PROKARYOTES

→ Only about 6300 species of prokaryotes have been assigned scientific names.

→ Three Domains of life:

1. Bacteria
2. Archea
3. Eukaryotes

CLASSIFICATION OF BACTERIA

1. Proteo bacteria:
   - → Gram-negative bacteria
   - → include photoautotrophs, chemoautotrophs and heterotrophs
   - → Furthur five ~~types~~ divisions

2. Chlamydias: parasitic Gram-negative bacteria

3. Spirochetes:
   - → helical heterotrophs
   - → spiral by means of rotating internal filaments
   - → may be free-living or parasitic

4. Gram-positive bacteria:
   - → possessing thick walls of peptidoglycan

5. Cyanobacteria: (Blue Green Algae)
   - → oxygen producing bacteria
   - → photosynthetic

→ Nostoc is a cyanobacteria
→ Nostoc is involved in fixation of atmospheric nitrogen

SUB-GROUPS OF PROTEOBACTERIA

1. Alpha - proteobacteria:
   → associated with eukaryotic hosts
   → e.g symbiotic association of Rhizobium species with roots of leguminous plants for fixation of atmospheric nitrogen

2. Beta- proteobacteria:
   → involved in nitrogen recycling, oxidizing ammonium, producing nitrites as a waste product
   → e.g Nitrosomonas

. Gamma- proteobacteria
   → Sulphur bacteria
   → oxidize H_2S instead of H_2O to obtain energy

. Delta- proteobacteria:
   → slime- secreting myxobacteria
   → release resistant myxospores in inappropriate conditions.

. Epsilon proteobacteria:
   → pathogenic

SUB-GROUPS OF GRAM POSITIVE BACTERIA:

1. Actinomycetes:
   → cause tuberculosis and leprosy
   → most species are free-living and decompose organic matter in soil

2. Streptomyces:
   → source of many antibiotics including streptomycin

3. Mycoplasma:
   → only genus of bacteria known to lack cell wall.

* Peptidoglycan is a carbohydrate-protein complex

FLAGELLATED BACTERIA

1. Atrichous: lack flagella
2. Monotrichous: one flagellum
3. Lophotrichous: group of two or more flagella inserted at one pole of cell
3. Amphitrichous: Groups of flagella inserted at both ends of cell
4. Peritrichous: flagella are dispersed on entire surface of cell

→ In a bacterial cell, the enzymes involved in the production of energy are all located in the cell membrane and hence it resembles the membrane of mitochondria in eukaryotic cell.

→ In photoautotrophic bacteria, chlorophyll is dispersed in the infolded region of cell membrane in cytoplasm.

→ In photosynthetic bacteria, sulphur is released as a byproduct whereas the cyanobacteria release oxygen during photosynthesis

→ The source of Hydrogen:

In Bacteria: Hydrogen sulphide (H_2S)

In Cyanobacteria: H_2O

→ Pigments:

Bacteria: chlorophyll a

Cyanobacteria: chlorophyll a, phycocyanin, allophycocyanin, phycoerythrin

REPRODUCTION IN BACTERIA

* ASexual Reproduction:

Binary Fission

* Sexual Reproduction:

Through genetic Recombination

Three Methods:

1. Transformation
2. Transduction
3. Conjugation

* Temperate phage → The phage which displays a lysogenic life cycle

* E.Coli can synthesize:
  Amino Acids → Methionine, Threonine, Leucine
  Vitamin → Biotin

BACTERIAL DISEASES

1. Airborne: Diphtheria, Tuberculosis, Bacterial pneumonia, whooping cough

2. Water Borne → Typhoid fever, gastroenteritis, dysentery, cholera

3. Food Borne → Botulism, Food Poisoning

4. Wounds or cracks → erysipelas

EXOTOXINS AND ENDOTOXINS

- Exotoxins:
  → proteins secreted by some species of bacteria
  → exotoxins diffuse into surrounding medium and cause damage to the host cell.
  → may be released by gram negative or gram positive bacteria

* ENDOTOXINS
  → lipo polysoccharide complexes present in cell wall of Gram-negative bacteria
  → released only when bacteria die or their cells break down
  → Endotoxins are pyrogens; which are fever causing agents.

PLANT DISEASES

1. Bacterial Leaf spots → Pseudomonad spp.
2. Bacterial wilt → Ralstonia solana cearum
3. Bacterial soft rot → Erwinia carotovora
4. Bacterial galls → Agrobacterium tumefacians
5. Bacterial blights → Xanthomonas campestris pv. Phaseoli

* Facultative Bacteria: The bacteria that makes ATP by aerobic respiration if oxygen is present, but is capable of switching to fermentation of anaerobic respiration if oxygen is absent.
* Aspergillus produce toxins in stored seeds and grains.
* Bacteria are more sensitive to antibiotics during lag phas
* Endosperm of Gymnosperms is haploid
* Protonema is the algae like structure in which spores of moss are developed. This structure is not developed in liverworts.

