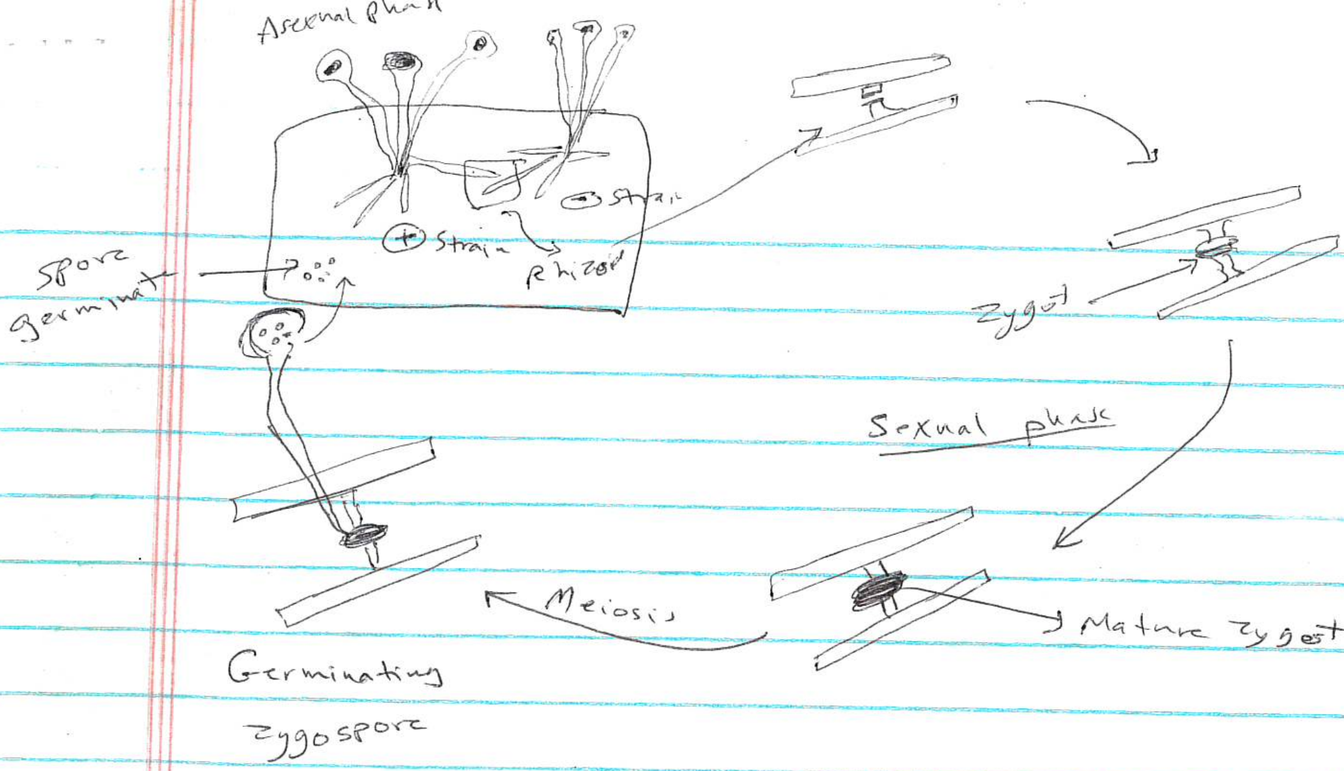

The roles of fungi in nature and industry:

- Agricultural industry: 40% of the yearly crop of fruit is consumed not by humans but by fungi → rots
- pathogens to field plants e.g: corn, grain, rot harvested fresh produce during shipping and storing e.g: potatoe.
- Beneficial side:

a) essential role in decomposing organic matter and returning essential minerals to the soil

b) They form association with plant roots e.g: mycorhizae, → increase the ability of roots to absorb water and nutrients

c) Biochemical potential to produce large quantities of antibodies (biotics), alcohol, organic acids, and vitamins

d) Food: the yeast Saccharomyces: 1) produces the alcohol in beer and wine 2) the gas that causes bread to rise for baking.

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Metabolism of Microorganisms:

Metabolic Task:

(1) Bringing nutrients into cell:

. To transport nutrient across the cytoplasmic membrane to process them.

(2) Metabolism:

a - Anabolism: Synthesis of new material needed

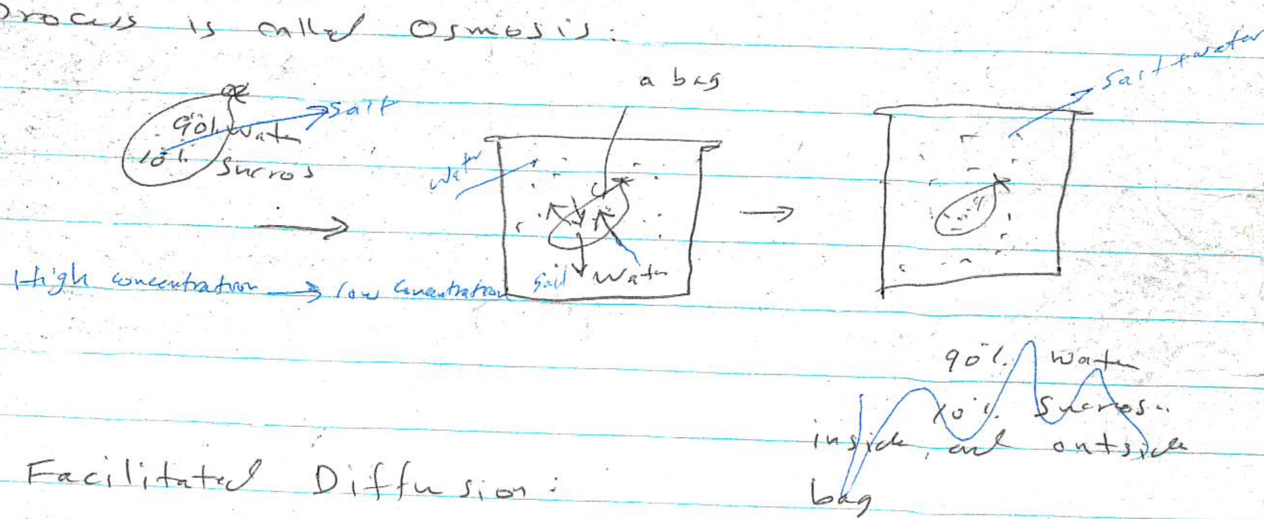
b - Catabolism: Convert nutrients into organic compds.

