HANDWRITTEN NOTES

DAMS

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MICROBIOLOGY

CRISP, CONCISE, CONCEPTUAL

Integrated Edition

Student first @DAMS

DAMS Publications

Published by Delhi Academy of Medical Sciences (P) Ltd.

HEAD OFFICE

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HOW TO MAKE BEST USE OF NOTES?

A Message by Mentor Duo Specially for you,

- *Read the notes thoroughly, they are absolutely concise, crisp & conceptual and hence it is best advised not to add a lot of extra information to them as that will dilute the quality.*
- *Images have been provided alongside to aid in better understanding and also help you solve image-based questions, these images have been specially picked by the faculty so have a high probability of being asked in exams.*
- *Notes are handwritten in a way to help make them easier to retain, a lot of tables, graphs and algorithms have been used to simplify the learning.*
- *While reading notes try and use the CFAQ technique —*
  A. *Use the C to denote concept part in the notes and ensure you are clear with this part in the first go if not then it's advisable to listen to this part of the video from your course.*
  B. *Use the F To denotes facts in your notes, it is okay if you can't remember them in first go but will need repeat reading. But these facts are important for exams as they could be integrated to clinical questions.*
  C. *Use A to denote applied parts, this is how concepts and facts are asked indirectly in exams. This will also help you develop MCQ solving skill.*
  D. *Use Q to denote areas where faculty has said it's a direct question or a PYQ or a potential question.*
- *This technique will help you summarize your notes In way that your second reading will become easy and faster.*
- *Active space has been provided with these notes to make your own annotations alongside and this will help you maintain one single notebook for one subject.*
- *Try and solve MCQs with every topic from DQB. Your goal should be to start with at least 30 MCQs every day and then increase to at least 50 MCQs every day. Also, when you do a topic wrong write it alongside the notes that this topic needs to be read again but mark only the specific area that you have done wrong not the whole topic.*
- *After the topic is covered then in the active space try and summarize the topic in the form of mind map. This will help in active recall and make your revision easier.*

Best Wishes & Happy Learning!!!!!

INDEX

MICROBIOLOGY

1. GENERAL MICROBIOLOGY

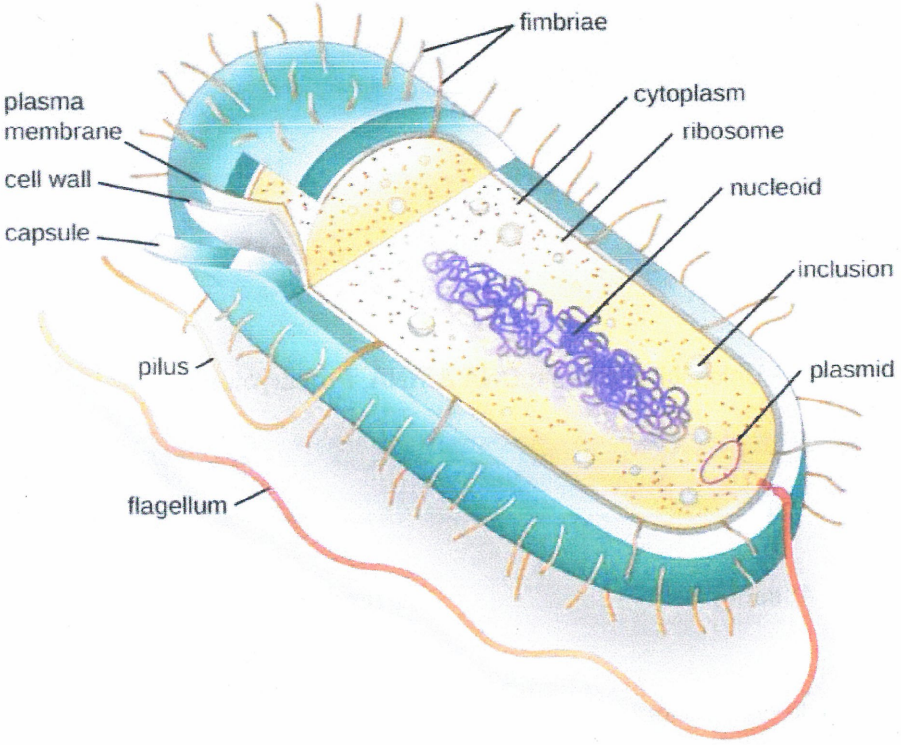
- **Bacterial Anatomy, Physiology and Genetics**
- **Laboratory Diagnosis**
- **Sterilization and Disinfection**

Bacterial Anatomy

Bacteria - Unicellular, contain DNA & RNA, Prokaryotes.

