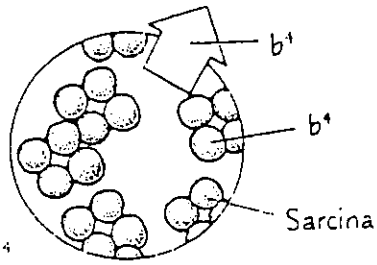
DIPLOCOCCUS b^2

STREP THROAT b^3



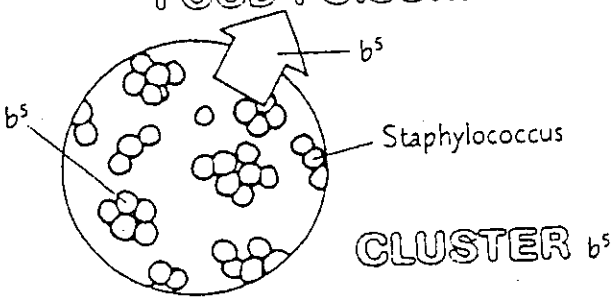
CHAIN b^3

NON-PATHOGENIC b^4



PACKET b^4

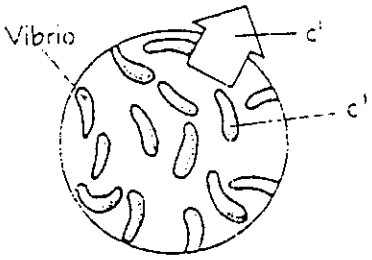
FOOD POISONING b^5



CLUSTER b^5

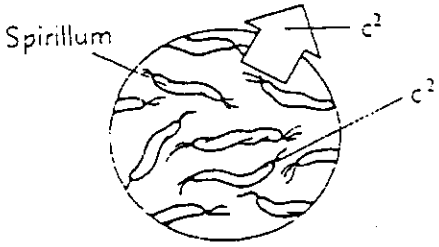
SPIRAL (c)

CHOLERA c^1



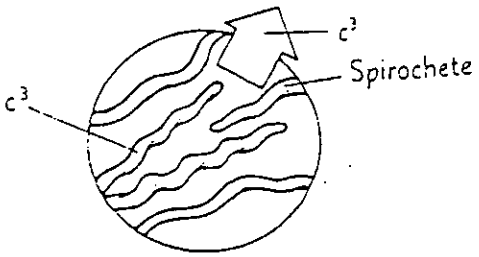
SINGLE SPIRAL c^1

RAT BITE FEVER c^2



CORKSCREW & FLAGELLUM c^2

SYPHILIS c^3



CORKSCREW, NO FLAGELLUM c^3

E3

Forms of Bacteria

The word "bacterium" may have been used for the first time in the 1850's when the French investigator Casimir Davaine used the term to mean "rod" or "staff". As the years unfolded it became apparent that many bacteria are not rodlike, but the name remained and soon it was applied to all microscopic organisms of that general size and with properties similar to the rods. In the coloring page, three basic forms of bacteria and their arrangements are examined and related to their role as disease agents. **Define the following word parts.**

1. Bacter-: _____ staph: _____
   Cocc: _____ strept: _____

The rod form of a bacterium is called a bacillus. Bacilli vary in size and may be as long as 20 um or as short as 0.5um. Certain bacilli (*Bacillus anthracis*) are rectangular with sharply rounded ends, these bacilli cause anthrax, a disease of such animals as cows, goats, sheep and deer. The disease is communicable (transferable) to humans by air, contaminated meat, and contact with animals. Certain rod-shaped bacilli are wide at one end and tapered at the other end (*Cornybacterium diptheriae*). They are known to cause diptheria. In this disease of the respiratory tract, bacterial toxins damage the nerves and the heart. One type of bacillus (*Clostridium tetani*) is rod-like but swollen at one end. These swollen ends contain endospores, a very resistant for of the bacterium. Tetanus, a disease caused by these bacteria, is characterized by muscle spasms, seizures, and paralysis of respiratory muscles. There are several species of bacilli that occur in chains. A streptobaccillus is know and refers to bacteria linked end-to end in chains. Certain streptobacilli cause rat bite fever, a disease characterized by chills, vomiting and fever.

2. Contrast diptheria and tetanus.

3. Define endospores:

The sperical form of a bacterium is known as a coccus. Some cocci called diplococci are paired (diplo-: double). One species of diplococcus (*Streptococcus pneumoniae*) has tapered sides and causes pneumonia, an inflammation of the air spaces of the lungs accompanies by fluid formation. Another type of diplococcus (*Neisseria gonorrhoeae*) resembles two tiny beans lying fact to face. *N. gonorrhoeae* causes gonorrhea, a disease transmitted by sexual contact. The streptococcus is a well-know group of cocci characterized by individuals in a chain. "Strept throat", a serious infection of the pharynx, is caused by a species of streptococcus. In contrast, a harmless species of streptococcus is one of the "active cultures" in a cup of yogurt. A cubelike packet of four or eight cocci is called a sarcina. One sarcina called *Micrococcus luteus* is a common nonpathogenic inhabitant of the human skin. Another type of coccus, called staphylococcus, occurs in clusters and produces toxins in food resulting in staphylococcal food poisoning. Other staphylococci enter hair follicles and inflame the skin causing boils or "staph infections".

4. Describe two diseases that bacteria of spherical form cause.

5. List two ways, from the passage above, bacteria are helpful.

A third form of a bacterium is spiral. In the spiral form called vibrio, the bacterium has only a single turn, appearing curved, like a comma. One vibrio causes cholera, a serious disorder characterized by vomiting, diarrhea, and cramps. Severe dehydration caused by *Vibrio cholerae* is induced by toxins that interfere with sodium absorption in the intestines. Another form of spiral bacteria is the spirillum. The spirillium resembles a corkscrew, with the spiral making several turns. The spirillum possesses a rigid cell wall with flagella for movement. This bacterium causes rat bite fever, which is similar in symptoms to the rat bite fever caused by streptobacilli. The spirochete is a spiral bacterium that has the corkscrew form but a flexible cell wall and no flagella. It uses axial filaments to move in a snakelike manner. A spirochete (*Treponenia pallidum*) is responsible for syphilis, a disease in which the bacteria enter the tissues through breaks in the skin, such as the skin of the genital organs.

6. Contrast vibrio, spirillium, and spirochete.

7. Briefly explain the disease cholera.

The anatomical pattern of a bacterium can be of great practical value. In the diagnostic laboratory, for example, the technician may note the characteristic diplococci of gonorrhea in a patient's urine sample and report this observation to the physician. The diagnosis of syphilis is aided considerably by locating the characteristic spirochetes in material from a skin lesion. And step throat may be pinpointed by observing streptococci in bacterial colonies isolated from the throat.

