17-2: Monerans - Prokaryotic Cells

<u>Monerans - Prokaryotic Cells</u>

A. Prokaryotes: *single-celled organism whose cells do not have a nucleus*

They are found *<u>everywhere</u>*

Ted-Ed Microbes

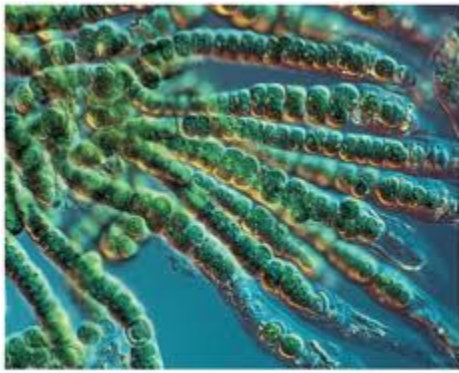
II. Classification of Monerans

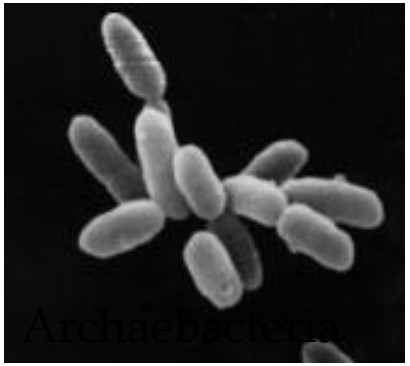
A. All prokaryotes belong to the kingdom *Monera*

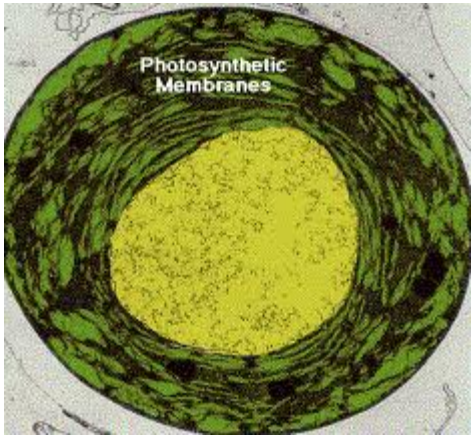
B. Divided into 4 Phyla:

1. ***Eubacteria***
2. ***Cyanobacteria***
3. ***Archaebacteria***
4. ***Prochlorobacteria***


E. C oli - Eubacteria




Archaebacteria



Prochlorobacteria

C. Bacteria: ***one-celled prokaryote; chiefly parasitic or saprophytic***

(saprophytic = lives on dead organic material)

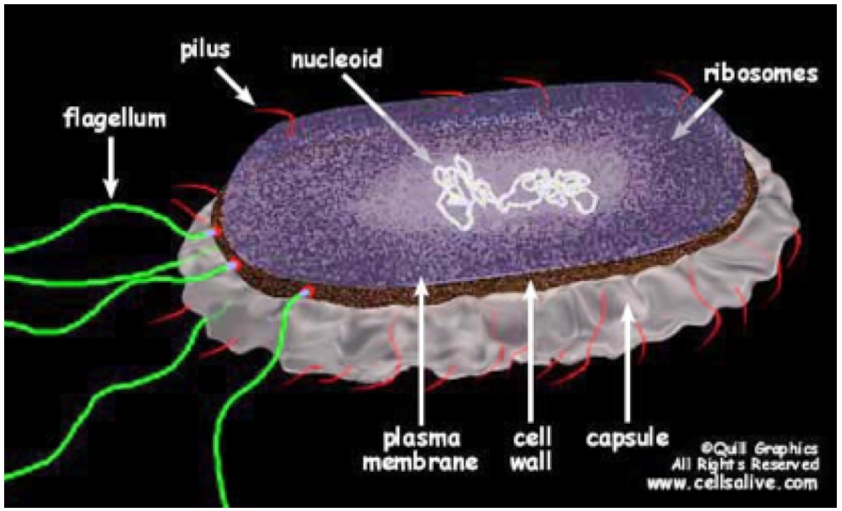
1. Size: ***1 to 10 micrometers***

2. Smaller than eukaryotic cells because:

bacteria do not contain the complex range of membrane-enclosed organelles that are found in most eukaryotic cells