Bringing nutrients into the cell:

Methods of transport:

(1) - Simple diffusion:

any molecule that crosses a membrane freely until reaches equal distribution, In case of water, the process is called Osmosis:



(2) - Facilitated Diffusion:

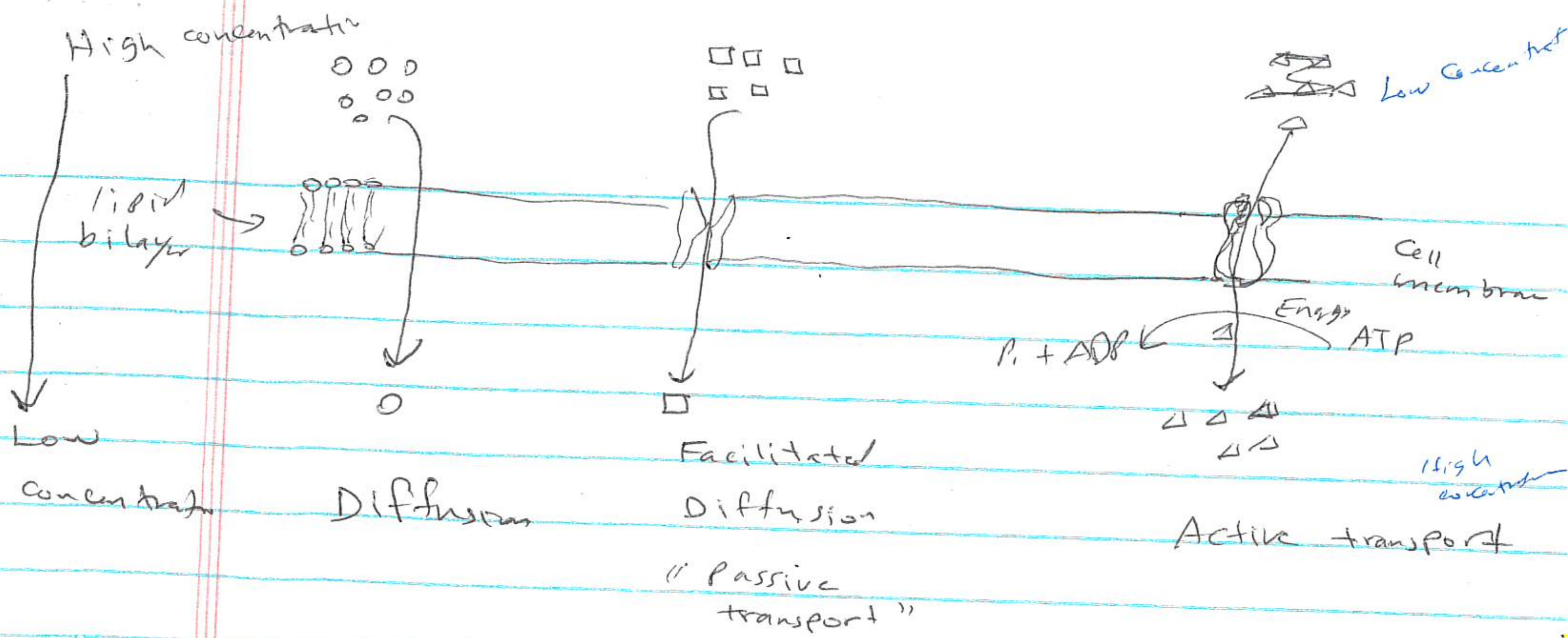
Substances that cannot diffuse across membranes, passage → mediated by carrier proteins embeded in the cell membrane.

(3) Active transport.

Bring essential nutrients (sugars, amino acids, vitamins) into cell when concentration outside are low.

→ movement against concentration gradient

→ requires energy in the form of ATP



Exocytosis
Vesicle moves to plasma membrane, fuses with it, contents released outside

Endocytosis
Vesicle forms at surface of plasma membrane, sinks into cytoplasm.

Chemical composition of E. Coli:

	Percent of dry weight
Proteins	55
RNA	20.5
DNA	3.1
Lipid	9.1
lipopolysaccharide	3.4
Peptidoglycan	2.5
Glycogen	2.5
Small molecules	2.9
ions	1.0
Total	100%

Cell membrane

Bringing Nutrient into Cells → Metabolism in the cell → Biosynthesis → Polymerization → Assembly

Metabolic Strategies among Microorganisms:

1. Anaerobic metabolism (Fermentation)

Glucose 6C

Glycolysis (NAD → NADH) → Production of 2 ATP

$CH_3-CO-COOH$ Pyruvic acid 2x(3C)

System: yeast

→ CO_2

CH_3-CHO
Acetaldehyde

(NADH → NAD)

CH_3-CH_2OH
Ethyl alchol

Alcoholic fermentation
↓
Products = ethanol + gas (CO_2)
a gas that account for the bubbles in champagne and beer
↓

System: bacteria

(NADH → NAD)

$CH_3-CH(OH)-COOH$

Lactic acid

Acidic fermentation
↓
Souring of milk by lactobacillus
↓
yogurt

Micro (6)

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Microbial nutritional types:

① Autotrophs: primary carbon source is inorganic carbon — CO_2

② Heterotrophs: Dependent on organic carbon compounds.

