

BIOL10002 SUBJECT NOTES

LECTURE 1 - INTRODUCTION

The 3 Foundations of Biology:

1. Evolution through natural selection
2. Unity of biochemical processes
3. Cell Theory

EVOLUTION THROUGH NATURAL SELECTION

- All life evolved from pre-existing life
- Homology
- Fossils

Ontogeny recapitulates phylogeny: our development is a fast action replay of everything that happened to us during evolution (ancestry). By looking at embryos of all organisms, we can tell they're all similar e.g. our embryos have a tail that disappears

Homology: derived from a common ancestral feature e.g. limbs

- We all came from the same ancestor with 4 limbs to evolve to become the limbs we have today e.g. the limbs of a fish, frog, bird or human all come from the ancestral organism that had 4 limbs => derived from the same ancestral thing
- We all have similar bones in the limbs to become different uses

Biogeography: Unique Australian flora and fauna due to protracted evolution on isolated continent e.g. marsupials => evolved in isolation

Darwin's three observations

1. **Fitness**: adapted in a way that makes it more suitable as individuals in a population vary in their ability to survive in the environment
 2. **Heredity**: pass on traits (fitness) to offspring
 3. **Competition**: never enough resources so there is fight for the ability to fight for things and ability to survive/reproduce
- **Survival of the fittest**: if a population has different survival ability, the more fit, the more likely it will survive to reproduction maturity which means the offspring will inherit from the parents

Evolution is a two step process

1. **Variability**
2. Ordering that variability by **NATURAL SELECTION**

UNITY OF BIOCHEMICAL PROCESSES

- All organisms share main biochemical reactions e.g. the way we make energy is the same as the way bacteria does
- The rationale is that all this is homologous => goes way back to the first organisms e.g. All organisms have genetic material, the DNA, that contains the instructions on how that organism will develop => infers that everything that descended from this first organism
- Proteins: all organisms use this to carry out the instructions from DNA

CELL THEORY

1. All known living things are made up of one or more cells
2. All living cells arise from pre-existing cells by division
3. The cell is the fundamental unit of structure and function in all living things
4. Cells contain hereditary information (DNA) which is passed from cell to cell during division

LECTURE 2 - PROKARYOTES

- Non capitalised words indicate the members of the domain
- Bacteria: wall of peptidoglycan, a circular chromosome, located in the middle of their cells
- The two prokaryote groups have flagella

Life depends on prokaryotes

- Archaea allow herbivores to break down the sugar in plants
- Bacteria in our intestines help to make essential vitamins

Microbiome/Microbiota: different collection of bacteria in your gut which vary depending on where you live, how you interact with environment

- About 70% of biologically available nitrogen is processed by bacteria
- More than 50% of the earth's free oxygen is generated by bacteria
- Cyanobacteria oxygen-producing convert carbon dioxide to oxygen

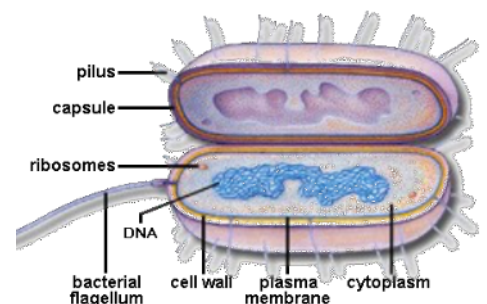
Bacterial Diseases

- Colonise our bodies in ways that steal the resources that we have and spread very quickly
- Archaea do not cause any infectious disease: can live in our bodies and would have them in our microbiome but so far none cause diseases
- But archaea are most related to us, so potentially easiest to colonise us

PROKARYOTIC CELLS

- Usually microscopic (1-10 microcentimetres)
- DNA is single, circular chromosome (nucleoid)
- No proteins attached to DNA = Bacteria
- Proteins (histones) attached to DNA = Archaea
- Wall (peptidoglycan) similar in Bacteria and Archaea but different biochemically
- Peptido= protein
- Glycan = sugar
- If you compare the two pictures bacteria vs. archaea there's not a lot of difference
- Both small, not many internal components, single celled
- DNA sequences between the two are super different
- In terms of evolution, they're extremely far away from each other that they can't be in the same domain
- The zone where the DNA is bunched up is called the nucleoid
- Every cell is composed of a membrane
- Capsule or a pilus
- Prokaryotic DNA is single, circular chromosome

Typical prokaryotic cell



Bacteria cells

- Cells typically have a wall peptidoglycan
- Two types bacterial cells:
1. **One surrounding membrane (Gram +)**
 2. **Two surrounding membranes (Gram -)**
- Gram + bacteria come out really dark purple in the stain (+ve cos they stain positively)
 - Other bacteria remain indistinct in the stain
 - Gram +: plasma membrane, thick peptidoglycan wall outside
 - Gram -: plasma membrane, peptidoglycan wall (thinner), outside is another plasma membrane