D. Eubacteria

1. **Commonly called: *bacteria***

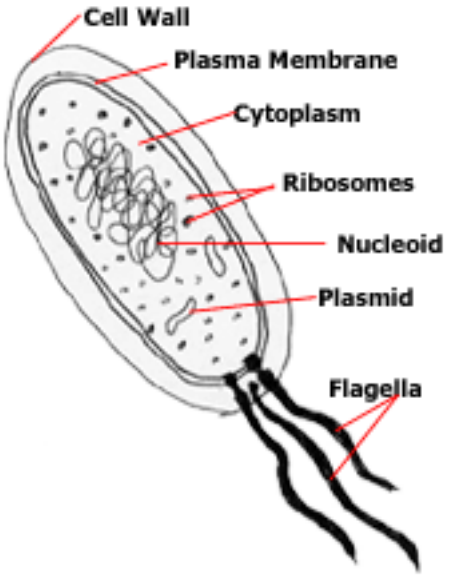


2. **General appearance:**

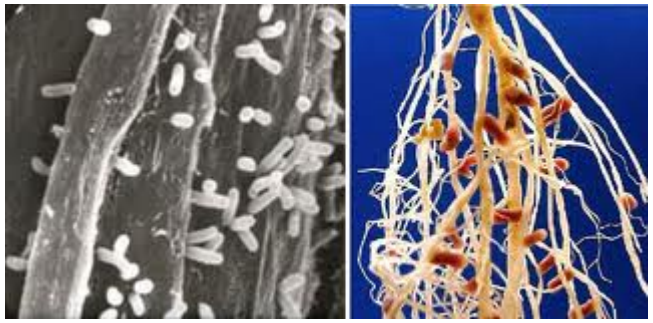
   a. **Cell wall composed of: *complex carbohydrates***

   b. **Within the cell wall is a *cell membrane that surrounds the cytoplasm***

   c. **Some have *long whip-like flagella* that protrude from cell *membrane* through the cell *wall*; these are used for *movement.***



3. Lifestyles of bacteria include:



a. Live in the soil

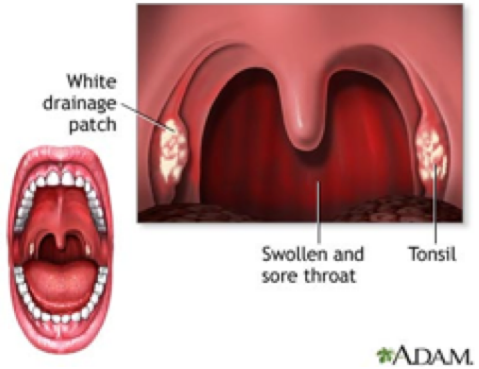
eg: Rhizobia

b. *Infect larger organisms and produce disease*

eg: Streptococcus pyogenes

(causes Strep throat)

