Honors Biology
Carmel High/Dooner
Ch 19 Bacteria

Bacteria(Prokaryotes)

- Prokaryotes are unicellular organisms that lack a nucleus; common name is "bacteria"; also known as "micro-organisms"; in popular culture referred to as "germs"
- Range in size from 1-5 micrometers compared to 10-100 micrometers in diameter for eukaryotic cells
- They all used to be classified in the kingdom MONERA
- Now they have been divided into:
  1) EUBACTERIA
  2) ARCHAEBACTERIA

EUBACTERIA:

- Larger of the two groups; live everywhere; many phyla; surrounded by a CELL WALL; cell walls of Eubacteria contain PEPTIDOGLYCAN(a carbohydrate) which helps to distinguish them; they have a cell membrane inside the cell wall

ARCHAEBACTERIA:

- ARCHAEBACTERIA LACK THE PEPTIDOGLYCAN OF EUBACTERIA AND ALSO HAVE DIFFERENT MEMBRANE LIPIDS; ALSO THE DNA SEQUENCES OF KEY ARCHAEBACTERIA GENES ARE MORE LIKE EUKARYOTES THAN THOSE OF EUBACTERIA

- Scientists believe that **Archaebacteria are the ancestors of eubacteria**

- **Many Archaebacteria live in EXTREME ENVIRONMENTS and are called extremophiles(ANAEROBIC, ACIDIC, SALTY, HIGH TEMP, TOXIC CHEMICALS etc)**

- The kingdom Archaebacteria includes exotic prokaryotes that live in extreme environments such as deep ocean vents and hot sulfur springs; Archaebacteria also include common prokaryotes that live in the digestive tracts of all animals, especially in the rumina of cows and other grazing animals; these prokaryotes, called methanogens, use hydrogen and carbon to produce methane(CH_4)---- **most of the methane in the atmosphere is the result of this process!;** in the atmosphere, the methane reacts with oxygen to produce CO_2—if it were not for methanogens Earth would be very different- carbon would pile up in huge deposits in the ground and oxygen would make up a much greater percentage of the atmosphere!!

IDENTIFICATION OF PROKARYOTES

- Prokaryotes are identified by characteristics such as: **SHAPE**, the **CHEMICAL NATURE OF THEIR CELL WALLS, THE WAY THEY MOVE**, AND THE **WAY THEY OBTAIN ENERGY**

Shapes:

1) **Bacilli- rod-shaped**
2) **Cocci- spherical shaped**
3) **Spirilla- spiral and corkscrew-shaped**

Cell Walls:

- 2 different types of cell walls are found in EUBACTERIA; a method called Gram Staining using dyes is a way to tell them apart
- GRAM POSITIVE BACTERIA- thick peptidoglycan walls; stain violet
- GRAM NEGATIVE BACTERIA- thin peptidoglycan walls; stain pink

Movement:

- Some do not move at all
- Some are propelled **by FLAGELLA**
- Others "snake" or "spiral" forward
- Some glide along a layer of slime they secrete

Obtaining Energy:

- most are heterotrophic; they can be CHEMOHETEROTROPHS(like animals) or PHOTOHETEROTROPHS(need the sun and organic compounds)
- others are autotrophic; they can be PHOTOAUTOTOPHS(like green plants) or CHEMOAUTOTROPHS(like bacteria at deep sea vents)

Releasing Energy:

-if they need oxygen to survive they are called **OBLIGATE AEROBES**

-if they are killed by oxygen they are called **OBLIGATE ANAEROBES**

-if they can function with or without it, they are called **FACULTATIVE ANAEROBES**(like *E.coli* that can live in intestines without oxygen or in sewage with it!

Growth and Reproduction:

- they reproduce by **BINARY FISSION**(my favorite kind of fishin')
- many bacteria are also able to exchange genetic information by a process called **CONJUGATION;** during conjugation, a hollow bridge forms between two bacterial cells and genes move from one bacteria to another; this **INCREASES GENETIC DIVERSITY IN POPULATIONS OF BACTERIA**
- WHEN GROWTH CONDITIONS BECOME UNFAVORABLE, MANY BACTERIA CAN FORM STRUCTURES CALLED SPORES
- An **ENDOSPORE** is formed when a bacterium produces a thick internal wall that encloses its DNA and some cytoplasm
- ENDOSPORES can remain dormant for months or even(thousands!) of years waiting for more favorable growth conditions
- They can survive HARSH conditions as a result

IMPORTANCE OF BACTERIA:

1) **CAPTURE ENERGY BY PHOTOSYNTHESIS; RELEASE OXYGEN GAS**
2) **DECOMPOSERS**
3) **NITROGEN FIXERS(*Rhizobium*)**
4) **HUMAN USES:**

- Clean up oil spills
- Used to synthesize drugs(insulin)
- Used for genetic engineering
- Produce vitamins that are used by their host(in human intestines)
- Source of enzymes used in medicine, food, and industrial chemistry
- Used in foods- yogurt(*Lactobacillus)*, cheese, etc

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The Scarcity of Nitrogen

Although about 80% of the air surrounding Earth is nitrogen gas(N2), usable forms of the element are scarce in ecosystems. The reason for this is that the two atoms in atmospheric nitrogen are held together by TRIPLE COVALENT BONDS that only lightning, volcanic action, and certain bacteria can break.

In addition, the ammonia, nitrite, and nitrate formed by NITRIFYING BACTERIA are very susceptible to leaching and runoff, which carry away nitrogen dissolved in the water.

Nitrifying bacteria use NITROGENASE, an ENZYME, to break the covalent bonds in N2 molecules. Nitrogenase functions only when it is isolated from oxygen. On land, nitrogen-fixing bacteria accomplish this by living inside oxygen-excluding NODULES or layers of insulating slime on plant roots.

In aquatic systems, CYANOBACTERIA- the primary nitrogen-fixers- have specialized cells called heterocysts that exclude oxygen.