

BABS1201 Study Notes

Life

Universe = 13.8bya

Solar System = 4.6bya

Life = 3.8bya

1.8million species identified, thousands more each year, with 10-100 million species in total, $\frac{3}{4}$ of which are arthropods

Characteristics of Life:

- Reproduce
- Grow and Develop
- Metabolise
- Respond to Stimuli/Environmental Changes
- Have Cells (organizational units)
- Possess the Chemicals of Life
 - Carbohydrates
 - most abundant, chemically simple organic molecules
 - store/transport energy (mostly in plants, animals use lipids), structural components
 - monosaccharides link to form oligosaccharides (2-6) or polysaccharides
 - Proteins
 - Dependent on amino acid sequence, linked by peptide bonds
 - 4 different levels of organisation (shape-dependent)
 - Lipids
 - fats, oils, waxes, cholesterol, fat-soluble vitamins (A, D, E, K), monoglycerides, diglycerides, phospholipids
 - energy storage, structural component of cell membrane
 - Nucleic Acids
 - formed by linking nucleotides
 - store/transfer genetic information
 - DNA, RNA

Prions (proteinaceous infectious particles) are altered proteins that can change other proteins through conformation.

Domains (classification), defined by Carl Woese (compared ribosomal RNA, formed phylogenetic tree):

- Eukarya (35 subdivisions) - plantae, fungi, animalia, 50-100 protist kingdoms
- Bacteria (19 subdivisions)
- Archaea (16 subdivisions) - many are extremophiles (halophiles, thermophiles, methanogens - swamps/marshes, anaerobic and produce methane)

Prokaryotes = bacteria + archaea; thrive almost anywhere, more in handful of soil than the number of people who have ever lived

Bacteria/Archaea	Eukarya
no-membrane around organelles	membrane-enclosed organelles
no nucleus	nucleus (usually largest organelle)
simple, small (1µm; 0.5-5µm)	complex, larger (10-100µm)

Viruses - 50-100nm (only seen with electron microscope)

Origin of Life:

- 1) Abiotic synthesis of small, organic molecules
- 2) Joining of these into macromolecules
- 3) Packaging into protobionts (perhaps by membrane, prokaryotic precursors)
- 4) Origin of Self-Replicating Molecules

Fossil Record - biased for species that existed for a long time, were abundant and widespread, and had hard parts. However it shows macroevolutionary changes (one's you'd be able to see, not genetic) in many species. Comparisons in common structures, such as common DNA or the same structure of cilia in Paramecium (protist) and windpipes are evidence for evolution (as with the pentadactyl limb, comparative embryology, comparative biochemistry - comparing proteins like haemoglobin).

Darwin's Theory of Natural Selection explained the duality of unity and diversity through two main points:

- species showed evidence of descent with modification from common ancestors
- natural selection was the mechanism behind this

Cells

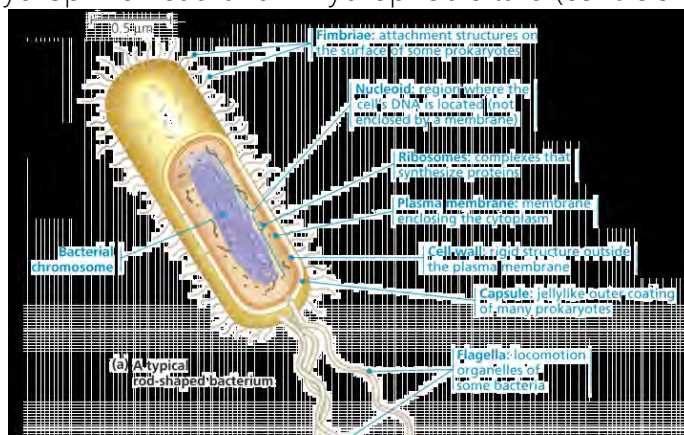
Bacteria and Archaea:

- most numerous cells on the planet
- no defined nucleus (DNA in cytoplasm)
- very wide range of metabolic diversity
- cell wall
- 10-20 times as many bacteria in/on the human body than there are human cells (of which there are 10^{13})