c. *Photosynthetic*

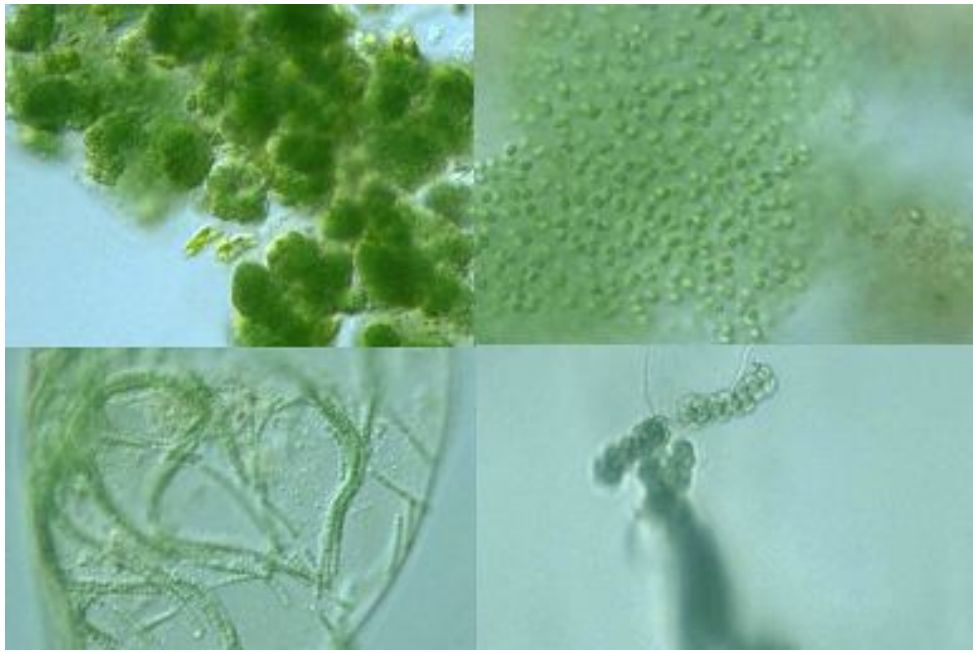


E. Cyanobacteria

1. **Commonly called: *blue-green bacteria***

2. **Origin of the name: *are blue-green in colour***

3. **All cyanobacteria can carry out the reactions of *photosynthesis***

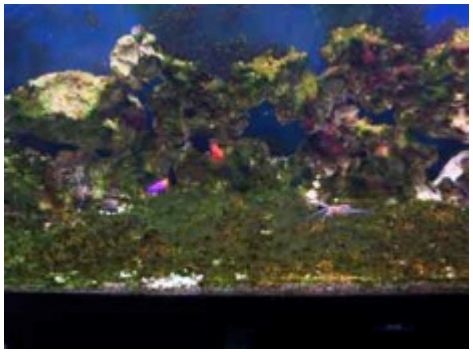


Ted-Ed: Extinction!