8. List the three shapes of bacteria: _____, _____ & _____

9. Name the two sexually transmitted diseases from the passage.

BACTERIAL ULTRASTRUCTURE

FLAGELLUM a

CAPSULE b

CELL MEMBRANE d

CELL WALL c

PILUS e

MESOSOME f

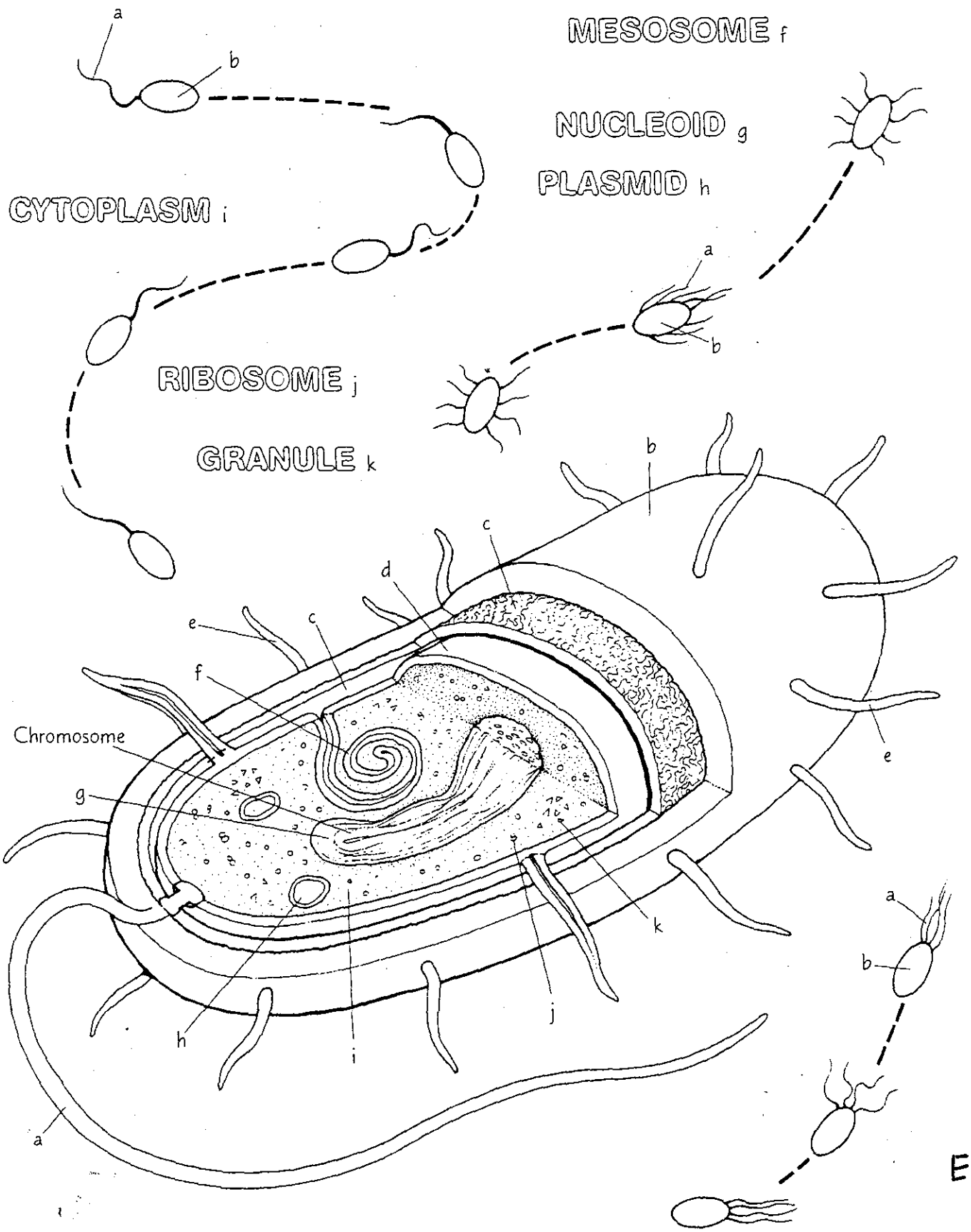
NUCLEOID g

PLASMID h

CYTOPLASM i

RIBOSOME j

GRANULE k



E5

BACTERIAL ULTRASTRUCTURE

The transmission electron microscope magnifies bacteria over 100,000 times and reveals a wealth of detailed structures that can be closely correlated with cellular function. In this plate, bacterial structures will be examined and related to cellular behavior.

Set aside a light yellow color for (i). Color the titles (a) through (k) and related structures. Try to select colors that do not obscure cellular detail. Use darker colors for very small structures. Color over the flagellum/flagella (a) on the bacteria shown in motion on the plate and represented in the illustration by their capsules (b).

Many species of bacilli and spirilla, and a few species of cocci, move by means of one or more flagella (a). The flagellum is composed of thin fibers made of protein. The movement of the bacterial flagellum is rotary thereby creating a propellerlike motion that drives the bacterium forward.

Some species of bacteria, many of them pathogenic, have a capsule (b). The capsule is secreted by the bacterium and adheres to the outer surface of the cell wall. It is composed of complex polysaccharides and small proteins. When the capsule has a looser consistency, it is called a glycocalyx. The capsule is a storehouse for nutrients, a depot for cellular waste products, and a protective shield against dehydration and potentially harmful changes in the external environment. It also retards phagocytosis by white blood cells of the host's immune system.

The cell wall (c) is composed primarily of complex organic acids and is found in virtually all species of bacteria. This structure provides a rigid framework for the organism and helps determine its shape. The molecular construction of the bacterial cell wall is unique, and the nature and significance of this structure is explored in Plate 13.

The cell or plasma membrane (d) is the outermost border of the cytoplasm and internal to the cell wall. The cell membrane (Plate 13) is constructed of protein globules suspended in lipids. It is a boundary layer and a dynamic vehicle for the transport of material into and out of the cell. It holds many of the cell's enzymes, and it is the functional equivalent of the mitochondrion in eukaryotic cells. Antimicrobial substances, such as certain detergents and antibiotics, can interfere with the function of the cell membrane, spelling death to the bacterium.

Certain bacteria, usually Gram-negative bacteria (see Plate 14), have hairlike pili (e; sing. pilus; also called fimbriae) extending from the surface of the cell. They are not to be confused with the larger flagella. Pili help anchor the bacterium to a surface. In some cases, they assist the transfer of genetic material between bacterial cells. Many bacterial species display a coiled inward extension of the cell membrane called the mesosome (f). The function of this structure may be to serve as a site for attachment of deoxyribonucleic acid (DNA) during replication in bacterial reproduction. The mesosome may also be an artifact introduced by chemicals used in fixation for electron microscopy.