Properties	Prokaryotes	Eukaryotes
Nuclear structures **Nucleus, Nucleolus, Nuclear membrane, nucleoplasm, histones**	Absent	Present
DNA / Chromosome	Single chromosome- circular, super coiled Neisseria, Borrelia	Many, Linear
Mitochondria, ER, Golgi apparatus	Absent	Present
Ribosomes	70s - 30s, 60s	80s - 40s, 60s
Respiration	Mesosomes	Mitochondria
Multiplication	Binary fission	Mitosis/ Meiosis
Sterols in cell membrane	Absent Mycoplasma - cell membrane contains cholesterol	Present

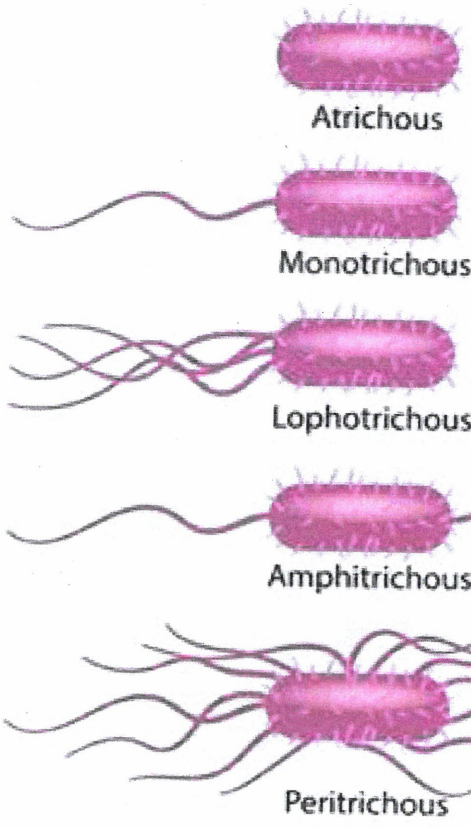
Bacterial Anatomy



Flagella

Name	Flagella
Composition	Flagellin
Function	Organ of Locomotion
Medical Application	Identification of Bacteria — Based on structure, arrangement, motility, antigen
Extra edge	Endoflagella - sheathed flagella, Axial Filament - Spirochetes

Arrangement -



No Flagella - Shigella , Klebsiella

Vibrio Cholera, Pseudomonas

Tuft of flagella at one end - H. Pylori

Flagella on both poles - Spirilla

All over the cell/body . E. Coli,
Salmonella,
Proteus, B. Cereus, Clostridium tetani

Based on motility :
Darting motility: Vibrio
Tumbling Motility: Listeria
Swarming : Proteus
Stately : Clostridium
Gliding : Mycoplasma
Corkscrew: Spirochetes
Lashing : borrelia

Based on structure:

Gram positive: 2 rings : S & M membrane rings
Gram negative: 4 rings
L : lipopolysacchdire
P : Peptidoglycan
S : membrane
M : membrane

Fimbriae

Contains fibrin protein
Main function- attachment with cell surface

Medical application- Typing of Bacteria
Eg. Mannose sensitive
Mannose Resistant

Pili (Pilus) - contains pilin protein
Main function- Conjugation - gene transfer method