4. Habitat:

a. Fresh water

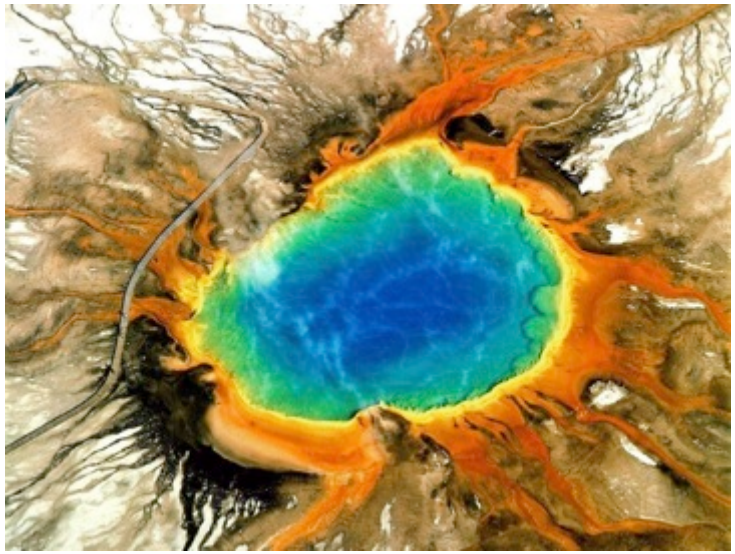
b. Salt water



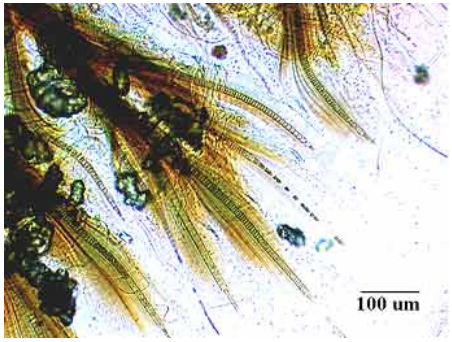
b. ***Land***

5. Some "extreme" habitats:

a. ***Hot springs*** **b.** ***Arctic***



The Grand Prismatic Hot Spring and its famous thermophilic cyanobacteria



Tapered cyanobacteria filments from Nunavut

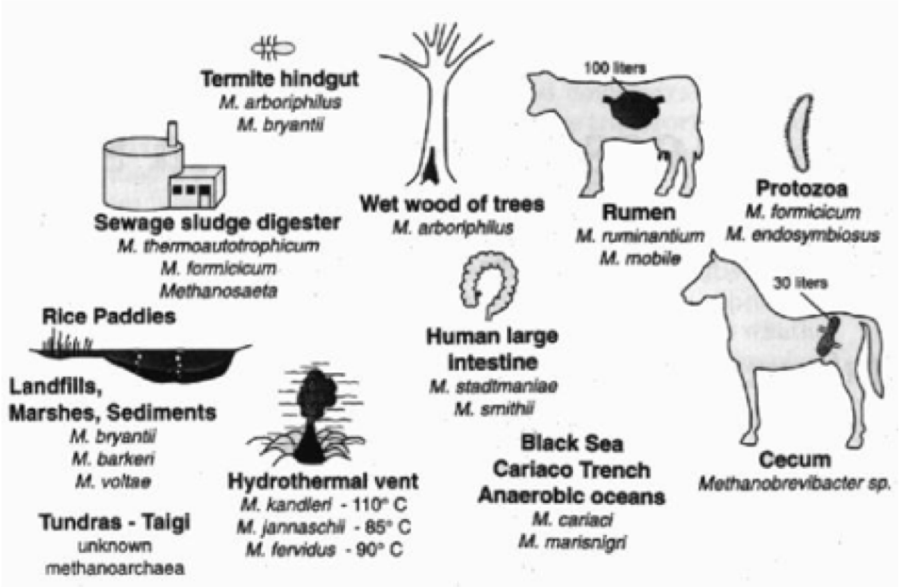
F. Archaebacteria

1. **Habitat: *extremely harsh environments***

2. **Methanogens:**

a. Habitat: *oxygen-free environments*

i. Examples: thick *mud* & animal *digestive* tracks

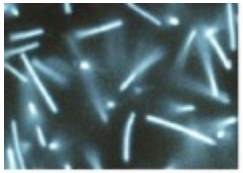


b. Origin of name: *these bacteria produce methane gas*

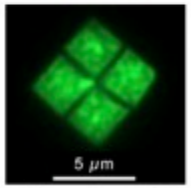
c. Other "extreme" habitats:

i. *salty environments*

ii. *extremely hot environments*



Methanopyrus kandleri
Methanogen



Holoquadra walsbyi:
Halophile

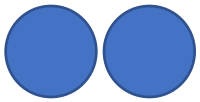
Pogonophorans: Thermophile

III. Identifying Monerans

Name and sketch the basic shapes of bacteria:

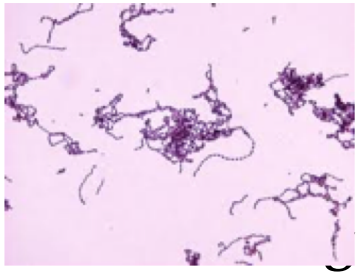
Shape:	Name:	Sketch
Rod	Bacilli	
Sphere	Cocci	
Spiral	Spirilla	

B. Sketch: 2 cocci together (diplococci):

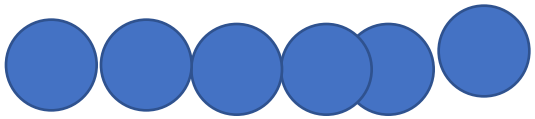


Sketch: long chain of cocci

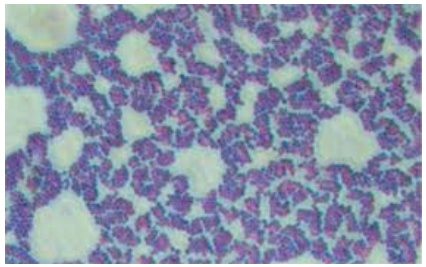
Neisseria sp.

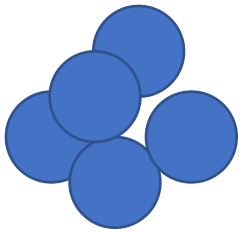


clump of cocci:



Streptococcus sp.



