SHAPE, SIZE AND ARRANGEMENT OF BACTERIA

Faculty: Dr. Rakesh Sharda
Shapes of Bacteria
1. Coccus (pl. cocci) – round or spherical
2. Bacillus (pl. bacilli) – rod or cylindrical
3. Spirillum (pl. spirilli) – spiral
SHAPES OF BACTERIA

- **Cocci** – Spherical or ovoid cells, e.g. *Staphylococcus*.

- **Bacilli** –
  - Straight and cylindrical rods, e.g. *Bacillus* spp.
  - Long, thin filamentous form, e.g. *Actinomycetes*

- **Spirillum** –
  - Comma-shaped (vibrio), e.g. *Vibrio, Campylobacter*
  - Spiral-shaped, loosely coiled (spirochete), e.g. *Spirochetes*,
  - Elongated, tightly coiled (spirillum), e.g. *Azospirillum* spp

- **Pleomorphic** – variable shape
Other Common Shapes

- **Coccobacilli**
  - cells in between round and rod shape

- **Vibrio**
  - curved cell

- **Spirillum**
  - spirilla, plural
  - rigid, wave-like shaped cell

- **Spirochete**
  - Corkscrew shaped cells
Bacteria are very small in size

- cocci are approx. 0.5 to 1.0 μm in diameter.
- rods range from 2 to 5 μm in length by 0.5 to 1.0 μm in width
- Spirochetes are longer (up to 20 μm) and narrower (0.1 to 1.0 μm)

- varies with the medium and growth phase
- usually smallest in the logarithmic phase of growth.
Bacteria are very small compared to cells with nuclei.
Bacteria compared to a white blood cell that is going to eat it.
Bacteria on pin-head
Clean skin has about 20 million bacteria per square inch.
Surface area/volume ratio

The surface area/volume ratio of a spherical bacteria of 1 µm in diameter is high (6:1) as compared to a spherical eukaryotic cell having a diameter of 20 µm (0.3:1).

Consequently:

• the intake of nutrients and removal of waste products is quick - the bacteria has high rate of growth and metabolism.

• no circulatory mechanism for nutrients is needed - the cytoplasmic streaming is absent.
ARRANGEMENT OF BACTERIAL CELLS

Cocci

➢ *Diplococci* - Cells divide in one plane and remain attached predominately in pairs, e.g. pneumococci.

➢ *Streptococci* - Cells divide in one plain and remain attached to form chains, e.g. *Streptococcus*

➢ *Tetracocci* - Cells divide in two planes and forms groups of four cells. (also called as ‘tetrads’), e.g. *Aerococcus*.

➢ *Sarcinae* - Cells divide in three planes, in a regular pattern producing a cubodial arrangement of cells.

➢ *Staphylococci* - Cells divide in three planes, in an irregular pattern producing bunches of cocci, e.g. *Staphylococcus aureus*
Spherical is called coccus.

Division along the same plane forms chains; 2 cocci together - Diplococcus

4 - 20 in chains - Streptococcus.

Division along 2 different planes - Tetrads

Division along 3 planes regularly - Sarcinae

Division along 3 planes irregularly - Staphylococci
Small cocci occurring singly or in small groups
A tetrad appears as a square of four cocci (arrows)
COCCCI ARRANGED IN CLUSTERS
Bacilli

- **Single**
- **Diplobacilli** - in pairs
- **Streptobacilli** – in chains, e.g. *Bacillus subtilis*
- **Trichomes** - rod-shaped bacteria arranged in chains with a larger area of contact between adjacent cells, e.g. *Beggiatoa* spp.
- **Palisade** – the cells are lined side by side as match sticks, e.g. *Mycobacterium tuberculosis*.
- **Chinese letter like** – e.g., *Corynebacterium* spp.
- **Filamentous** – long, mycelium like branching, mono-nuclear, e.g. *Actinomycetes*
- **Hyphae** – long, branched, multinucleate filaments, e.g. *Streptomyces*.
Rod shape is called Bacillus.

Two bacilli together - Diplobacilli

Chains of bacilli are called Streptobacilli

Palisades - Rods side by side or in X, V or Y figures
Long, thin rods
BACILLI ARRANGED IN LONG CHAINS
CHINESE LETTER LIKE ARRANGEMENT
Basic Bacterial Structure

Being small offers bacteria unique opportunities for survival and reproduction
Bacterial Structure: Cell Envelope

- Components of the bacterial cell envelope:
  - Cytoplasmic Membrane
  - Cell Wall
  - Capsule
  - Slime
  - Flagella
  - Fimbriae/Pilli
Bacterial Structure: Intracellular Structures

- Intracellular components:
  - Nucleoid
  - Ribosomes
  - Inclusion granules
  - Endospores
<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Wall</td>
<td>Protects and gives shape</td>
</tr>
<tr>
<td>Cell Membrane</td>
<td>Regulates movement of materials, contains enzymes important to cellular respiration</td>
</tr>
<tr>
<td>Cytoplasm</td>
<td>Contains DNA, ribosomes, essential compounds</td>
</tr>
<tr>
<td>Chromosome</td>
<td>Carries genetic information</td>
</tr>
<tr>
<td>Plasmid</td>
<td>Contains some genes obtained through recomb.</td>
</tr>
<tr>
<td>Capsule &amp; Slime Layer</td>
<td>Protects the cell and assist in attaching cell to other surfaces</td>
</tr>
<tr>
<td>Endospore</td>
<td>Protects cell against harsh environments</td>
</tr>
<tr>
<td>Pilus</td>
<td>Assists the cell in attaching to other surfaces</td>
</tr>
<tr>
<td>Flagellum</td>
<td>Moves the cell</td>
</tr>
</tbody>
</table>
MYCOPLASMAS
(PPLO)

• naturally lack cell walls
• Gram-negative
• size ranges from 50-60 to 100-250 nm
• highly pleomorphic eubacteria
• five genera require sterols and three do not.
• no free-living Mycoplasma; strictly parasitic
• parasitize a wide range of organism including humans, plants, animals, and insects.
MYCOPLASMAS

- facultative anaerobes and obligate anaerobes.

- growth on artificial media is slow with a generation time ranging up to nine hours in some species.

- supplementation with other factors, such as serum, may be required

- utilize glucose or arginine as the major source of energy.

- ‘fried egg’ or ‘nipple shaped’ colonies, which can be stained by Dienes’ stain.
RICKETTSIA AND CHLAMYDIA

• coccoid to rods in shape, with a diameter of 0.3-0.7 μm.
• Gram-negative type cell walls
• except one rickettsia (*Rochalimaea*), all are obligate intracellular parasites.
• contain both DNA and RNA.