Autotroph
→ (A) Photoautotroph
→ (B) Chemoautotroph

— (A) Photoautotroph
↓ e.g. cyanobacteria, algae, plants

(A)

$$CO_2 + H_2O \xrightarrow[\text{absorbed by chlorophyll}]{\text{Sunlight}} (CH_2O)_n + O_2$$

$(CH_2O)_n$ = Carbohydrate

(B) $$CO_2 + H_2S \xrightarrow[\text{absorbed by bacteriochlorophyll}]{\text{Sunlight}} (CH_2O)_n + S + H_2O$$

e.g: green or sulphur bacteria

— Chemoautotroph: e.g: methanogens bacteria

$$8H + CO_2 \longrightarrow CH_4 + 2H_2O$$

Methane (natural gas)
(swamp gas)

— Heterotroph
→ Chemoheterotroph
→ Saprobe
→ Parasite

Chemoheterotroph (majority of heterotroph): many bacteria, protozoa, fungi

Saprobe: fungi, bacteria (Decomposers) of plants, animals, dead microbes (Nutrients recycled)

Parasite: bacteria, fungi, Protozoa

Chemoheterotrophs:–

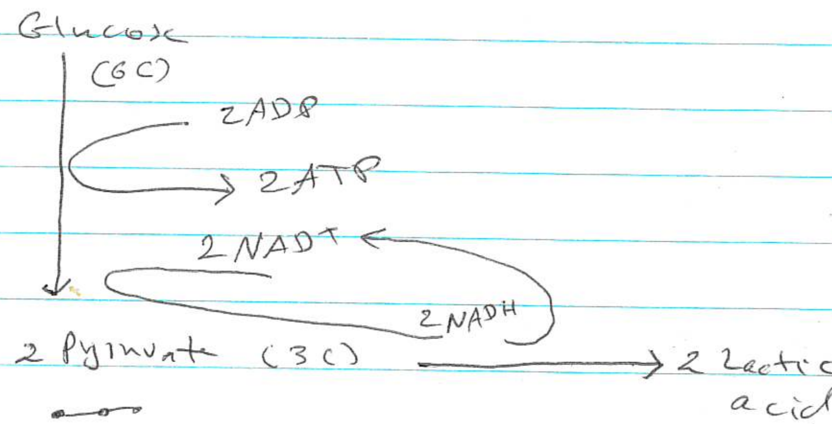
Derive Carbon and energy from organic componds.

Glucose $(CH_2O)_n + O_2 \longrightarrow CO_2 + H_2O$ + Energy (ATP)

e.g. aerobic resipiration or

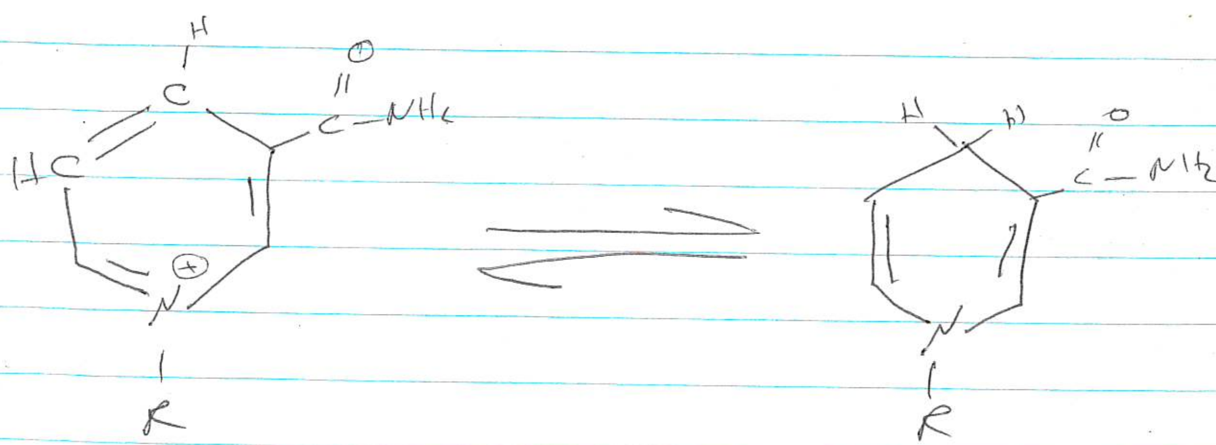
fermentation

Fermentain : anaerobic metabolism : Glycolytic pathway



Reducing power:

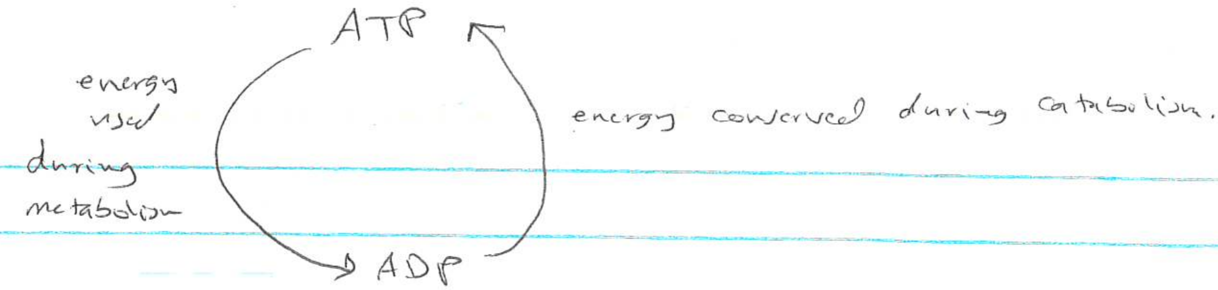
$NAD(P)^+ + 2H \longrightarrow NAD(P)H + H^+$



oxidized $NAD(P)^+$

Reduced NAD(P)H

either NADH or NADPH ⟶ produces 3 ATP

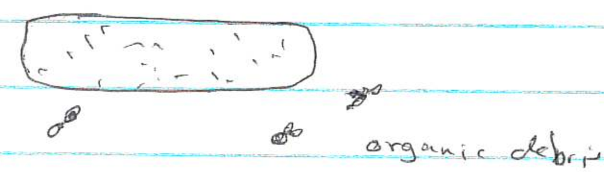


Saprobic Microorganisms:

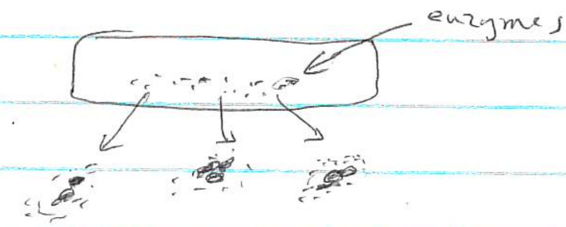
without it earth would gradually filled up with organic materials and nutrients would not be recycled.