As in other prokaryotes, there is no nuclear membrane around the bacterial genetic material. A bacterium exhibits a single long chromosome of DNA arranged as a closed loop folded over itself many times. The chromosome is suspended in the cytoplasm without a covering or membrane. The region of cytoplasm occupied by this chromosome is called the nucleoid (g). The chromosome contains all the hereditary information of the cell, and provides all the necessary "instructions" for producing the proteins essential to the life of the cell. Smaller molecules of DNA, called plasmids (h), form closed loops in the cytoplasm apart from chromosomes. A single bacterium may have several dozen plasmids, each with a few genes. In the plates ahead, the activity of plasmids in genetic recombination will be examined.

The bacterial cytoplasm (i) is a gelatinous mass of proteins, carbohydrates, and other organic and inorganic chemical substances. The cytoplasm is the site of bacterial growth, metabolic reactions, and reproduction. Suspended within it are such bodies as the nucleoid and plasmids, as well as the ribosomes, and inclusions called granules. The ribosomes (j) are composed of ribonucleic acid (RNA) and protein. They are the sites of protein synthesis. They are the places where amino acids, the unit molecules of protein, are bound together by enzymes in the precise sequence that gives each protein its functional character. Granules (k) appear to be protein membrane-lined storage sites for starch, glycogen, lipid, or other essential materials.

BACTERIAL ULTRASTRUCTURE- *Answer the following questions in your own words. DO NOT copy the text word for word, that is plagiarism.*

1. A flagella is composed of?
2. Explain the function of the flagella.
3. A capsule is made of?
4. Explain 2 functions of the capsule.
5. The cell wall is comprised of?
6. Explain the function of the cell wall.
7. The cell membrane is constructed of?
8. Explain 2 functions of the cell membrane.
9. The pili can be described as?
10. Explain 2 functions of the pili.
11. Bacteria chromosomes can be described as?
12. What is the nucleoid?
13. Describe plasmids.
14. Bacterial cytoplasm is comprised of?
15. The ribosomes are made of?
16. Explain the function of the ribosomes.
17. The function of granules is?

STUDENT WORKSHEET

FOR

MICROSLIDE™ LESSON SET 105

HARMFUL AND HELPFUL BACTERIA

STUDENT'S NAME _____ CLASS _____ DATE _____

INTRODUCTION

In this unit we will study bacteria using the Micro-Slide-Viewer, Microslide and Text Folder.

Read and follow the directions for the use of the Micro-Slide-Viewer and the Microslide on the envelope attached to the text folder and holding the slides.

Examine each slide and study the description in the text folder. After studying each slide and the printed text, answer the question for that slide on this worksheet. If you don't know the answer, go on to the next slide and question. You may find the answer as you learn more about the subject. Draw what you see in the space provided.

a. Bacteria are (single) (many celled). Underline your choice.

b. All bacteria are harmful to man (true) (false). Underline your choice.

c. Bacteria grown in a glass containing food that the bacteria need to grow is called a _____

d. Bacteria grow best in a place that is _____, _____, and _____, and where there is food that they can use.

SLIDE 1 - 3 TYPES OF BACTERIA

a. Draw what you see in this slide.

b. How many different shapes or types of bacteria can you see in this slide?

_____

SLIDE 2 - BACTERIA OF DIPHTHERIA

a. Diphtheria bacteria are (ball-shaped) (rod-shaped) (spiral-shaped) Underline your choice.

b. Why is the inside of the human body a good place for bacteria to live? _____

c. Doctors help your body to build up protection against diphtheria by injecting you with a _____.

SLIDE 3 - BACTERIA OF TYPHOID FEVER

a. The long threads growing out of the bacteria in this slide enable the bacteria to _____.

b. Why do campers boil drinking water? _____

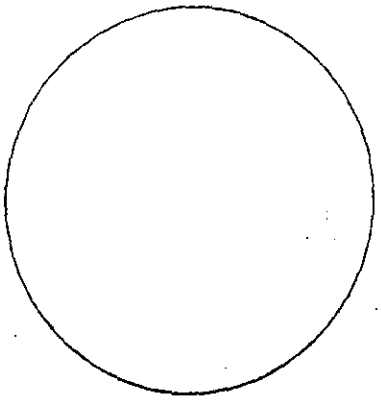
SLIDE 4 - BACTERIA OF FOOD POISONING

a. Draw one bacterium of food poisoning.

b. Slides 2, 3, and 4 all show rod-shaped bacteria. In the spaces below record the similarities and differences you can see:

	DIPHTHERIA BACTERIA	TYPHOID BACTERIA	FOOD POISONING BACTERIA
Check which is the largest			
Check which is the smallest			
Looks like a tennis racquet			
Has many tiny threads			
Is rod-shaped			

SLIDE 5 - BACTERIA OF POTATO RING-ROT



a. Draw what you see in this slide.

b. What is the part of this slide labeled A?

_____

c. What are the red spots at B?

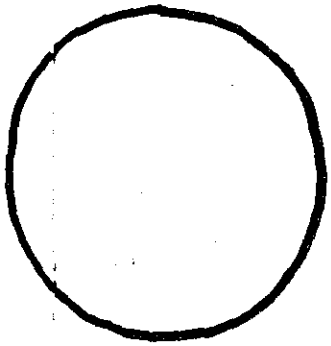
_____

d. Which is larger, the healthy potato cell or the infected cell? _____

e. What is R?

_____

SLIDE 6 - BACTERIA OF BLOOD POISONING



a. The bacteria in this slide are (rod-shaped) (ball-shaped) cells tha grow in chains. Underline your choice

b. The large shapes around the bacteria are _____

_____

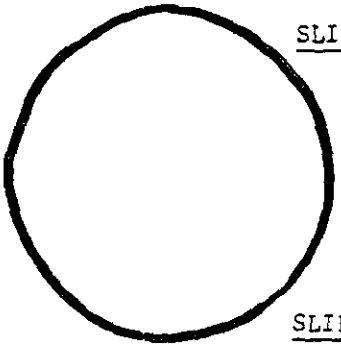
c. How do blood poisoning bacteria get into a person's body?

_____

d. Three body defenses against blood poisoning bacteria are

_____, _____, ar

_____.



SLIDE 7 - CHEESE BACTERIA

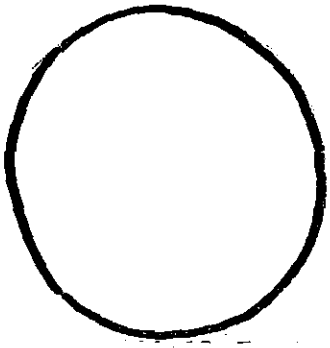
a. Cheese bacteria are (helpful) (harmful) to man. Underline your cho

b. These bacteria are _____ - shaped.

c. Are all bacteria with this shape harmful? _____

d. These bacteria cause milk to turn into _____

SLIDE 8 - VINEGAR BACTERIA



a. When vinegar bacteria turn wine sour, the alcohol changes into

_____

b. Vinegar is called _____ acid.

c. When the soured wine becomes too acid from the vinegar, the vinegar bacteria stop growing. Why is vinegar used for pickling food?