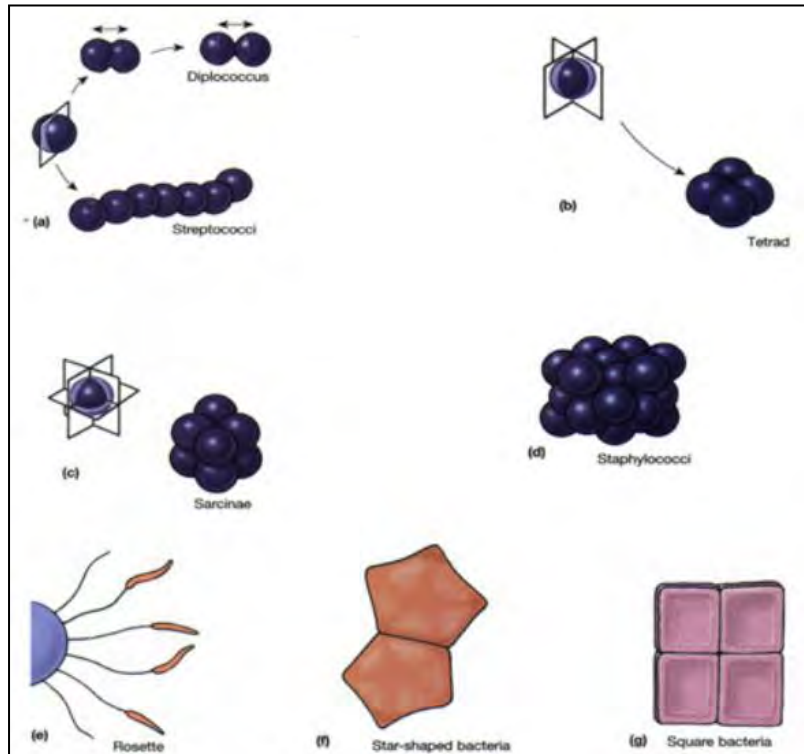
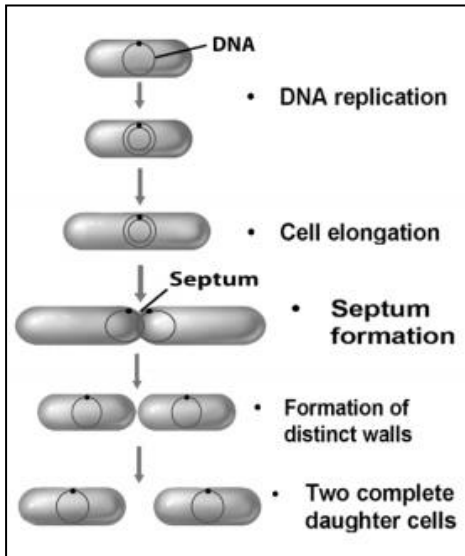
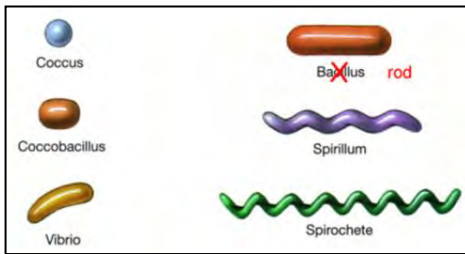
Cell Membrane has a hydrophilic head and 2 hydrophobic tails (controls what comes in and out of cell).

All cells contain:

- plasma membrane
- cytosol (semifluid)
- chromosomes
- ribosomes



Bacterial Morphology and Colony Formation



Bacteria and Archaea undergo binary fission (not mitosis which involves nuclear division, which they do not have, and instead chromosomes simply replicate)

Bacteria	Archaea
Cell membrane contains ester bonds	Cell membrane contains ether linkages
Cell wall made of peptidoglycan	Cell wall lacks peptidoglycan
One RNA polymerase	Three RNS polymerases (like eukaryotes - genes and enzymes are more like this)
Bacterial ribosomes sensitive to some antibiotics	Archaea (and Eukarya) are not
Ubiquitous	Typically extremophiles , also in many marine environments

Whilst archaea are similar to bacteria in size, shape, lack of interior membranes (and hence organelles), no nucleus (DNA in a single loop - plasmid), and they are both usually bound by a cell wall, archaea are more genetically similar to eukaryotes.

Cell Theory:

- The smallest unit of life is a cell
- All life forms are made of cells
- Cells only arise from pre-existing cells

Major cellular components of eukaryotes:

- **cytoplasm** - comprised of organelles and cytosol (gelatine-like aqueous fluid containing salts, minerals and organic compounds)