Most saprobes: bacteria + fungi

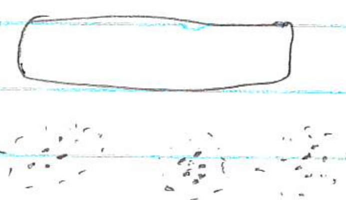
— have a rigid cell wall and cannot engulf large particles of food. To compensate, they release enzymes to extracellular environment and digest the food particles into smaller molecules that can pass freely into cells.



a) walled cell is inflexible

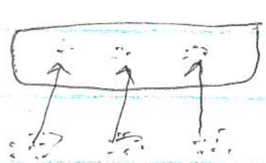


b) Enzymes are transported accross the wall



c) Enzymes hydrolyze the bonds on nutrients

d) smaller molecules are transported into the cytoplasm of cells



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Enivonmental Factors that Influence Microbes:

Temperature Adaptations

Bacterial (Microbial) cells are dependent in adapting to whatever temperature variations of their natural habitats.

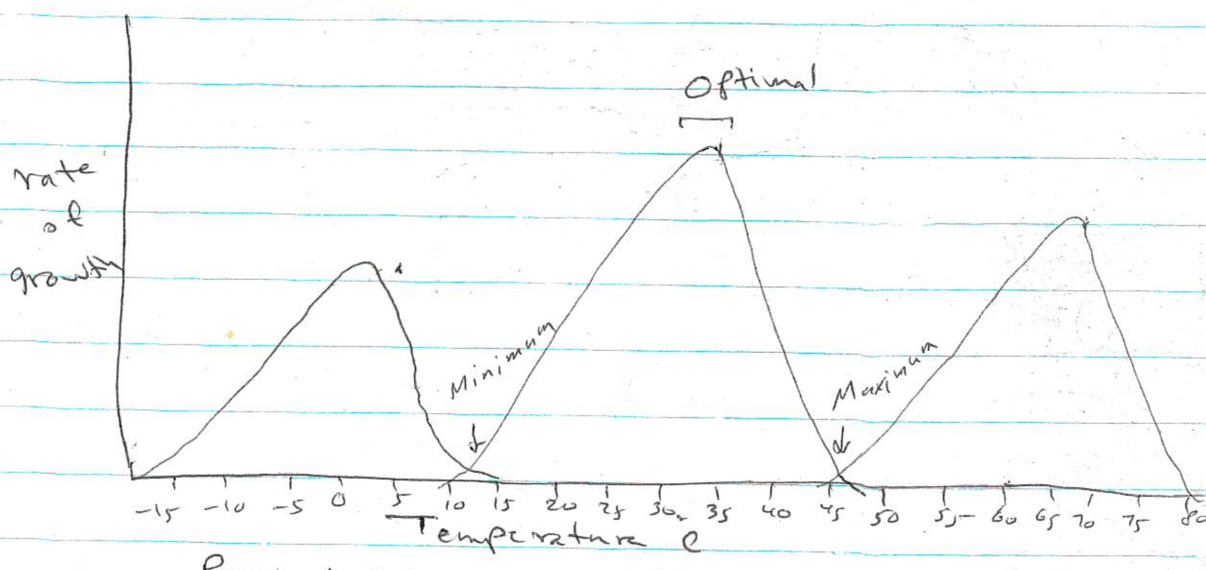
3 ~~kinds~~ range temperatures;

1) Minimal T: is the lowest T that permits continued growth and methabolism

2) Maximum T: is the highest at which growth and metabolism can proceed.

3) Optimal T: promotes the fastest rate ~~of~~ of growth and Metabolism

Ecological groups of T:



a) Psychrophile: has Topt below 15°C, is capable to grow at 0°C, cannot grow above 20°C
bacteria, algae, & bacteria → snowfields & polar ice or deep ocean.

Facultative psychrophiles: grow slowly in cold, e.g. Staphylococcus aureus & Listeria monocytogens are a concern because they can grow in refrigerated food & cause food-borne illness.

b) Mesophiles : Topt = 20-40 °c

Most human pathogens have Topt = 30-40°, human T = 37°c.

c) Thermophiles :: groups can grow:

- 45 — 80 °c
- 80 — 110 °c

there is intense interest in thermal microorganisms by biotechnology companies:

- 1965: thermus aquaticus was isolated from Yellowstone's pool park.
- 1984: Development of the polymerase chain reaction (PCR), a versatile tool for making multiple copies of DNA fragments by using thermus DNA copying enzyme = Taq polymerase which was isolated from thermophilic bacteria Topt = 72°c, withstand T = 95°c, such T is needed to denature DNA for the process of PCR reaction.

PCR is a revolution in modern science.

Yellowstone park has over 10,000 hot springs, biotech companies discovered other enzymes for = application in dairy, brewing, baking — for high T processing.

others are being considered for waste treatment and bioremediation.

<u>Ecological Associations among microorganisms</u>:

association between a) similar e.g: bacteria & bacteria

b) dissimilar : eg. bacteria + plant or animal)