_____

_____

Name_____

Body Series "Food Poisoning"

per__

1. What is the effect of *Salmonella* on chickens?

2. After the chicken is cooked, why is the *Salmonella* in the leg still alive?

3. What happens to most of the living *Salmonella* digested by humans?

4. Where does the surviving *Salmonella* find a safe haven?

5. What two things does the *Salmonella* do there?

6. After the infected cell dies what happens?

7. How many bacteria are there after 8 hours? 1 hour later?

8. What are macrophages? What do they do?

9. What is the secret weapon of *Salmonella*? What does this enable them to do?

10. With macrophages out of action what 2 things does the body do to deal with the infection?

11. What happens as the toxin from *Salmonella* invades the bloodstream?

12. As the salmonella spreads it triggers a release of what type of cell?

13. What kind of cells do the helper cells target? What do they do to these?

14. What finally rids the body of the *Salmonella* infection?

NOVA: Video- Killer Disease on Campus

1. Where is the bacterium that causes Meningitis found? When does it become pathogenic?

2. When the bacteria gets in the blood stream in can cause one of two diseases: Meningitis and Meningicoccal sepsis.
   a. What are the symptoms of Meninigicoccal disease? What is the mortality rate of Meningicoccal disease?

   b. What are the symptoms of Meningicoccal sepsis? What is the mortality rate of Meningicoccal sepsis?

3. One tell-tale symptom of the disease is a rash. What is happening in the progress of the disease that causes it?

4. What is the effects of the bacterium's endotoxin on the body (.i.e. what organs does it target and what happens to them)?

5. What is the drug therapy of choice to combat the bacterium? What effect it have on the bacterium and the endotoxin?

6. How does the vaccine for meningococcal disease help prevent the disease?

7. Risk factors in the young adult's lifestyle attributes to the high risk for that group. Why does smoking and binge drinking increase risk?

8. Why won't the government mandate vaccination for young adults?

9. How is the vaccine, Metamune, limited in its effectiveness?

10. There are five known pathogens that cause Meningicoccal Disease.
    a. How are the different?

    b. Which type is most common in Africa?

    c. Which type is most common in the US and Great Britain?

11. How does the immune system combat the bacterium? What is the effect on the blood vessels? What symptom does this produce?

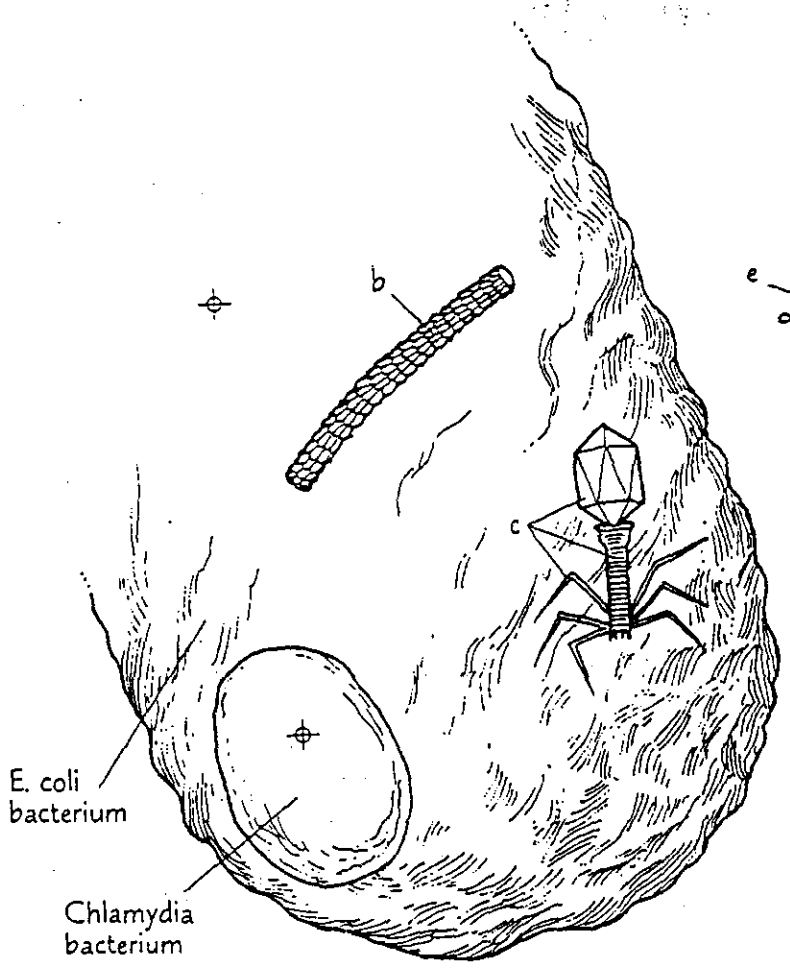
12. Patients who die from Meningicoccal Sepsis usually die due to what?

13. Current research focuses on treating Meningicoccal Disease by neutralizing what? What is the drug's name?

14. What did the data from the drug trial show? Did the FDA approve it? Why or why not?

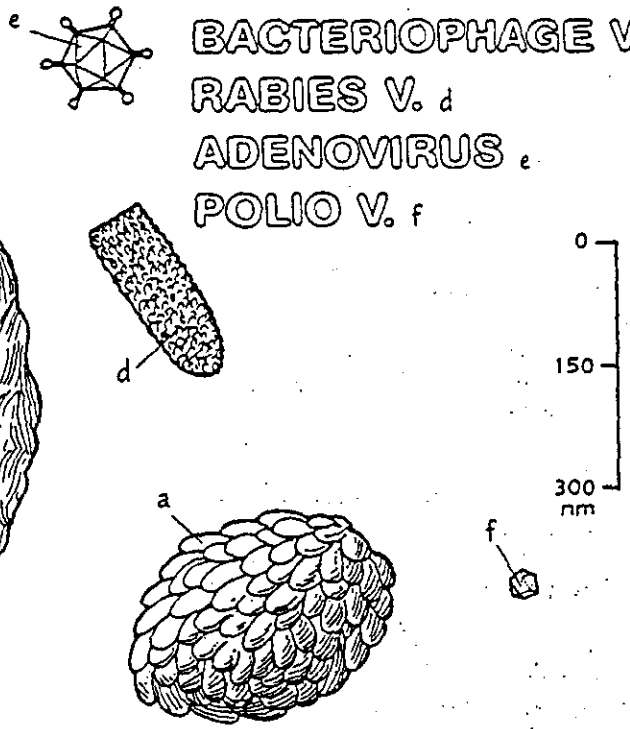
15. How is a vaccine usually made? What are two reasons why a vaccine can't be made for the type B?