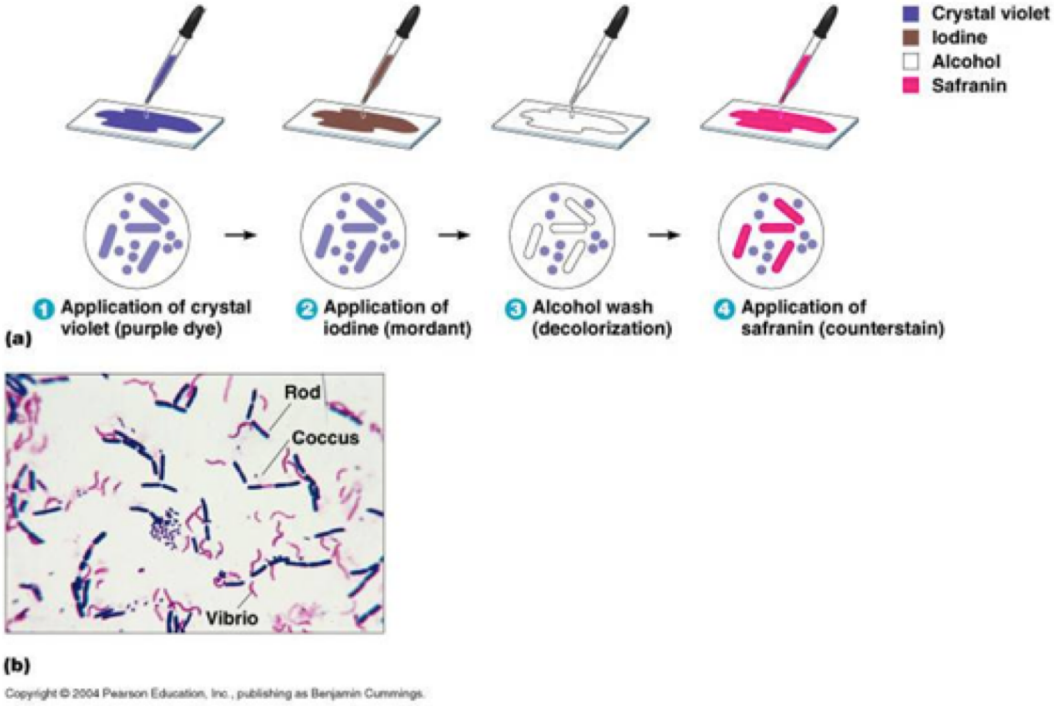


Staphlococcus sp.

C. Cell wall

Gram Stain: **Gram staining studies the *chemical* nature of the bacterial cell *wall***

Gram-positive bacteria have a thick mesh-like cell wall made of peptidoglycan (50-90% of cell wall), which stains purple while Gram-negative bacteria have a thinner layer (10% of cell wall), which stains pink.

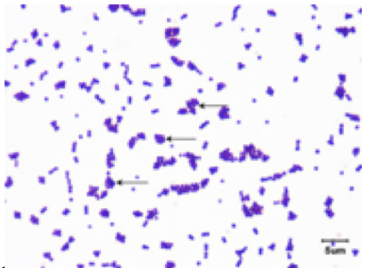


2. Gram-positive bacteria are coloured

purple **because they take up the stain*crystal violet***

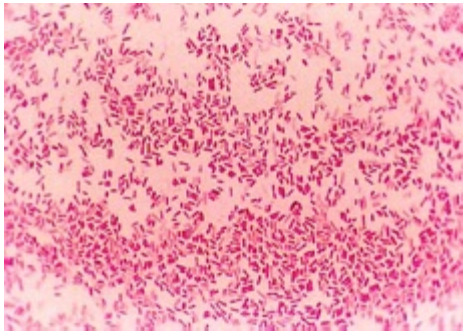
a. Their cell walls are made of: ***one***

thick layer of carbohydrate and protein molecules



3. Gram-negative bacteria are coloured *red* because they take up the stain *safranine*

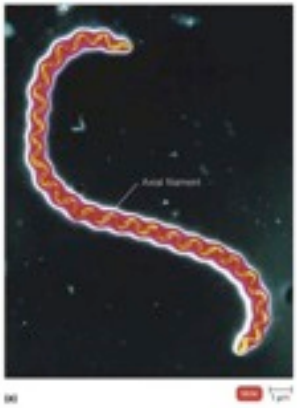
a. Their cell walls are made of: ***a second, outer layer of lipid and carbohydrate molecules***



D. Types of bacterial movement:

1. ***propelled by one or more flagella***

2. ***helical bacteria which have a specialized internal structure known as the axial filament***



3. ***glide slowly along a layer of slime like material that they secrete themselves***