Microbial associations

Symbiotic

Organisms live close nutritional relationships: required by one or both members

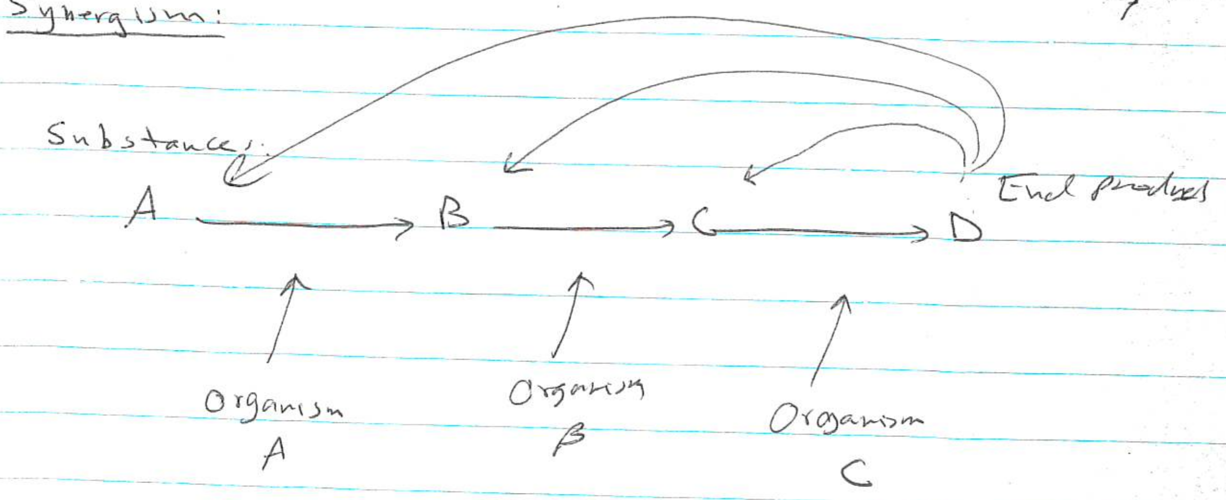
- **Mutualism:** ~~Mutalism~~ obligatory; both members benefit
- **Commensalism:** the commensal benefits; other member not harmed
- **Parasitism:** host harmed

Non-Symbiotic

Organisms are free-living; relationships not required for survival

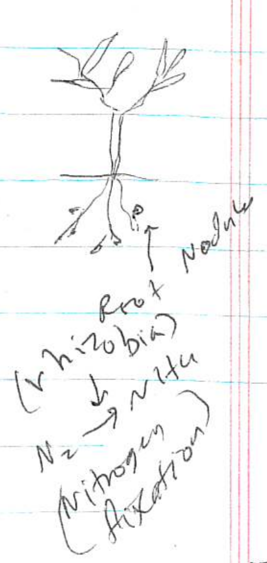
- **Synergism:** Members cooperate and share nutrients
- **Antagonism:** some members are inhibited by others

Synergism:



Each organism performs a specific action on a chemical in the series. The end product useful to all.

Example: Soil bacteria and plant roots, the plant roots provide growth factors, bacteria help fertilize the plant



Antagonism: e.g. Antibiosis: the production of inhibitory compounds called antibiotics: Hundreds of naturally occurring antibiotics isolated from bacteria & fungi.

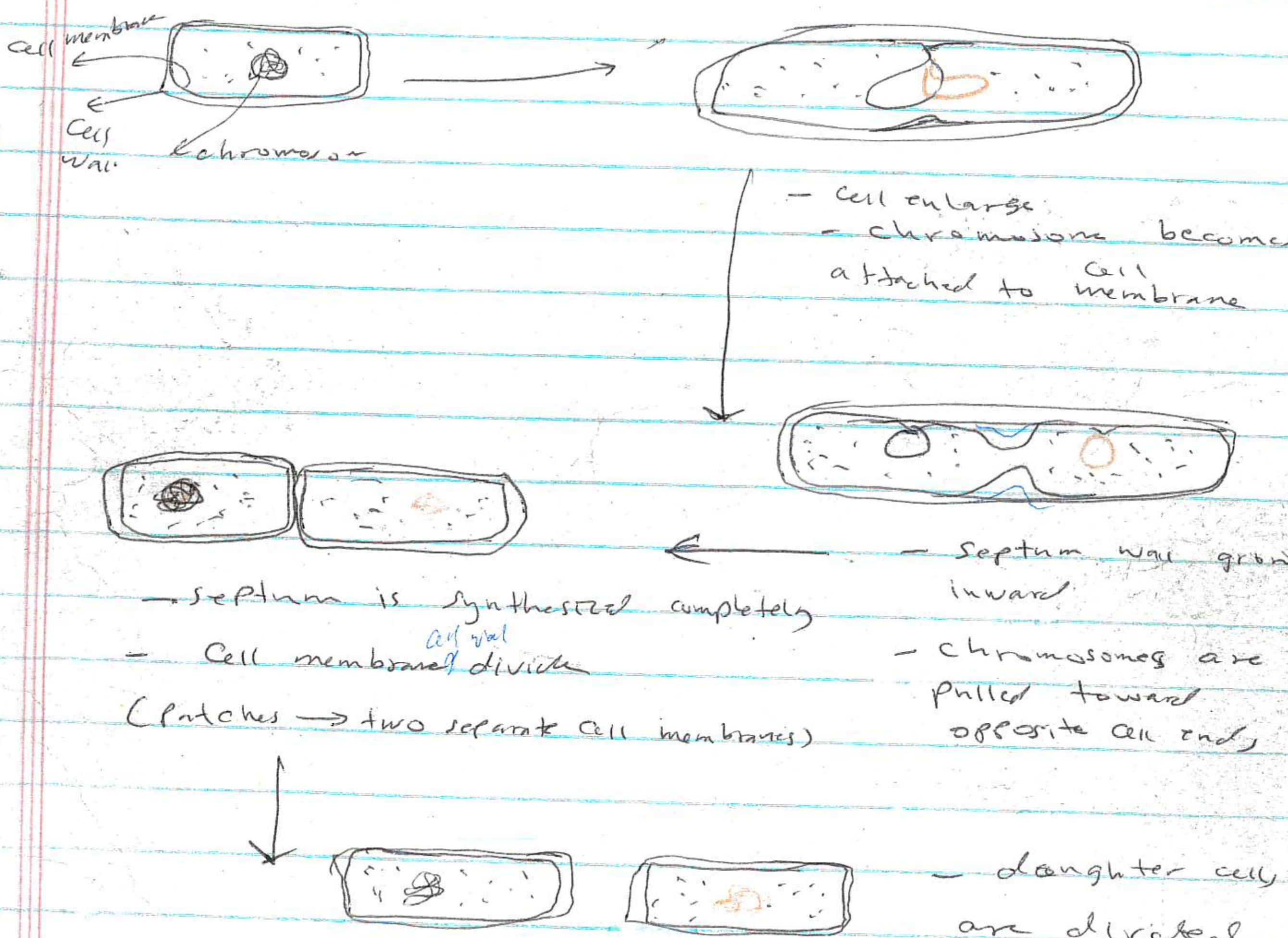
Micro (18)
7/25/04

Microbial Growth:

The basis of population growth: Binary fission:

Binary = means that one cell becomes two
- Parent cell enlarges
- Duplicates its chromosome
- forms a central septum that divides the cell into two daughter cells.