Glycocalyx

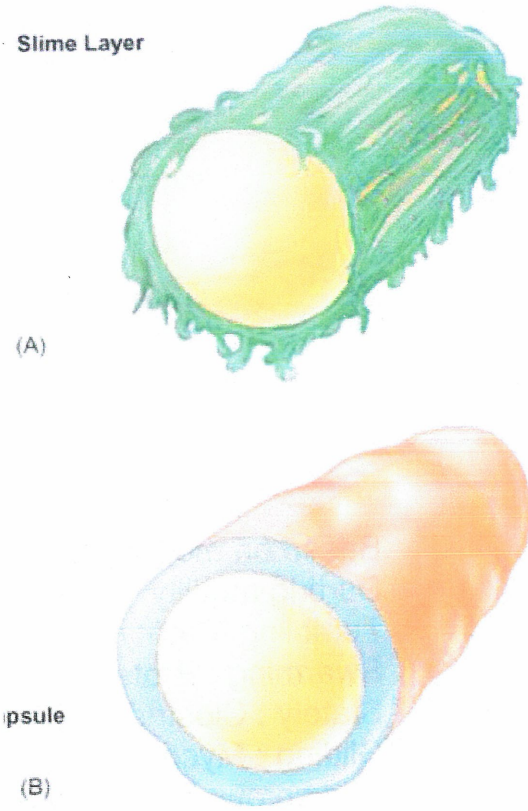
1. Loosely arranged (Slime layer)
Anti Phagocytic

Produces Biofilm formation
Causes Antibiotic resistance
Attachment with medical devices

Bacteria possessing biofilm -
Staph. Epidermidis
Strep. Viridans
Pseudomonas aeruginosa

2. Well organized (Capsule)
Anti phagocytic

Made of
A anti phagocytic polysaccharide capsule
V virulent factor
M mucoid colonies
S serotypes



N. MENINGITIDIS
H. INFLUENZA
S.. PNEUMONIA

K. PNEUMONIA
E. COLI
S. TYPHI

B. Polypeptide: Bacillus Cereus
C. Hyaluronic acid: S. Pyogenes, GAS

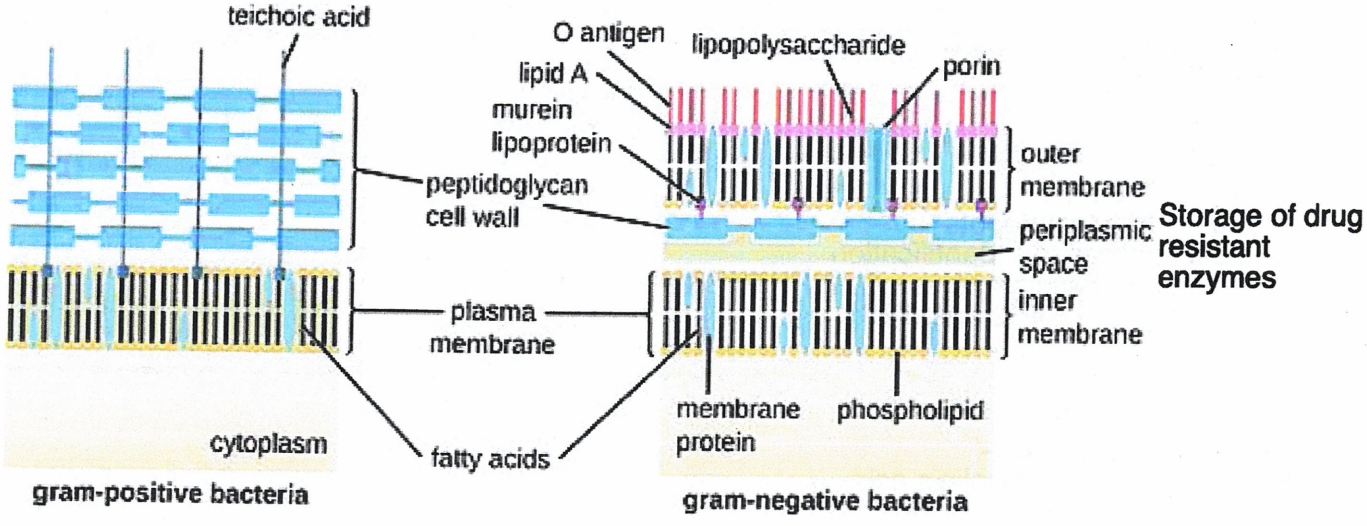
Cell Wall

Made of peptidoglycan-
NAM : N-acetyl muramic acid
NAG : N- acetyl glucosamine

Function - shape, support, acts as a virulence factor, attachment

Medical application - Target for antibiotics :
Penicillin, Cephalosporins, Vancomycin, Bacitracin