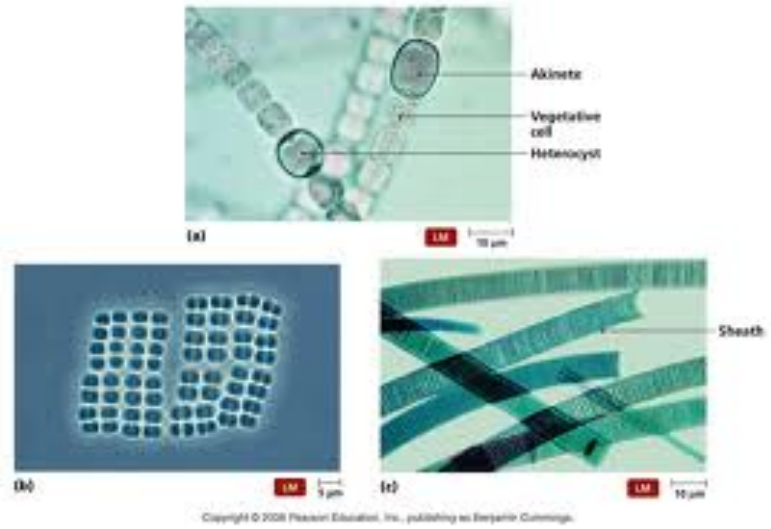
4. ***do not move***

IV. How Monerans Obtain Energy

A. Autotrophs

1. Phototropic autotrophs: ***organisms that trap the energy of sunlight and convert it to organic nutrients***

a. Example: ***cyanobacteria, eubacteria***



2. Chemotrophic autotrophs: ***organisms***

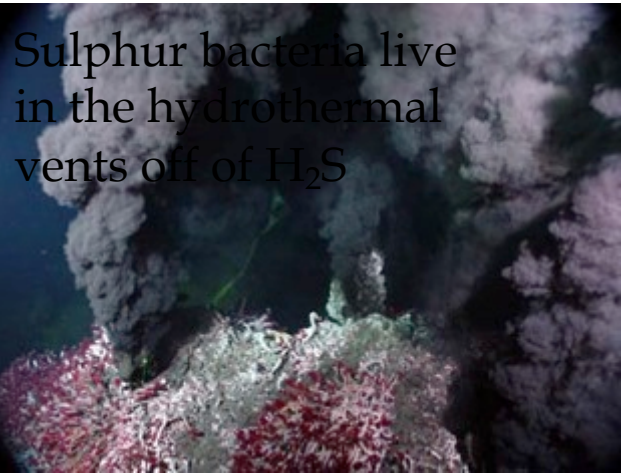
that can obtain energy from inorganic molecules

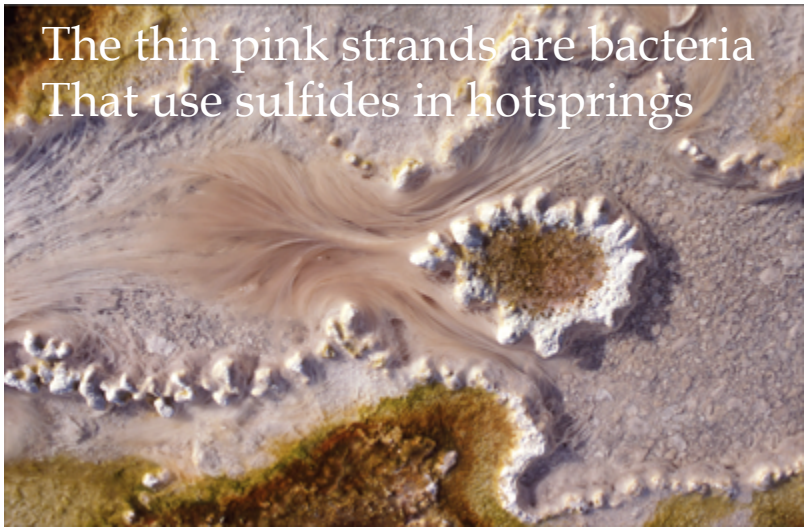
a. Example inorganic molecules used:

hydrogen sulfide, nitrites, sulfur, and iron

b. Example: ***Nitrosomonas***

(uses ammonia and oxygen)





B. Heterotrophs

1. Chemotrophic heterotrophs: ***organisms that can obtain energy from organic molecules***

Example: ***bacteria***

2. Humans are also ***chemotrophic heterotrophs***

a. Many bacteria compete with us for:

food sources

b. Example: ***Salmonella*** **grows in raw meat,** ***poultry,*** **&** ***eggs***

c. If not properly cooked (to kill the bacteria) they will "eat" this food and release ***poisons*** **into it**

d. This causes the illness we call ***food poisoning***

V. Bacterial Respiration

A. Aerobic Respiration: ***process that involves oxygen and breaks down food molecules to release energy***

B. Fermentation: ***process that enables cells to carry out energy production in the absence of oxygen (Anaerobic respiration)***

Bacteria can be classes as:

C. **Obligate aerobes:** ***organisms that require a constant supply of oxygen in order to*** live.

eg: Bacillus subtilis

D. **Obligate anaerobes:** ***organism that lives only in the absence of oxygen***

Eg: Clostridium botulinum

E. **Facultative anaerobes:** ***organisms that can survive with or without oxygen***

eg: Staphlococcus, E. coli, Listeria

The Case of *Clostridium botulinum (An obligate anaerobe)*

1. Example organism: *Clostridium Botulinum*

2. Often found in: *soil*

3. Causes no problems because it is unable *to grow in the presence of oxygen, it normally causes very few problems*

4. If it finds its way into a place free of *air* and filled with *food material*, they grow very quickly

5. A perfect place for them: *canned food*

6. They produce *toxins* that cause "botulism"

7. These are deadly; they interfere with *nerve* activity, causing *paralysis* andsometimes *death*

8. Commercially canned goods are safe because: *the bacteria and their toxins have been destroyed by heating the foods for a long time before the cans are sealed*