Fig. 7.14



↑ Steps in binary fission of a rod-shaped bacterium

The mathmatics of population growth:

No of Cells	1	2	4	8	16	32	
No of generation		1	2	3	4	5	
Exponential Value		2^1	2^2	2^3	2^4	2^5	

Example: $2^5 = 2 \times 2 \times 2 \times 2 \times 2$

But for 20-30 generations, calculation is tedious

An easier way to calculate the size of population over time is to use an equation:

$$N_f = (N_i)\, 2^n$$

N_f = total number of cells (final)

N_i = initial or starting number

n = exponent denotes the generation no.

2^n = represents the number of cells in that generation.

Example:

Staphylococcus aureus (10 cells) present in egg salad sandwitch after it sits in a warm car for 4 hrs.

N_i = 10 (number of cells deposited in the sandwitch while it was being prepared).

n = 4 hrs = 240 min. Generation time = 20 min

240 ÷ 20 = 12

N_i = 10

$2^n = 2^{12}$, Referring to log tables $2^{12} = 4096$

Final No:

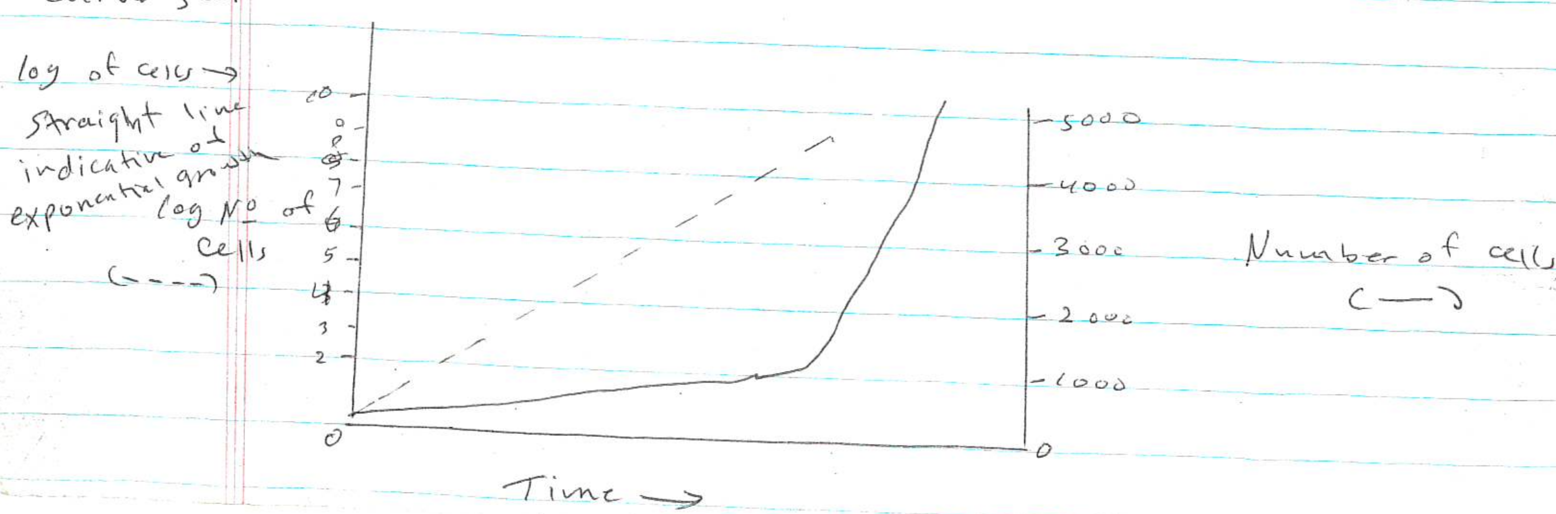
$N_f = 10 \times 4096$

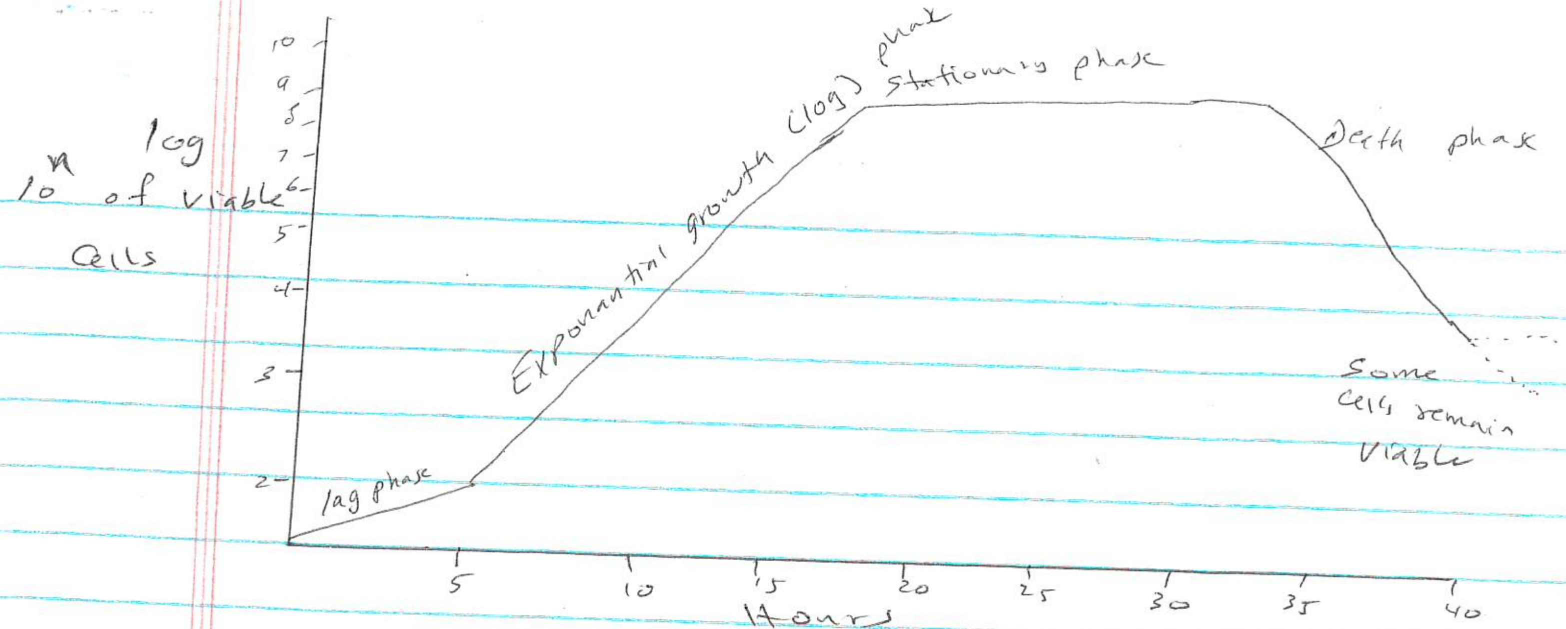
= 40,960 cells in the sandwitch

plotting:

Cell No. arithmetically → curved slope

log of cells → straight line indicative of exponential growth





Practical importance of the Growth curve:

- Understanding the stages of cell growth is crucial for work with culture of microorganisms. Rapid, slow growth and death has important implications in:
- microbial control, - infection, - food microbiology.