Properties	Gram Positive	Gram Negative
Techoic acid	Present	Absent
LIPOPOLYSACCHRIDE	Absent	Present
Periplasmic space	Absent	Present
Porins	Absent	Present
PEPTIDOGLYCAN	Thick	Thin



Devoid of cell wall - L forms (Lister institute)
Gram +ve : loss of cell wall c/a protoplast
Gram -ve : loss of cell wall c/a spheroplast

Cell wall deficient forms - MYCOPLASMA

Cell Membrane

Permeaze enzymes

Main function- Transportation:
Influx of nutrients, Efflux of toxic metabolites

Medical application -Target for antibiotics - Polymyxin/ Colistin, Daptomycin

Mesosomes

Respiratory enzymes
Septal - facilitates septum formation- binary fission
Lateral - Respiration
Called as Chondroids

Ribosomes

Enzymes for protein synthesis
Main function target for antibiotics
70s- 30s & 50s
30s AMINOGLYCOSIDES, TETRACYCLINE
50s STREPTOGRAMIN ERYTHROMYCIN LINCOMYCIN LINEZOLID
Buy AT 30, SELL at 50

DNA

Single, Circular, super coiled
Genes
Controls & regulates all the functions of bacteria
Medical application - target for antibiotics
DNA - Fluoroquinolones
RNA - Rifampicin

Plasmid

Extrachromosomal Free DNA
Conjugation

Storage Granules

Contains Nutrients
Acts as Nutritional depots
Medical application - Identification
Eg. Metachromatic granules - C. DIPHTHERIA
Much granules - LIPID - M. TB

Spores

Bacterial Endospores -
Rich in calcium + dipicolinic acid
Heat resistant (>100°C to kill)
Protection of bacteria - heat / adhesive condition

Medical application:
Quality control agents in sterilization process

Bacterial spores are only for survival purpose.

Bacterial Physiology

Growth Requirements

Based on O2 requirement : Oxidation

Obligate aerobe
M. Tuberculosis
P. Aeruginosa
Bordetella/Brucella

Obligate anaerobe
Fermentation
ABCF
Actinomyces
Bacterioides
Clostridium
Fusobacterium

Facultative aerobe/ anaerobe
grow in presence of O2
Oxidation
Or
Absence of O2
Fermentation
Called as Pasteur effect
Eg. E.coli

Microaerophilic
Low O2 concentration
M. Bovis/ Spirochetes
H. Pylori / C. Jejuni

Aerotolerant anaerobe
Anaerobe withstands O2
Clostridium perfringens

Based on pH :