INTRODUCTION TO VIRUSES



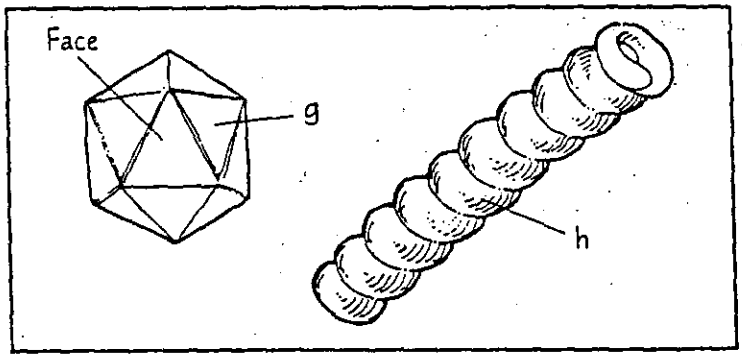
SIZE ✿

- SMALLPOX V. a
- TOBACCO MOSAIC V. b
- BACTERIOPHAGE V. c
- RABIES V. d
- ADENOVIRUS e
- POLIO V. f



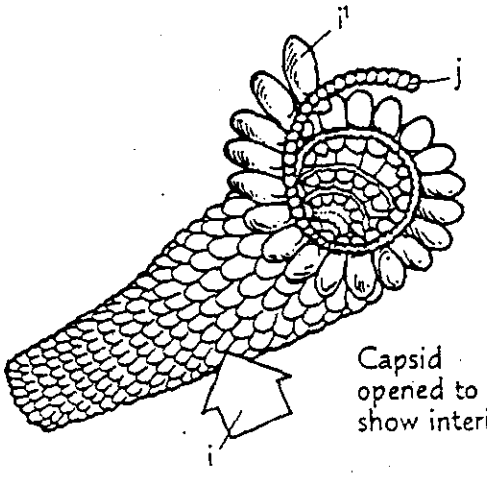
SHAPE ✿

- ICOSAHEDRON g
- HELIX h

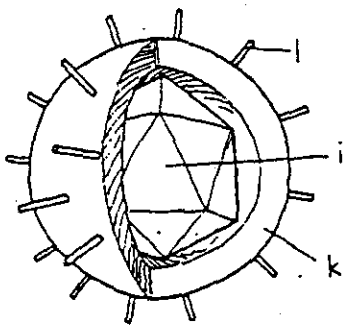


STRUCTURE ✿

- CAPSID i
- CAPSOMERE i'
- GENOME j
- ENVELOPE k
- SPIKE l



Capsid opened to show interior



Section of envelope removed to show interior

BCB: Introduction to Viruses

1. How did scientists discover viruses?

2. Which is smaller, a bacterium or a virus? With what tool are viruses observed?

3. Name the largest virus and its dimensions. Name the smallest virus and its dimensions.

4. Describe the two common shapes of viruses.

5. Name and describe the two main components of viruses.

6. Describe the outermost membrane found in some viruses. Where does it originate and what is its function?

7. How does a virus replicate?

8. List some human diseases caused by viruses.

The virus is among the smallest and simplest agents of disease. Viruses are so tiny that they cannot be seen with a light microscope and researchers must use the electron microscope to view them. Viruses have a unique chemical structure and a parasitic dependence on other organisms associated with an unusual method of reproduction. Viruses cause such well-known diseases as chicken pox, influenza, hepatitis, and infectious mononucleosis.

During the early 1900s, medical scientists observed that carefully filtered fluids of diseased tissues (disrupted, devitalized tissue caused by the growth and toxins of microorganisms) were capable of inducing disease. They reasoned that tiny microorganisms (viruses) in the diseased fluid passed through the smallest filters, and when this filtered fluid was injected into a living, healthy host, the viruses present induced disease processes to occur.

Color the subheading Size and the titles and viruses (a) through (f) in the upper half of the plate. Note the 300 nm ruler at right. Use light colors for the larger structures; beware of colors that obscure the detail of the illustration.

Viral dimensions are measured and viral structural characteristics are observed with the aid of the electron microscope. Most viruses are substantially smaller than bacteria, but some viruses approximate the sizes of very small bacteria. The average *Escherichia coli* bacterium, used here as a reference bacterium, is about 3000 nm (2000 - 6000 nm) in length (Plate 8). The bacterium *Chlamydia* is about 250 nm long and is tiny in comparison with *E. coli*, but it is about the same size as the smallpox virus (a; about 300 nm long).

Most viruses are about the same size or smaller than the smallpox virus. The tobacco mosaic virus (b), a parasite of tobacco plants, is a mid-size virus with a length of about 300 nm. Note the bacteriophage (c) is only about 300 nm in length, considerably smaller than the *E. coli* bacterium. The rabies virus (d), well known for its catastrophic effect in humans after bites from infected animals, is about 200 nm long. The smaller adenovirus, agents of a number of human miseries, including pneumonia and conjunctivitis, measure about 75 nm in length. One of the smallest of this group of microorganisms is the polio virus (f) with an average diameter of 25 nm. Polio viruses affect the central nervous system of humans, destroying the motor neurons that supply the skeletal muscles of the body.

Color the subheading Shape, titles (g) and (h), and the related shapes in the boxed area. Then color the subheading Structure, and the related titles and structures (i) through (l) at the lower part of the plate.

Electron microscopy has revealed that viruses generally have one of two shapes. One is the icosahedron (g), a geometric figure characterized by 20 triangular "faces." Icosahedral-shaped viruses include bacteriophages, chicken pox, genital herpes, mononucleosis, and polio. The second shape is that of a helix or tightly wound coil (h), somewhat resembling a corkscrew. Helical viruses include those that cause rabies and tobacco mosaic disease.

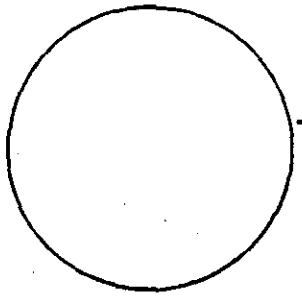
Viruses consist of two main components: the outer capsid (i) and the inner genome (j). The capsid is the outer coat, and gives shape to the virus, either icosahedral or helical. In most viruses the capsid is composed of multiple protein subunits called capsomeres (i'), the number of which varies among viruses. The genome is found in the core of the virus. It consists of a single or double strand of nucleic acid which is either DNA or RNA, but not both. In some viruses the strand is unbroken; in others it is divided into segments. In icosahedral viruses, the genome is commonly a closed loop folded over itself (not shown); in helical viruses, the genome is coiled in the shape of a helix.

The outermost membrane of some viruses is the flexible, lipoprotein envelope (k) around the capsid. It is usually derived from the host cell during replication. Many envelopes have an array of spikes (l) that contain enzymes that assist in cell penetration. The influenza and human immunodeficiency virus are notable for the presence of spikes coded for by viral genes.

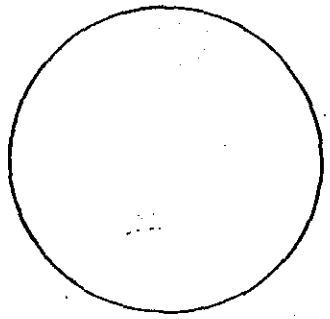
No cytoplasm or organelle has been identified in viruses. The virus is dependent upon a host for metabolic machinery and for reproduction. An apparent inert particle in isolation, it swiftly replicates in the appropriate host, even to the extent of killing the very living entity upon which it depends.