- Antimicrobial agents: - heat, - disinfectants } rapidly accelerate the death phase.
- microbes in the exponential phase are more vulnerable to these agents (it disrupts cell membranes, metabolism & binary fission). Microbial cells during exponential phase a) numerous, b) virulent. A person shedding bacteria in the early and middle stage of an infection is more likely to spread it to others than is a person in the late stage of infection.
- Bacterial culture:

it is unwise to continue incubating a culture beyond the stationary phase
1) death
2) selection may be lost
3) plasmids may be lost

- Do stains, motility tests, competent cells on young cultures during the log phase → they show their natural size and correct reactions. Industries uses → fermentors → to produce Vit. & antibiotics.

(Continuous culture)

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Utilization of Energy

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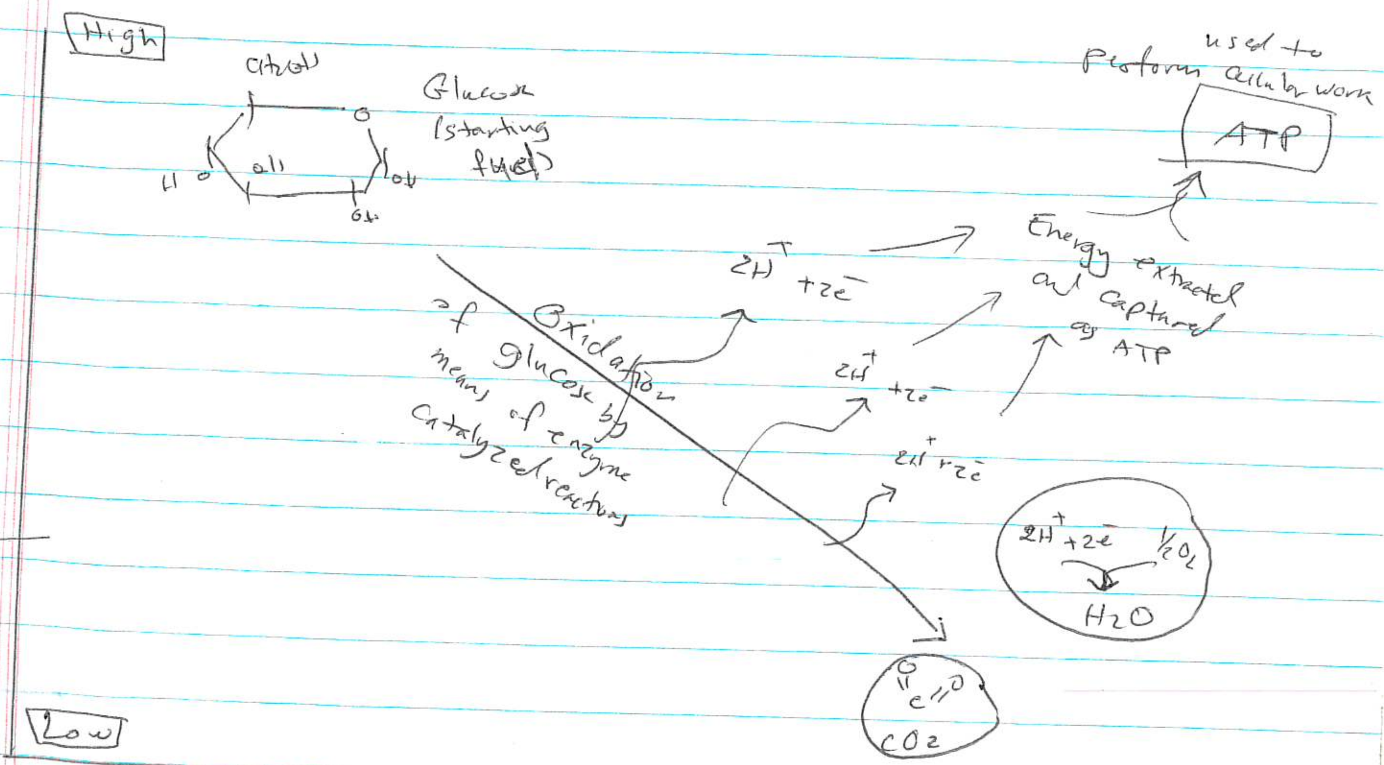
Energy level of Substrate

Fig 8.12



Progress of energy extraction

Glucose ($C_6H_{12}O_6$) + 6O_2 + ~~38~~ 32 ADP + ~~38~~ 32 P_i ⟶ 6CO_2 + 6H_2O + ~~38~~ 32 ATP

The primary catabolism of fuel that results in energy release in many organisms proceeds through a series of 3 - coupled - pathways

1 - Glycolysis :

also called Embden - Meyerhof Pathway

2 - The tricarboxylic acid cycle = TCA = citric acid cycle = Krebs cycle

3 - Respiratory chains =

electron transport and oxidative phosphorylation chains pathways.

