Kingdom/Domain System Evolution

1. 2 Kingdoms	- Plants - Animals
2. 5 Kingdom System	- Manera - Plant - Animal - Fungi - Protists *wrong bbecause this is saying that all the differences are equal, which is false because they evolved at different times*
3. 3 Domain System	*Current System. Domains are more broad than kingdom*

Bacteria V. Archaea

Archaea = Hottest places on earth

Archaea cell membrane
- Formed by phospholipid bilayer

Hydrocarbon chains can be linked so their lipids can be a monolayer. Makes membrane more stable/loss fluid. Helps retain integrity

Bacterial Peptidoglycan

Carbohydrate chains cross linked with amino acids

- Plant cell walls are made of cellulose in strands

- Cellulose doesn't contain the cross linked amino acids that connect the chains (PLANTS = cellulose)

Cross link= very strong substance. need this because bacteria is single celled

What Unites Prokaryotes

All are conditional with known exceptions

Unicellularity: *almost* always single-celled

Cell size: *mostly* very small

Chromosomes: *typically* have a single circular chromosome, genetical material can be exchanged via HGT

Cell division: *mainly* occurs by binary fission, no mechanism for sexual reproduction (asexual reproduction)

Internal compartmentation: *no true membrane* bound organelles

Flagella: *simple structure* allows only for simple mechanism

Metabolic diversity: *can be* capable of metabolic feats requiring remarkable chemistry

Gram Stain- Often first step in treatment

- Gram-stains are still ofte the first figure in clinical articles about pathogens

How does genetic diversity arise?

Examples of Horizontal Gene Transfer

Conjugation	*Transduction*
1. One strand of F+ cell plasmid DNA breaks at arrowhead	1. Phage infects bacterial donor cell with A+ and B+ alleles
2. Broken strand peels off and enters F- Cell	2. Phage DNA is replicated and proteins synthesized
3. Donor and recipient cells synthesize complementary DNA strands	3. Fragment of DNA with A+ allele is packaged within a phage capsid
4. Recipient cell is now a recombinant F+ cell	4. Phage with A+ allele infects bacterial recipient cell

How does genetic diversity arise? (cont)

5. Incorporation of phage DNA creates recombinant with genotype A+B

Chromosomes are mostly sincle celled and horizontal transfer can be given to anyone in the same environment

Pili merge and join cytoplasm

plasmids: where antibiotic genes are held

Virus serving as a boat for exchange of genetic material

Cellular Life

Unicellular	- Most of earths organisms in history
Multicellular	- Fungi, Plants, Animals

Domains

Archaea are more closely related to eukarya than bacteria

	Bacteria	**Archaea**	**Eukarya**
Nuclear Envelope	Absent	Absent	Present
Membrane-enclosed Organelles	Absent	Absent	Present
Peptidoglycan in Cell Walls	Present	Absent	Absent
Membrane Lipids	Unbranched Hydrocarbons	Some branced hydrocarbons	Unbranched hydrocarbons
HNA Polymerase	One kind	several kinds	several kinds

Domains (cont)

Initiator amino acid for protein synthesis	Formyl-methionine	Methionine	Methionine
Introns in genes	Very rare	present in some genes	present in many genes
Responsible to the antibiotics streptomycin and chloramphomicol	Growth usually inhibited	Growth not inhibited	Growth not inhibited
Histones associated with DNA	Absent	Present in some species	Present
Circular Chromosome	Present	Present	Absent
Growth at temperatures >100C	No	Some Species	No

Archea membrane lipids can form monomers

Introns show more complex genetically

Histones allow packaging of DNA. No histones means doesn't have to be as compacted

Internal Membrane or Organelles?

Some internal membranes are complex invaginations of the Plasma Membrane

Aerobic Prokaryote	Photosynthetic Prokaryote
Respiratory membrane	Thylakoid Membrane

Cyanobacteria--> started O2 release

Metabolic Diversity of Prokaryotes

Carbon Source	Energy Source
A. Autotrophs B. Heterotrophs	A.Phototrophs B.Chemotrophs --Organic (Chemo**organo**trophs) --Inorganic (Chemo**litho**trophs)

Prokaryotic metabolism varies with respect to O2

Obligate aerobes require O2 for cellular respiration

Obligate anaerobes are poisoned by O2 and use fermentation or **anaerobic respiration,** in which substances other than O2 act as electron acceptors

Facultatice anaerobes use O2 if it is available, but can survive without it

Nitrogen Metabolism

Prokaryotes ungergo NITROGEN FIXATION

Additional Points

1. Source of Carbon: *biomolecules have carbon skeletons*
-Where does the organism get the carbon atom from?
*--**heterotrophs**: Organic molecules*

2. Aquire energy to arrange carbon atoms
-phototrophs=sun
-Chemotrophs=organic

Oxygen has nothing to do with this at this time

Phacaltative: can survive with or without O2

Nitrogen Metabolism:Need nitrogen!
-can only get it from other molecules

only thing that can break the triple bond of nitrogen is prokaryotes. N2= most on earth

-not found purely in the environment. "chillin with other species"

First Cellular Life Form Appearance

3.9 Billion Years Ago

For 3.9 Billion Years life has been evolving to the present life forms

- Humans organise life by phylogeny

Closest # = least # of nucleotide differences

more differences in sequence, the longer the time difference

Interesting Facts

It is estimated that only 1-10% of bacteria species are know

We think that maybe 1% of archaea species are known

Why are so few prokaryotic species known?

We dont know more about bacteria because they have just been studied by growing them in a lab.

Most bacteria metabolisms are so complex they cant figure out how to get them to grow on their own, in a lab

Cell walls are found in which of the following domains?

Bacteria, Archaea, Eukarya

- Cell walls in all domains (cell walls are made of peptidoglycans)

Prokaryotic Shape

There is no correlation between prokaryotic cell shape and gram-stain or other test

Bacillus: 0.5um

Coccus: 2um
strep

Spirillum: 3um
lyme disease

There is no correlation between prokaryotic cell shape and gram-stain or other test

Bacterial Cell Wall

Bacteria can be classified by their cell wall

Gram (+)	Gram (-)
- Teichoic acid only in G+	- LPS major endotoxin
- Lipoteichoic Acid (LTA)	Thin peptidoglycan and outer/inner membrane
peptidoglycan very thick and only one membrane	- Outer lipid--> LPS **one of the major endotoxins that causes the body to get sick**

Cell wall of bacteria=traditional classification

Gram stains change approach to treatment

The Gram Stain-Identifies Bacterial Category

1. Bacteria are stained with crystal violet
all cells are stained purple

2. Iodine stabilizes the crystal violet with the cellular material

3. Alcohol may extract the crystal violet from the cell
The stain complex is removed from the gram-negative cells (makes them white/clear) and remains in the gram-positive cells (stays purple)

4. Bacteria are stained with safanin
Gram-negative cells are stained pink; gram ppositive cells are still purple

All microbes can be stained in this way. But with cells **in the Domain Bacteria** (only), the staining makes predictions about envelope structure.
cell wall and membranes

Other Notes

Alcohol breaks down membrane and wash out iodine
- + doesn't allow this to happen

This procedure only works for bacteria

Domains

Bacteria - prokaryotic	most abundant organisms on earth. Highly diverse and poorly understood.
Archaea - prokaryotic	But different from bacteria. Very poorly understood

Each domain is monophyletic

Monophyletic	Contain all decendents of common ancestor