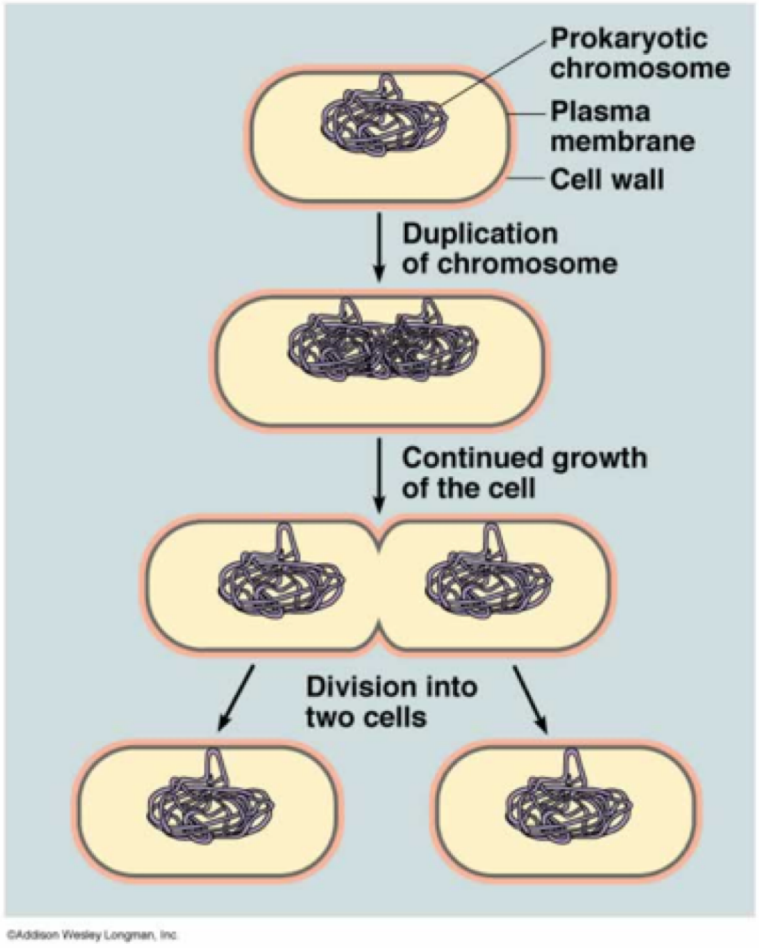
VI. Bacterial Growth and Reproduction

A. Bacterial growth is limited by:

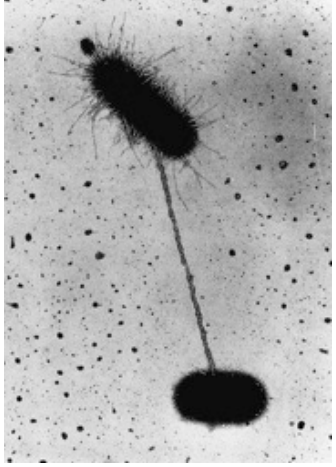
1. ***space***
2. ***food***

B. Binary fission: ***type of asexual reproduction in which an organism***

divides to produce two identical daughter cells



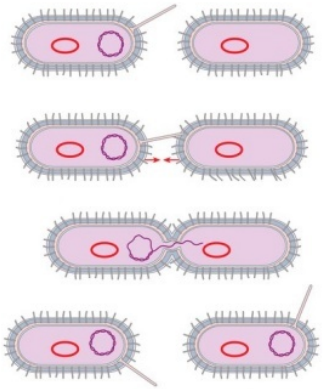
C. Conjugation



C. Conjugation: ***process in bacteria and protists that involves an exchange of genetic information***

1. List the steps:

a. A long bridge of protein forms between and connects two bacteria



b. The genetic information from one cell (donor), is transferred to the oth cell (recipient), through this bridge

c. The recipient cell has a different set of genes

d. New combinations of genes increase the genetic diversity in that population of bacteria