MICROVIEWER: VIRUS

SLIDE 1: LAMBDA PHAGE ON E. COLI



SLIDE 3: HUMAN VIRUS



_____ CLASS _____ DATE _____

INTRODUCTION

In this unit you will begin to learn about a subject that still is something of a mystery to science -- the virus. You will use the Micro-Slide-Viewer, Microslide and Text Folder.

Read and follow the directions for the use of the Micro-Slide-Viewer and the Microslide on the envelope attached to the text folder and holding the slides.

Examine each slide and study the description in the text folder. After studying each slide and the printed text, answer the question for that slide on this worksheet. If you don't know the answer, go on to the next slide and question. You may find the answer as you learn more about the subject. Draw what you see in the space provided.

SLIDE 1 - LAMBDA PHAGE ON E. COLI

a. What part of the virus in this slide is anchored to the bacterium?

_____

b. Indicate your estimate of the length of the bacterium here: _____ mm

c. Indicate your estimate of the length of the virus here: _____ mm

d. Why does the bacterium look so different here from the way it looks under the light microscope? _____

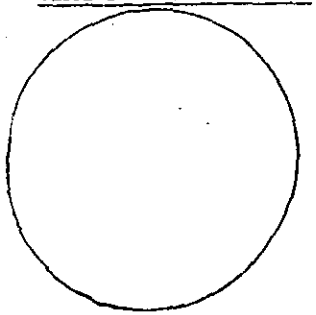
_____

e. Why can a porcelain filter catch all bacteria, but viruses go through?

_____

_____

SLIDE 2 - DISRUPTED PHAGE



a. Draw the disrupted phage in this slide.

b. Label the DNA mass, the head, the tail, the filaments.

c. Chemically speaking, a virus consists of a

_____ shell filled with

_____ acid.

d. In what way does the part near the head of the virus differ from the rest? _____

_____

SLIDE 3 - HUMAN VIRUSES

a. The influenza virus mutates readily. This means _____

_____

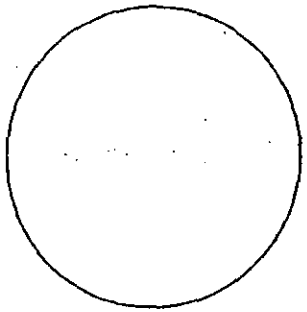
_____

b. Will recovery from one form of influenza make you immune to other forms? _____

c. Other common diseases caused by viruses include: (list as many as you can) _____

_____

SLIDE 4 - MEASLES VIRUS ATTACK



a. Draw a normal human cell and a cluster of cells infected with measles virus.

b. How can you tell that there were originally eight cells in this group?

_____

c. Have the nuclei changed shape? _____

_____

d. Why can't you see the individual viruses? _____

_____

SLIDE 5 - ANIMAL VIRUSES

a. What is the shape of the virus of Newcastle disease? _____

_____

b. Is there a head and tail structure? _____

c. Can you see the DNA core inside the vaccinia virus? _____

d. Does vaccinia virus have a tail? _____

e. What is the shape of this virus? (remember, it has three dimensions; the slide only shows one level) _____

_____

f. What does a vaccination do? _____

_____

_____

E13

SLIDE 6 - VIRUSES EMERGING FROM CELL

a. Draw what you see in this slide.

b. Label the cell membrane.

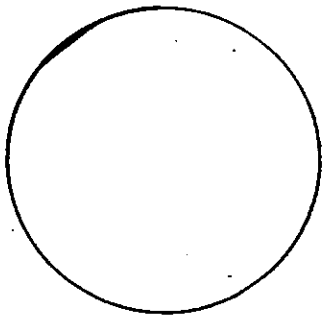
c. Label the viruses that are breaking out of the cell.

d. Do you see any other viruses that are already completely free of the cell? _____

e. What will become of them? _____

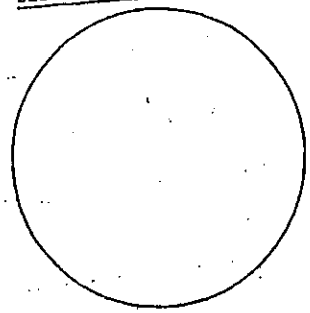
_____

SLIDE 5:



ANIMAL VIRUSES

SLIDE 7 - TOBACCO MOSAIC VIRUS



a. Draw the virus crystal shown in this slide.

b. Why don't you see all of the tobacco leaf hair cell in this slide? _____

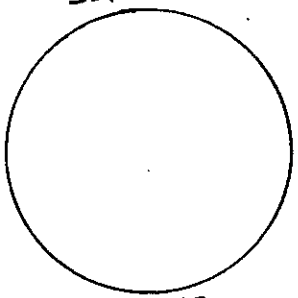
_____

c. Does the fact that viruses can form crystals imply that crystals may be alive? (Explain your answer)

_____

_____

SLIDE 8:



CANCER VIRUS

SLIDE 8 - CANCER VIRUS

a. Can viruses infect cells if they don't have "tails?" _____

_____

b. Can cancer be caused by viruses? _____

_____

_____

_____

SUMMARY

Why is the virus sometimes referred to as a SUPER-SALESMAN? _____

_____

_____

COMPARING VIRUSES AND MONERANS

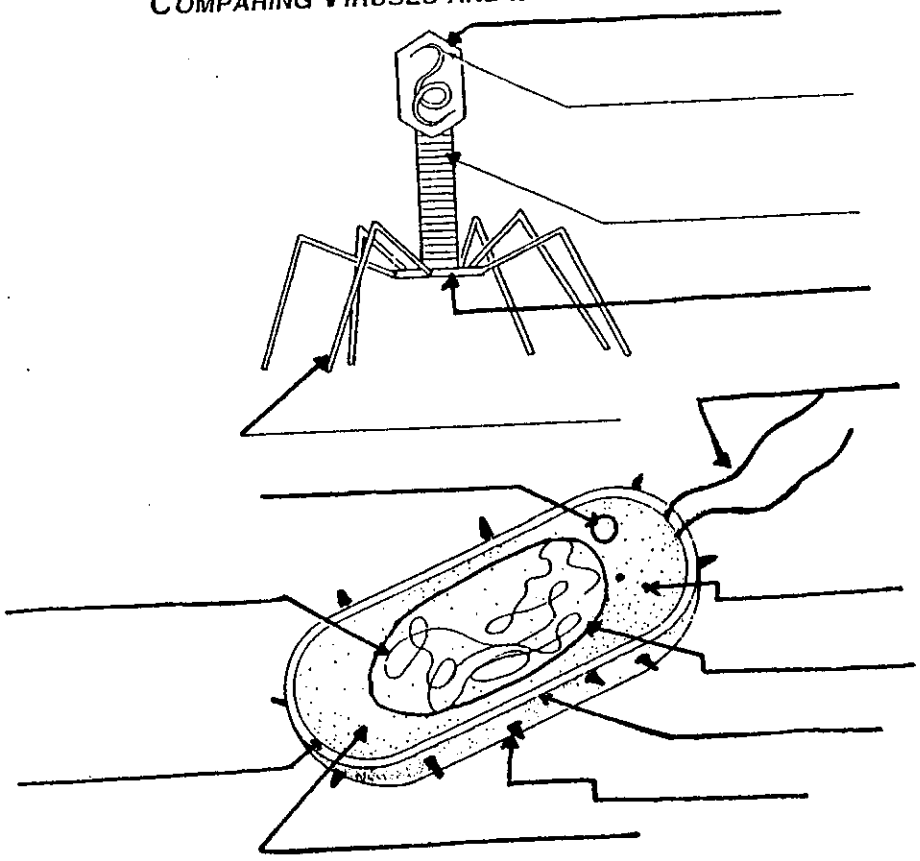
iruses are neither living nor nonliving. They are so tiny they can be seen only with an electron nicroscope. Viruses are not made of cells and have no cell parts. They do not grow or respond to hanges in their surroundings. They can reproduce only inside living cells.