Neutral pH
7.0
E.coli

Acidic pH <7.0
Lactobacillus 4.5 pH

Alkaline pH >7.0
Enterococci = 9.6 pH
Vibrio = 8.6 pH

Based on Temperature

Mesophile
25-40°C
E.Coli

Psychrophile
0-20°C

Thermophile
55-80°C

Environment

Halophile
High salt content
Vibrio

Capnophile
High CO2 content
Brucella abortus

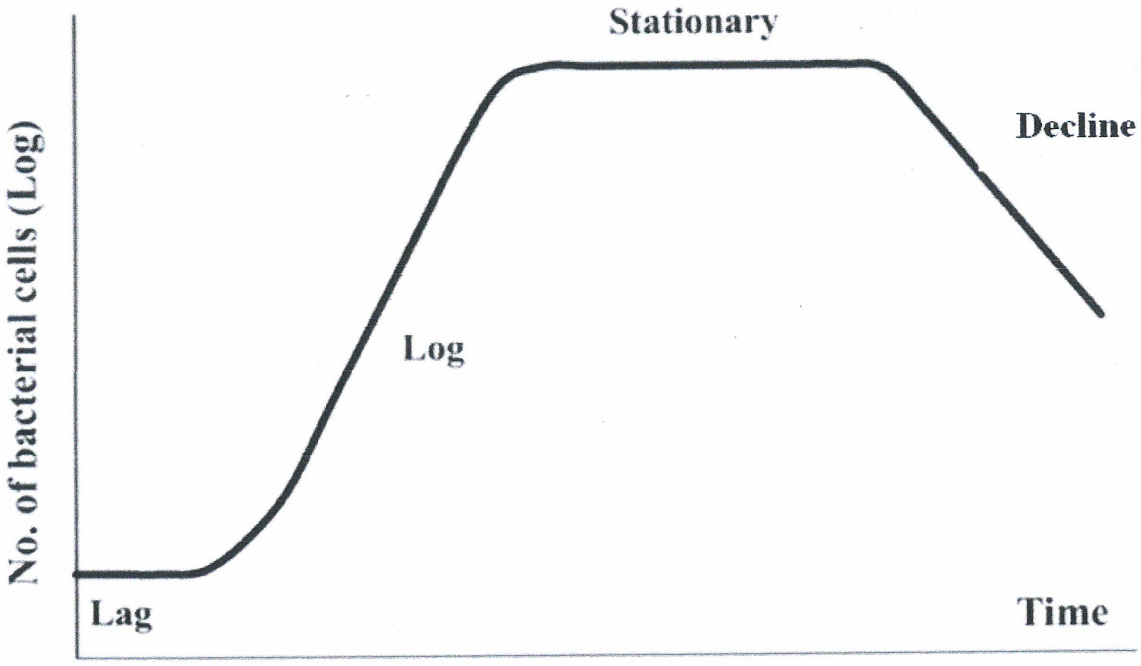
Barophile
Increase pressure

Xerophile
Increase dryness

Nutrition

Chemo
Organo
Heterotroph

Growth Curve



Lag phase - phase of adaptation
Pre multiplication phase
Bacteria increase in size
Few antibiotics are ineffective

Log phase -
Bacteria increase in number 2n
Exponential phase
Morphology/ biochemical reactions
Vaccine/ Antibiogram
Uniform gram stain
Antibiotics are more effective

Stationary phase - No. Of production = No. Of destruction
Lack of Nutrition
Sporulation
Storage of granules
Bacteriocin/ Antibiotics
Produce Exotoxins
Gram Variability in gram stain

Decline phase - No. of Destruction >> No. of production
Lack of nutrition
Increase toxic metabolites
Involutional forms

Bacterial Genetics

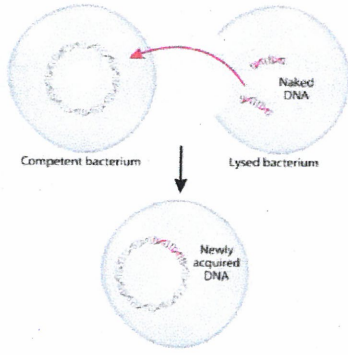
Single chromosome
Circular/ Super coiled

Mutation - 10^6- 10^8 divisions
Deletion
Addition
Duplication
Inversion

Nonsense mutation
Stop codons
Termination of mutation

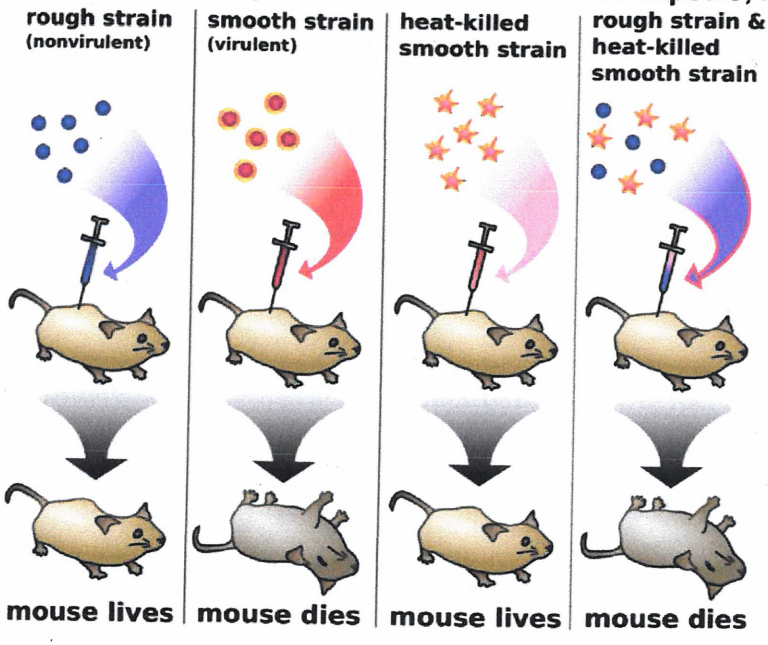
Suppression mutation/Reversion
Back to original/previous state