* Bacteria possess extra chromosomal DNA rings of small size called plasmids.

* The shape of the bacterial cell is controlled by its rigid cell wall.

* Some Gram-positive bacteria produce highly resistant structures called endospores. Endospores may develop near the end on in the centre of the cell.

* In bacteria, the chlorophyll is not contained in chloroplasts but is dispersed in the infolded region of cell membrane in cytoplasm.

* Photoautotroph bacteria have photosystem I but lack photosystem II

* Phases of Growth In Bacteria:

1. Lag Phase → First few hours
   → Period of no growth
   → Bacteria becomes accustomed to new environment

2. Log Phase:
   → Period of fast growth
   → Active stage of growth
   → Disease symptoms develop in this phase

3. Stationary Phase:
   → shortage of nutrients
   → Rate slows down

4. Decline Phase:
   → shortage of nutrients
   → accumulation of toxic wastes
   → No. of dying cells exceeds no. of new cells formed
   → Population declines

* TRANSDUCTION IN BACTERIA:

A process of genetic recombination in bacteria in which a genes from a host cell (a bacterium) are incorporated into the genome of a bacterial virus (bacteriophage) and then carried to another host cell when the bacteriophage initiates another cycle of infection.

PROCESS OF TRANSDUCTION:

1. Phage attacks bacterial cell.
2. Phage DNA injected into DNA of bacterium.
3. A piece of bacterial DNA becomes attached to phage DNA forming a recombinant DNA known as prophage.
4. Cell burst and lytic cycle completes
5. Newly formed phage attacks another bacterium called recipient bacterium.
6. Phage DNA inserted into recipient bacterium.

7. Lysogenic life cycle begins
8. Recipient bacterium contains three types of DNA: DNA of its own, DNA of donor bacterium, phage DNA.
9. All 3 types of DNA replicate along with bacterial division.
10. In daughter bacteria, some genes of donor DNA also express themselves.

CONCLUSION:

Genetic material of donor DNA carried to recipient through bacteriophage.

* CONJUGATION IN BACTERIA:

Conjugation is a unidirectional transfer of genetic material from a donor bacterium to a recipient through conjugation tube or cytoplasmic bridge.

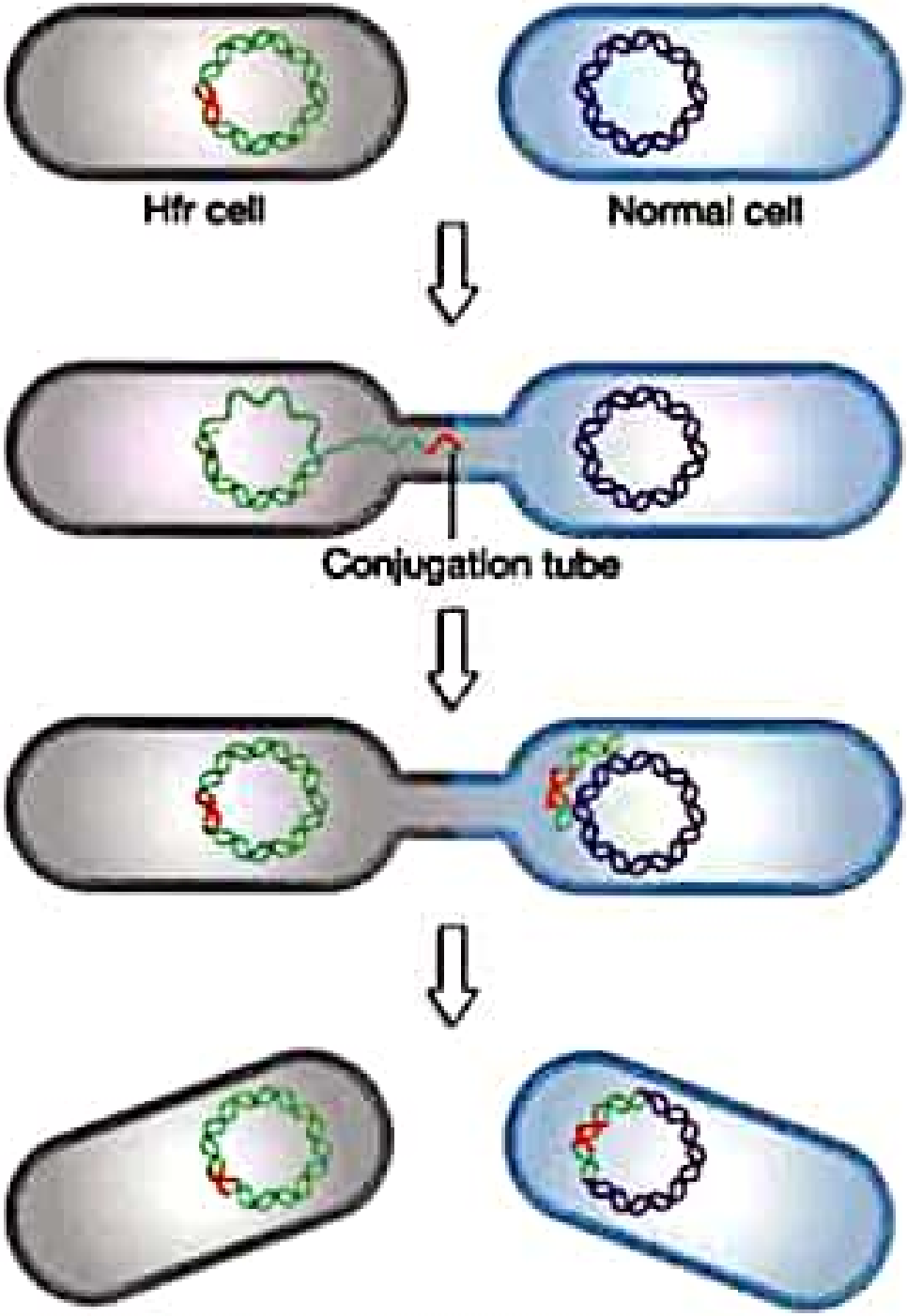
PROCESS OF CONJUGATION:

1. When plasmid integrates into its own chromosome, it is known as Hfr.

Hfr cells contain genes that allows them to transfer some or all their chromosomes to another cell.

2. Conjugation tube connects Hfr cells to normal cell. Copy of Hfr chromosomes begins to move to recipient cell.
3. Homologous sections of chromosomes synapse.
4. Cells separate. Section of Hfr chromosome into recipient chromosome by crossing over.

BACTERIAL CONJUGATION AND RECOMBINATION



1. Hfr cells contain genes that allow them to transfer some or all of their chromosome to another cell.

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IMPORTANCE OF BACTERIA

1. Escherichia coli → Gene cloning
2. Agrobacterium tumefacians → produce transgenic plants such as Golden Rice which prevents blindness that occurs in those whose diet is dificient in vitamin A. Golden Rice contains β- caroline, a precursor of vitamin A.
3. used in bioremediation.
4. used in plastic industry
5. helps produce ethanol from various forms of biomass such as agricultural wastes, willows and corn. Ethanol is used as substitute of fossil fuel.
6. Bacteria live in the guts of herbivores and help in digestion of cellulose by breaking it down.

* CONTROL OF HARMFUL BACTERIA

. PHYSICAL TREATMENT

1. HEAT TREATMENT:

(i) Moist Heat → more effective than dry heat

(ii) Boiling → 100°C

→ kills vegetative bacterial pathogens within 10 min.

(iii) Sterilization → temp above boiling water

→ Autoclave chambers for sterilization are filled with hot steam under pressure

(iv) Pasteurization → prevent spoilage of beverages

HTST → 72°C for 15 sec

UHT → 140°C for 3 sec

(v) Dry Heating → Direct flaming (inoculating loops and needles)

(vi) Incineration → Items placed in oven at 170°C for 2 hours

→ for Sterilization of disposable items such as paper cups, dressing etc.

2. FILTERATION

3. LOW TEMPERATURE TREATMENT:

→ Refrigeration at temp 0°C to 7°C

→ Microbes can neither reproduce nor produce toxins

→ called bacteriostatic effect

4. DESSICATION:
→ extraction of water
→ bacteria cannot grow or reproduce in absence of water

5. OSMOTIC PRESSURE TREATMENT
→ high concentration of salt or sugar
→ helps in controlling growth of microbes

6. RADIATION
→ ionizing radiation, UV light and microwave radiation kill microbes

• CHEMICAL TREATMENT

1. Phenolics :
→ effective used against Gram-positive bacteria
→ excessive use in infants is harmful

2. Chlorine :
disinfect drinking water and pools

. Tincture Iodine : antiseptic

Alcohol : kill bacteria

Heavy metal (copper, Selenium, mercury, zinc) :
used as disinfectant against skin wounds, in

pools, fish tanks, dandruff shampoos and mouthwashes

6. Formaldehyde (Formalin):
   → to preserve biological specimens
   → inactivates bacteria in vaccines.

7. Glutaraldehyde:
   → less irritating but more effective than formalin
   → used to disinfect hospital instrument

8. Ethylene oxide:
   → kills all microbes and endospores
   → requires 4-18 hours exposure