Ioncrans are one-celled organisms. Bacteria and blue-green bacteria are monerans. Bacteria are arger than viruses, but are so small they can be seen only with a microscope. They can reproduce nd grow. Blue-green bacteria get their color from chlorophyll. They can make their own food.

On the left in the table below is a list of traits. Place a checkmark in the column or columns to show which traits are found in viruses, bacteria, and blue-green bacteria.

Traits	Virus	Bacteria
blue-green color		
neither living or nonliving		
no nucleus		
flagellum		
able to reproduce		
no cell parts		
cell wall		
round, rod-shaped or spiral		
cell membrane		
chromosome-like part		
cause serious diseases		
produce antibiotics		
make their own food		
may live in thread-like chains		
round, rod-shaped or many sided		
one main chromosome		
produce oxygen		
break down waste material		

COMPARING VIRUSES AND MONERANS

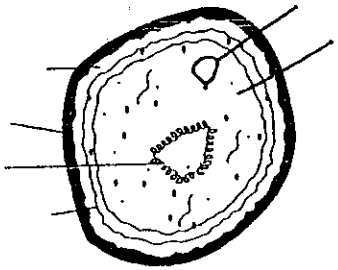


HOW ARE THESE 2 PATHOGENS/ORGANISMS RELATED?

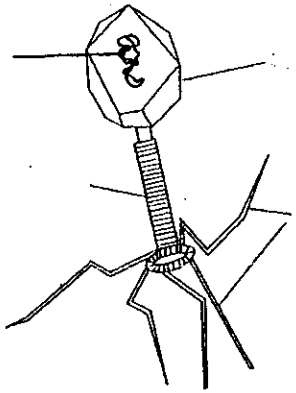
REVIEW: BACTERIA AND VIRUSES

I. Get the Big Picture

Study the pictures. Then write B after each sentence below that describes bacteria. Write V after each sentence that describes viruses.



Bacteria are the oldest form of life on Earth. Bacteria grow, reproduce, and carry out respiration. They are used to make yogurt, cheese, and some other foods. Bacteria can cause diseases, such as tuberculosis and strep throat.



Viruses are much smaller than bacteria. Most biologists agree that viruses are not alive. Viruses do not move, grow, or carry out respiration. Viruses need living host cells to reproduce. Viruses can cause diseases, such as the flu or chicken pox.

1. They cause chicken pox. _____
2. They can grow, reproduce, and carry out respiration. _____
3. They are the oldest life form on Earth. _____
4. Most biologists agree they are not alive. _____
5. They cause strep throat. _____
6. They do not move, grow, or carry out respiration. _____
7. They need a living host to reproduce. _____
8. They are used to make some foods. _____

USE THESE WORDS TO LABEL THE DIAGRAMS TO THE LEFT:

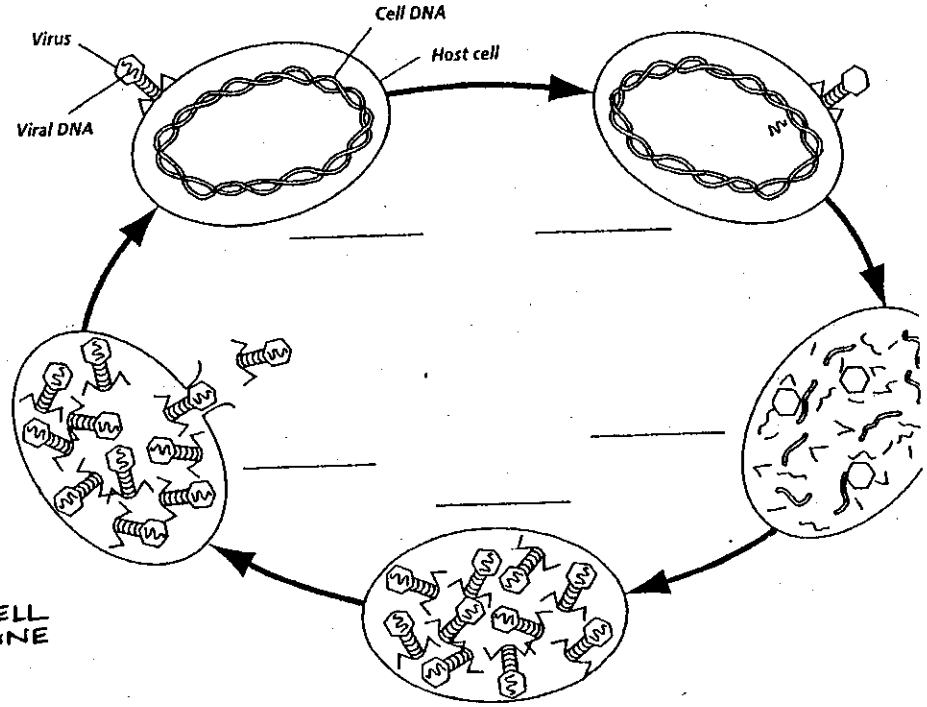
CELL WALL
TAIL
CAPSID/PROTEIN COAT
CAPSULE
TAIL FIBERS
CHROMOSOME
PLASMA MEMBRANE/CELL MEMBRANE
CYTOPLASM
PLASMID
DNA OR RNA CORE

I. Study the Cycle

Viruses use a host cell to make new viruses, then destroy the cell. This process is called the lytic cycle Here are the steps of the lytic cycle.

1. The virus attaches to the cell.
2. DNA from the virus enters the cell.
3. The cell makes new viral DNA and proteins.
4. New viruses are assembled from the proteins and DNA.
5. The cell breaks open and the viruses are released.