Transformation



Gene Transfer methods :

Non capsulated | Capsulated | No capsule, live bacteria, capsulated killed bacteria

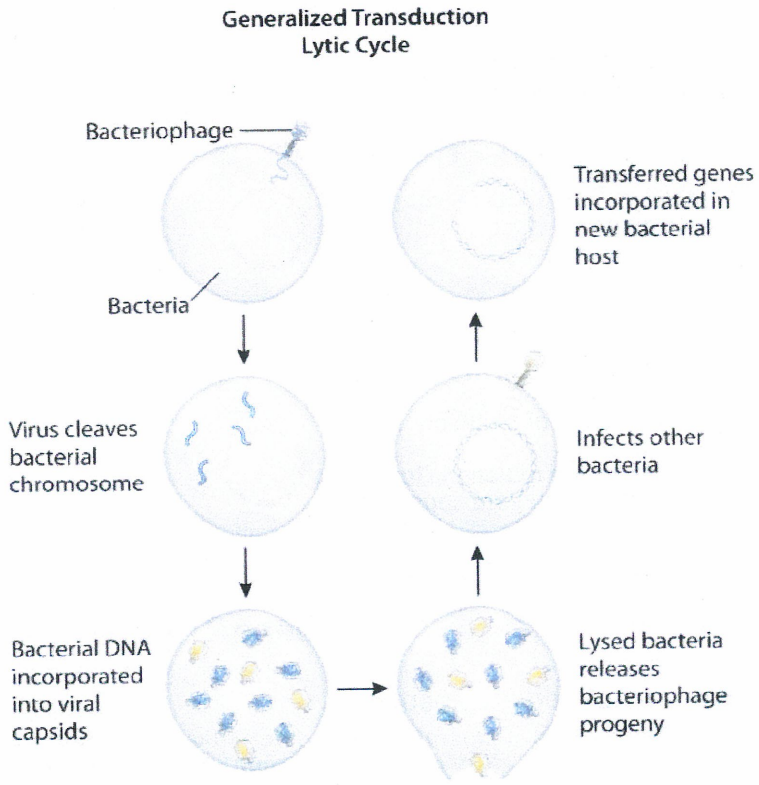


Transduction

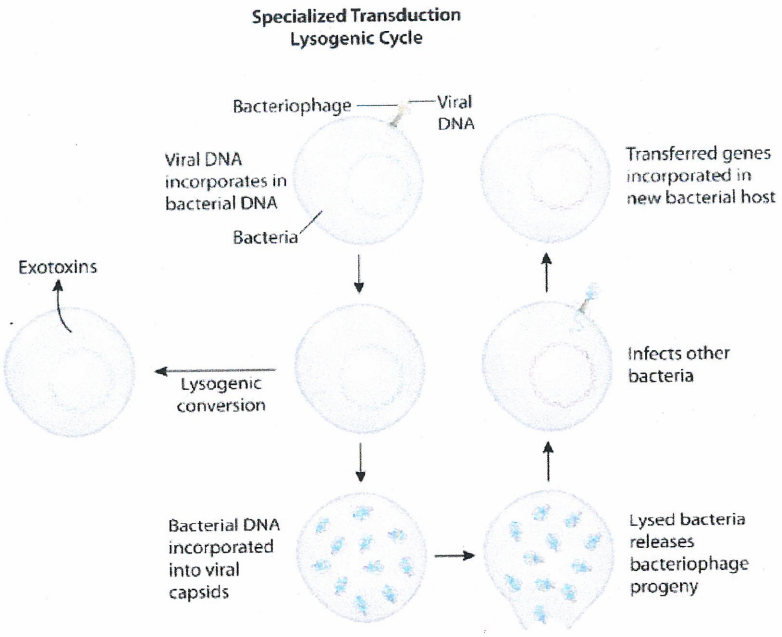
Gene transfer via bacteriophage
2 types
Generalized - any gene can be transferred
Lytic cycle

