

BACTERIA

Old kingdom name : Monera (monerans)

Today , bacteria are placed in either two of the new kingdoms :

- a) kingdom Archaeobacteria (no peptidoglycan)
- b) kingdom Eubacteria (cell wall contains peptidoglycan)

All bacteria (both kingdoms) contain these characteristics :

- prokaryote : lack membrane bound internal structures
NO true nucleus
NO organelles (mitochondria, chloroplast , lysosomes)
- unicellular : cell functions entirely on its own
Some bacteria stick together to form COLONIES but each cell acts on its own
- DNA : single chromosome , circular in shape (LOOP)
Called a PLASMID
- reproduction : all bacteria reproduce by BINARY FISSION
- asexual (no sex) - one cell splits to make two
- microscopic: need microscope to see , oil immersion (1000 x)
- live everywhere : need MOISTURE to be active

Other unique structures shared by some bacteria:

Flagella : simple whip-like tails used for locomotion

Pili : short , thick outgrowths

- used for ATTACHMENT of bacteria to surfaces or other bacteria
- help in sexual reproduction in some bacteria

Two Kingdoms of Bacteria

Kingdom Archaeobacteria

- oldest living bacteria , 3.5 billion years old
- live in EXTREME places , eg. Salty , no oxygen , very hot

All Archaeobacteria do NOT contain PEPTIDOGLYCAN in their cell wall

Three (3) main types - (based on where they live)

- Thermophiles : live in extremely HOT environments (over 45 °C)
ex. Hot springs
 - some do PS using hydrogen sulfide , H_2S , instead of WATER as the final electron acceptor
 - they produce SULFUR instead of OXYGEN gas
- Methanogens : anaerobic , grow on CO_2 and H_2 (hydrogen gas) to produce methane gas
 - found in places LOW in OXYGEN
 - eg. Volcanic vents , deep sea vents , swamps , intestines

* these are MAJOR DECOMPOSERS : they help to break down ORGANIC (contains CARBON) matter without the help of OXYGEN
- Halophiles : live in very SALTY environments
 - give SALT beds their PURPLE colour
 - use SUN to carry out PS

Bacterial Nomenclature: <http://www.dsmz.de/bactnom/genera2.htm>

Introduction to Archaea:
<http://www.ucmp.berkeley.edu/archaea/archaea.html>

Eubacteria:
<http://tolweb.org/tree?group=Eubacteria&contgroup=Life>

EXCELLENT WEBSITE

*** **Bacterial colonies, Gram reactions, and cell shapes:**
<http://helios.bto.ed.ac.uk/bto/microbes/shape.htm#crest>

Kingdom Eubacteria

_____ More common bacteria that are found everywhere.

All of the bacteria in this kingdom have PEPTIDOGLYCAN in their cell wall.

Classified according to :

- cell wall composition
- shape
- configuration
- respiration
- type of nutrition

1. Cell wall composition : all contain peptidoglycan
 - carbohydrate and protein polymer found in cell wall

IMPORTANCE - the amount of peptidoglycan found in the cell wall varies depending on the SPECIES of bacteria

* this difference can be used to IDENTIFY and CLASSIFY bacteria

_____ Thickness of peptidoglycan layer is determined by the GRAM-STAIN method
- developed by Danish scientist , Hans Christian Gram , 1884

GRAM METHOD :

- bacterial sample smeared on microscopic slide
- stained with crystal violet dye (purple)
- then fixed with Gram's iodine and decolourized with ethanol
- counterstained with safarin (red)

Result: Gram positive - stains PURPLE due to a THICK peptidoglycan layer

Gram negative : stains RED (purple colour lost)
- THIN layer of peptidoglycan

_____ Gram stain simulation

_____ <http://www.micro.msb.le.ac.uk/LabWork/gram/gram1.htm>

2. Shapes of Bacteria - see book page 111

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- | | |
|-----------------------------|----------------------------|
| a) coccus (cocci) - round | b) bacilli - rod |
| c) spirilla - spiral | d) filamentous - filaments |

3. Configuration

Bacteria may stay together after division to resemble a multicellular organism , but each cell functions individually (they are together only for appearances)

- _____ a) di - ex. dicoccus
- _____ b) strepto - ex. *Streptococcus* : bacteria in chains or filaments
- _____ c) staphylo - *Staphylococcus* : clumps

Colonies: when a large number of cells have grown together

ex. *Myxobacteria* : form specialized colonies during part of their growth cycle called fruiting bodies

_____ 4. Respiration : make energy with or without OXYGEN

- a) obligate aerobes : need oxygen to survive (aerobic)
ex. Bacteria that cause tuberculosis
- b) facultative anaerobes : can live with or without oxygen
ex. *E.coli*

c) obligate anaerobes : live without oxygen , die if oxygen present
ex. Bacteria that cause gangrene, tetanus , botulism

_____ 5. Reproduction

Three types of reproduction possible :

a) binary fission
b) conjugation
c) endospores

- a) binary fission : ASEXUAL
- single strand of DNA (plasmid) replicates (exact copy)
 - bacterium produces cross wall
 - bacterium splits making TWO daughter cells

See fig 9a) binary fission page 112_____

b) Conjugation : SEXUAL reproduction in SOME bacteria
ex. *E.coli* , *Salmonella*

_____ - not common _____

_____ Process :

- bacteria attach with the help of a structure called a SEX PILUS
- the PLASMID of one bacterium (donor) is transferred to another bacterium (recipient) giving the recipient an altered set of chromosomes (characteristics)

Importance : conjugation helps bacteria become IMMUNE to certain antibiotics

See fig 9b , page 112

c) Endospores :

_____ During unfavourable environmental conditions (no water , low temperatures , no oxygen) some bacteria survive by forming DORMANT or RESTING cells called endospores

_____ - these endospores are resistant to heat , lack of water

Structure : hard outer coat that surrounds the DNA

- basically a cell with all contents removed except the DNA

When conditions become favourable , endospores can turn back to bacteria and begin normal cell activities , eg. Reproduction

Botulism: soil bacteria forms endospores

_____ If these endospores are not removed from the food they are attached to , they may awaken and begin to release a TOXIN causing food poisoning

Sterilization : very hot temperatures usually destroy these endospores