The steps of the lytic cycle are shown in the diagram below. Use the list above to number the st



IDENTIFY THE FOLLOWING STEPS:
RELEASE
ASSEMBLY
REPLICATION
INJECTION
ATTACHMENT

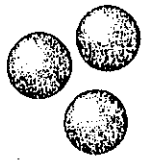
Q HOW DOES THE LYSOGENIC CYCLE DIFFER FROM THE LYTIC CYCLE?

Q C/C GRAM + AND GRAM − BACTERIA.

	GRAM +	GRAM −
CELL WALL		
COLOR IT STAINS		
CAN USE ANTIBIOTICS		
TYPE OF TOXIN PRODUCED		

II. Study the Shapes

Bacteria are the smallest and simplest living things. They come in three basic shapes: spheres, rods, and spirals. The figures below show the three shapes. Write the name of the shape below each figure.



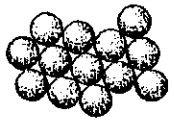
1. _____

2. _____

3. _____

Bacteria usually live in groups. The names of bacteria often tell how the bacteria are grouped. If the name starts with *Diplo-*, the bacteria live in pairs. If the name starts with *Staphylo-*, they live in clusters like grapes. If the name starts with *Strepto-*, they live in chains. The figures below show these three groups. Write the prefix of the name of the bacteria below each figure.

4. _____



5. _____

6. _____

Q C/C ARCHEABACTERIA AND EUBACTERIA.

	ARCHEABACTERIA	EUBACTERIA
CELL WALL		
CHROMOSOME		
HABITAT		

IV. Review the Vocabulary

Use the Chapter 18 vocabulary words in the box to fill in the puzzle.

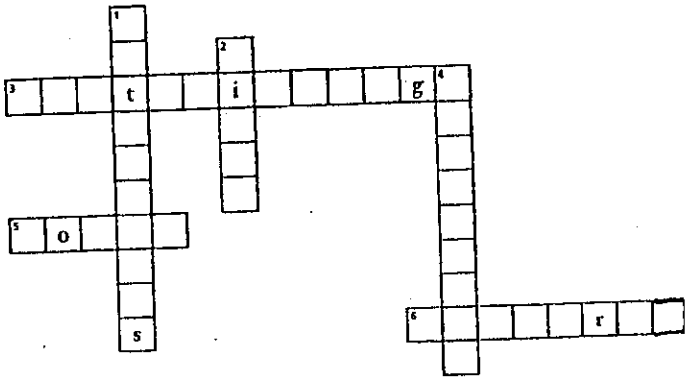
virus (VI rus)	bacteriophage (bak TEER ee yuh fayj)	retrovirus
provirus	toxin	endospore

Across

3. virus that infects only bacteria
5. poison produced by some bacteria
6. virus whose DNA has been inserted into the host cell's chromosome

Down

1. virus that has RNA
2. tiny, nonliving particle
4. bacterium with a tough outer covering



Look at each vocabulary word in the box below. If the word is related to bacteria, write it in the table under *Bacteria*. If the word is related to viruses, write it in the table under *Viruses*.

lytic cycle (LI tihk)
lysogenic cycle (li suh JEN ihk)
capsid
reverse transcriptase
obligate aerobe
binary fission
conjugation
obligate anaerobe
nitrogen fixation

Bacteria	Viruses

STUDENT WORKSHEET

FOR

MICROSLIDE™ LESSON SET 229

IMMUNITY

NAME _____ CLASS _____ DATE _____

What are some the of the diseases that can result when the immune system fails to do its job properly? (Name at least 3.)

_____, _____, _____,

_____, _____, _____.

SLIDE 1

(a) White blood cells called phagocytes are formed _____

_____.

(b) Phagocytes engulf bacteria that get past _____

_____.

(c) Phagocytes also secrete a chemical called _____.

This chemical causes _____.

SLIDE 2

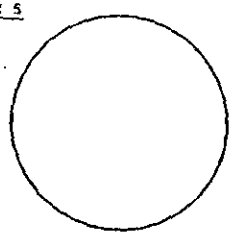
(a) Germs that escape phagocytes multiply and give off wastes that attract special phagocytes called _____.

(b) Germs or other "foreign" matter are called _____.

(c) The main agents of NON-SPECIFIC IMMUNITY are _____,

_____ and _____.

SLIDE 5



(a) Draw and label what you see in this slide.

(b) When a T-cell become immunocompetent, it means it can now help the body attack (any) (a specific) germ. Underline your choice.

(c) Name the 4 types of T-cells.

_____

_____

_____

_____

(d) What does the AIDS virus do to T-cells? _____.

(e) Why is this important to a person's health? _____

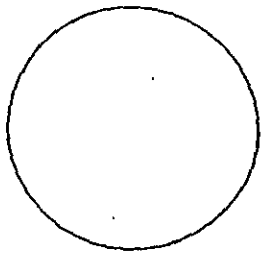
SLIDE 6

(a) Lymph cells can also change into _____ cells.

(b) When these cells meet T-cells, they can divide to become _____ cells.

(c) _____ are super producers of antibodies.

SLIDE 7



(a) Draw what you see on the left side of this slide.

(b) What are these cells? _____

(c) What happens when blood containing different antibodies is mixed together? _____

(d) Name at least 3 antibodies formed by the immune system: _____,

_____, _____,

_____, _____.

(e) For the 3 you named, describe what they do: _____

_____

_____

Name_____

Per_____

Body Series "The Flu"

1) What is the body's first line of defense against air borne pathogens?

2) What helps destroy pathogens in the nose?

3) Where are the target/host cells that Influenza B is looking for?

4) Explain how the virus fools the target cell.

5) What does the virus do to the target cell?

6) How many virus particles does the target cell release?

7) What is the function of macrophages?

8) What is the function of interleukins?

9) What are the results of a fever on the virus? Your body?

10) What are two types of cell that help destroy Influenza B?

11) What is the function of T cells?

12) What does B cells produce? How do these help combat the virus?

13) What is the function of the memory cells produced by T cells?

14) How come memory cells don't always recognize Influenza B?

Body Story- "Allergies"

Name_____

per____

1. What is the effect of the wasp venom injected into Pheobe?

2. What is released by mast cells?

3. What does this substance do?

4. What are the side effects of histamine?

5. What does it mean when we say antibodies are specific? Give an example.

6. Where do antibodies come from?

7. Why is there no antibody for wasp venom?

8. What is the function of the dendritic cells?

9. When Phoebe is exposed to dog hair, why do her blood cells leak mucus?

10. What is the result of Phoebe being overprotected from germs as a child?

11. What does the B cell in Phoebes' swollen gland do in response to the wasp venom?

12. When she is stung the second time, why is Phoebe allergic to wasp venom?

13. Briefly explain the reason for the following signs of anaphalactic shock:

itching-

low blood pressure/high heart rate-

difficulty breathing-

14. What is the antidote to histamine? What does it do?

15. Describe what the doctor does to save Phoebes' life.

16. Using what you learned from the video describe what an allergy is.