Specialized Transduction - A few genes can be transferred
Lysogenic cycle
Eg. C. Diphtheriae

Generalized Transduction
Any gene can be transferred

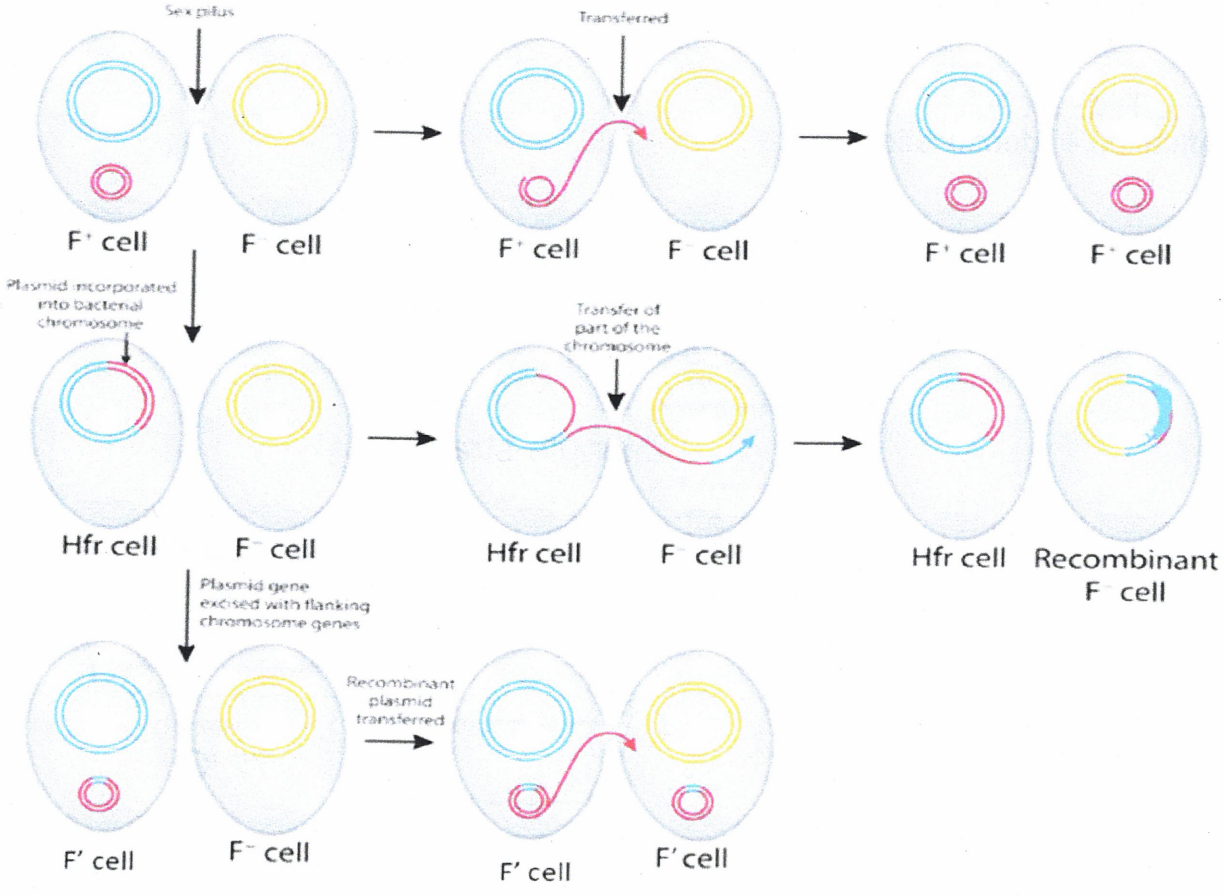


Specialized Transduction
Few genes can be transferred



Conjugation

Direct transfer of plasmid (extrachromosomal free DNA) via pilus
1st demonstrated by Lederberg eg. E.coli
Plasmid Responsible for -
VIRULENCE/ TOXIN/ DRUG RESISTANCE
SELF REPLICABILITY property



