Prokaryote Cell Structure

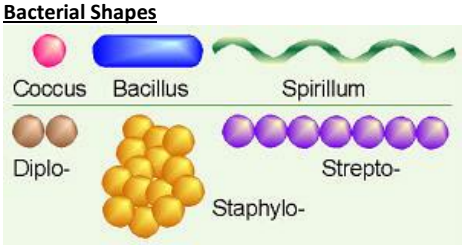
02 February 2015 13:30

Prokaryote: single-celled
Eukaryote: single or multicellular

Similarities

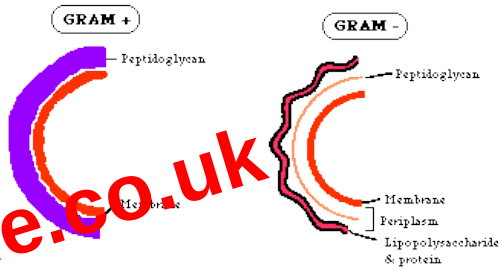
- Plasma membrane
- DNA
- Cell wall

Bacterial Shapes



Structure

- 3 parts
  - Cell membrane and wall
    - Membrane
      - Separates cytoplasm from exterior
      - Phospholipids
      - Proteins
    - Wall
      - Maintains shape
      - Prevents cell from bursting due to osmosis
      - Components
        - Peptidoglycans
          - Sugars
          - Peptide chains
        - Teichoic Acid (Gram positive)
          - Movement of ions
          - Attachment for bacteriophages
        - Outer membranes (gram negative)
          - Porin channels
          - Antigens



  - Internal Structures
    - Nucleoid
      - DNA
        - Usually one circular chromosome
        - *Vibrio cholerae*: 2
      - Plasmids
        - Extrachromosomal pieces of smaller DNA
        - Not required for cell function
    - Ribosomes
      - RNA and protein
      - Protein synthesis
      - Polyribosomes
      - 70S
        - 80S in eukaryotes
    - Internal membranes
      - Chromatophores
        - Photosynthetic membrane systems
    - Inclusions
      - Storage granules: glycogen or polyphosphate
      - Vesicles: gas or lipids
    - Endospores
      - Resistant resting structure found in some bacteria
      - Method of preservation of 1 cell, not reproduction
  - External structures
    - Flagella
      - Movement
      - Monotrichous
        - One polar flagellum
      - Amphitrichous
        - One at each end
      - Peritrichous
        - All over surface
      - Atrichous
        - No flagella
    - Pili

Special Media

- Selective medium
    - Encourages growth of some organisms, inhibits others
- Differential medium
    - Observable change - E.g. MacConhey agar
        - Bile salts ad crystal violet dye
            - Inhibit gram +ve organisms
        - Lactose
            - *E coli* ferments to give red colouration
        - Other G -ve organisms remain white/cream

Viruses

16 February 2015 17:08

- No independent metabolism
- Require elements of host metabolism for replication

- Helical capsids
  - Multiple, identical protein subunits
  - Spiral staircase arrangement
  - Coats genome
- Naked vs. enveloped
  - Enveloped bigger
  - May have some of host cell membrane
- Components
  - Structural proteins
  - Non-structural proteins - replication enzymes
  - Capsid- protein shell
  - Nucleocapsid - nucleic acid and capsid
  - Envelope
  - Virion - complete particle
- Budding
- Replication cycle
  - Attachment
  - Penetration and uncoating
  - Expression and replication
  - Assembly
  - Maturation
  - Release
- Lytic phages multiple or bacteria and kill it
- Lysogenic phages can enter a dormant state
- Bacteriophages are highly abundant
  - 10 billion per litre

Rumen Protozoa

09 March 2015 17:30

- Rumen in ruminants allows a diet of fibrous material

- 5 litre rumen in sheep. 100 litres in dairy cow.

- 10^9 bacteria, 10^5 bacteria
- Large and complex populations
- Essential
- Imbalance can lead to severe illness
- Major contribution to GHG
    - 500-600L methane/day

Energy supply to ruminants

- Volatile Fatty Acids - 70%

- Microbial Cells - 50%
- Digestible unfermented food - 20%

Anaerobic Fungi

- First isolated 1975
- Zoospores attach to feed (mistaken for protozoa)
- ~30 species, $<10^5$ cells/ml

Rumen Bacteria

- 5 groups
    - Free living in liquid
    - Loosely associated with food particles
    - Firmly adhered to food particles
    - Associated with rumen epithelium
    - Attached to protozoa and fungi
- Feed-adhering groups
    - 75% population
    - 90% endonuclease activity
    - 70% of amylase activity
    - 75% protease activity
- Adhesion
    - Large multicompound complexes
    - Filamentous extracellular material pili-protein complex
    - Carbohydrate epitopes of bacteria glycocalyx
    - Enzyme binding domains

Protozoa

- Flagellates, ciliates
- Reduce flow of microbial protein from rumen
- Control
    - Saponin - reduces populations
        - Inhibitors used to prevent breakdown
- Uncertain how many genera by morphology - adaptations vary in different organisms and condition
    - Molecular phylogeny - 18S RNA gene

Somatic incompatibility

- Non-self-recognition - zone lines
- Intra- and inter-specific competition
- Protection of territory
- Successional processes
- Lichenicolous lichens - photobiont takeover
- Parasitic fungi

Lichens and air pollution

- Inhabit exposed habitats
- Sensitive to airborne pollution
- SO_2 - acidification
- No_x pollution - affects competitive interactions

Lichens and rock weathering

- Organic acids are secreted to release nutrients
- Important in rock weathering

Lichens in medicine/biotech

- Lichen metabolites used in traditional and modern medicine
- Litmus
- Traditional pigments
- Ethanolic fermentation

    - e.g. *Symbiodinium* sp.
- Parasitic association
    - *Blastodinium* in copepods
        - Significant economic losses in copepods
- Mutualistic association
    - Zooxanthellae
        - *Symbiodinium* sp. (cnideria)
        - Endosymbiont
        - Physiology of host and symbiont integrated
- Development of symbiosis
    - Largely accidental
    - Many examples of eggs/larval stages devoid of symbionts
    - Localisation to specific point
    - Chemotaxis (movement due to chemicals in environment)
    - Genetically distinct "strains"
    - Preferential uptake and establishment