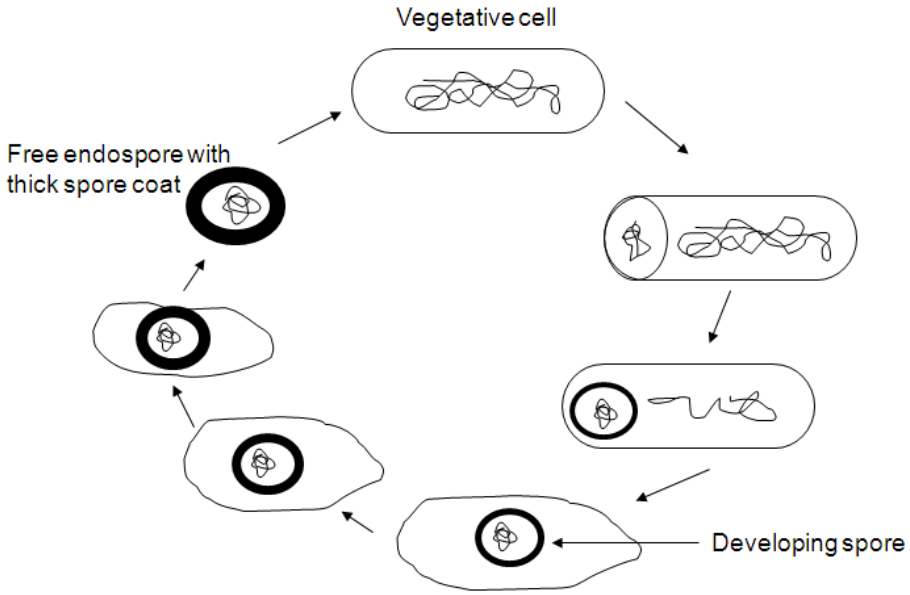
2. Genetic diversity helps to ensure ***that even if the environment changes, a few bacteria may have the right combinations of genes to survive***

D. Spore formation:

1. An endospore is formed when *conditions become unfavorable*

2. Can remain dormant for *<u>months or even years</u>*

3. When conditions improve *the endospore will open and the bacterium will begin to grow again*



VI. Importance of Monerans

TED-ED Tasty Food

A. Bacteria are used to produce:

1. ***Cheese***
2. ***Yogurt***
3. ***Buttermilk***
4. ***Sour cream***
5. ***Pickles***
6. ***Sauerkraut***
7. ***Wine***

B. Industrial uses of bacteria:

1. ***Cleaning up oil spills***
2. ***Remove waste products and poisons***

   from water
3. ***Mine minerals from the ground***
4. ***Synthesize drugs and chemicals***

C. Symbiosis: close relationship between two species in which at least one species benefits from the other

1. Example: humans and *E. coli*:

a. Bacteria benefit by being provided with:

i. ***Warm safe home***

ii. ***Plenty of food***

iii. ***Free transportation*** Ted-Ed Flatulence

b. Humans benefit by getting:

i. ***Help in digesting our food***

ii. ***Vitamins that we cannot produce***

c. Cattle benefit by: ***having the bacteria in their intestines to produce enzymes necessary to break down cellulose, the principal carbohydrate in grass and hay***

VII. Bacteria in the Environment

A. Nutrient flow: Bacteria recycle *and*

decompose, or break down, dead material

Winogradsky Column ***Streak Plate***

1. Saprophytes: *organism that uses the complex molecules of a once-living organism as its source of energy and nutrition*

2. Other non-monerans that also help

the process: *insects and fungi*

B. Sewage decomposition:

1. **Waste water contains:** ***human waste, discarded food, organic garbage, and even chemical waste***

2. **Bacteria grow** ***<u>rapidly</u>*** **here and as they grow, they** ***break down the complex compounds in the sewage into simpler compounds***

3. **This process produces:** ***purified water, nitrogen gas and carbon dioxide gas, and leftover products that can be used as crop fertilizers***

C. Nitrogen fixation:

1. *All* organisms on Earth are totally *dependent* on monerans for *nitrogen*

a. Green plants use it to make *amino acids* (building blocks for *proteins*)

b. Since animals eat plants, plant *proteins* is, ultimately, the ONLY source

2. Our atmosphere is *80* % N_2 gas – but living things need it in *ammonia* form

3. *Cyanobacteria* are the only organisms capable of performing *nitrogen* fixation

4. Many plants have *symbiotic* relationships with *nitrogen*-fixing bacteria:

a. Example: soybean and *Rhizobium*, which invades and grows in root nodules

i. Bacteria get: *home and a source of nutrients*

ii. Plant gets: *ammonia*

iii. Nodules are built-in *fertilizer* factories

5. More than *170* million tons of nitrogen fixed every *year*

Nodules of a legume

Courtesy Nitragin Company, Inc.