Plasmid - Not needed for survival of bacteria
F plasmid - Fertility plasmid
R plasmid - Resistance plasmid
Col plasmid - Colicin plasmid

3 types of Conjugation-
Simple Conjugation
HFr cell /Episome Conjugation
Sexduction/ F' Conjugation

Transformation-
Direct uptake of naked DNA from the environment
Eg. Strep. PNEUMONIA

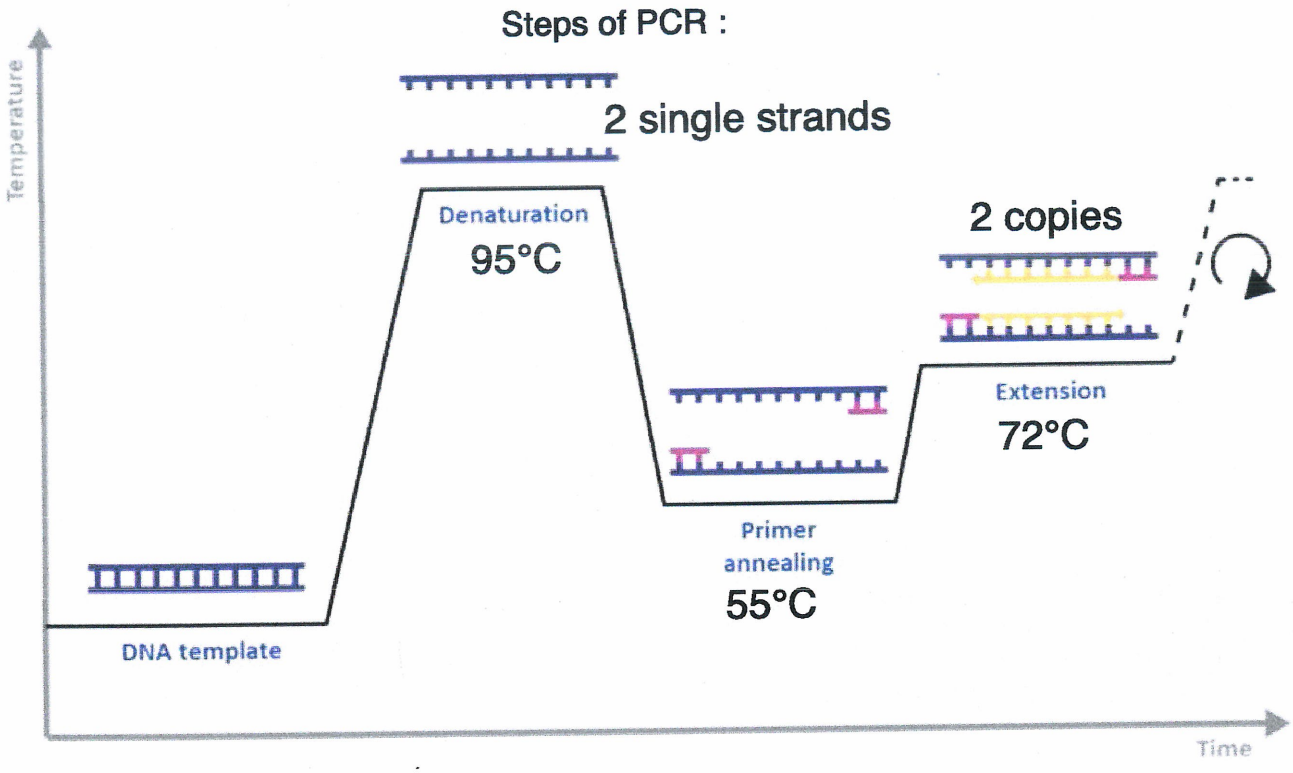
RT-PCR

Polymerase chain reaction

Principle - nucleic acid amplification Test (NAAT)

2 types of PCR
1. CONVENTIONAL
Step 1. Amplification
Step 2. Identification

2. REAL TIME PCR
Amplification + Identification



RT PCR : REAL TIME PCR
rt RT PCR: REVERSE TRANSCRIPTASE PCR

Multiplex PCR- detects MANY TARGETS

Nested PCR - To increase specificity