Each segment is responsible for a specific set of rxns glu.

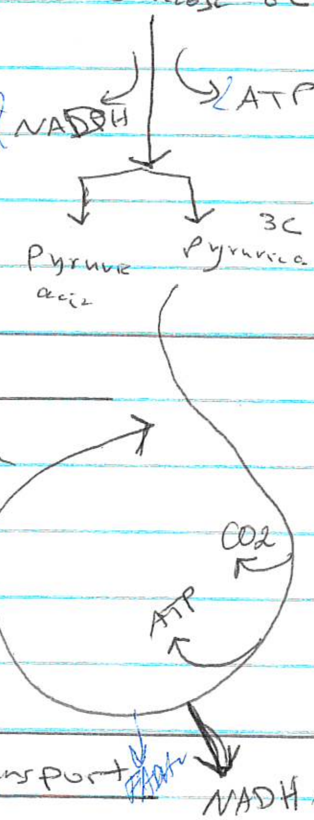
NADH → 2.5 ATP

$FADH_2$ → 1.5 ATP

Fig 8.18

Procaryotic Cell

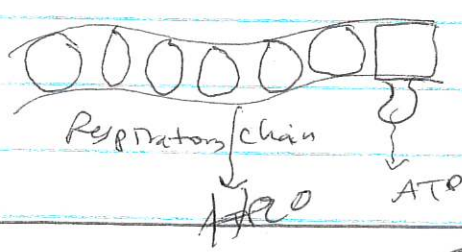
Pathway Involved	Net output	Description
Glycolysis — Occurs in cytoplasm of cells	2 ATP 2 NADH 2 Pyruvic Acid	Anaerobic metabolism Fermentation — NO O_2 required
TCA cycle — occurs in cytoplasm of procaryotes and mitochondria of eucaryotes	6 CO_2 2 ATP 2 $FADH_2$ 8 NADH	— CO_2 is an important product — electrons & H^+ are shuttled via NAD & FAD to electron transport to be used in ATP synthesis.
Electron transport — occurs in the cell membrane of procaryotes and the mitochondria of eucaryotes	30 (28) ATP 6 H_2O	— O_2 is required



Mitochondria

Eucaryotic Cell

Mitochondria

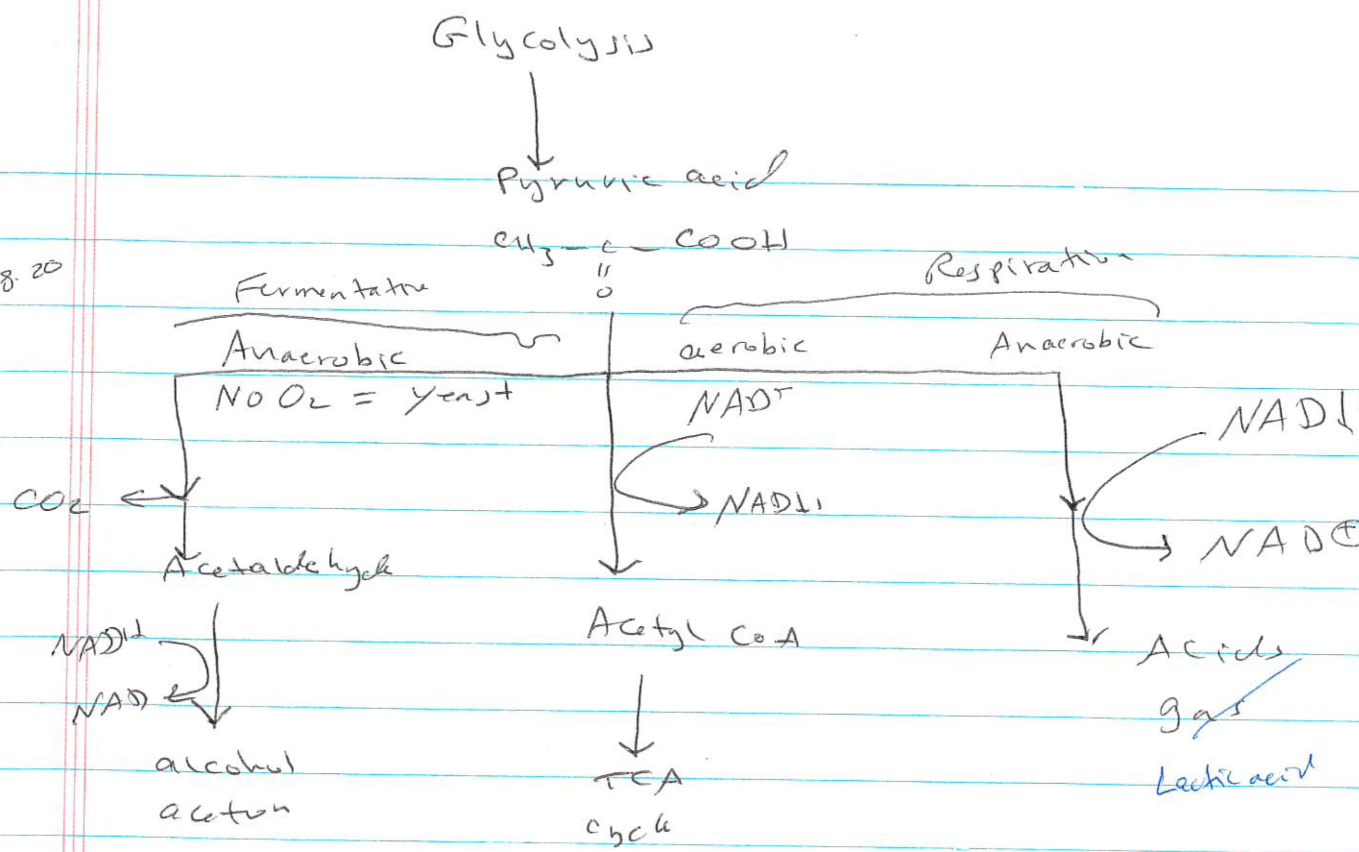


Total 38 ATP
32

Anaerobic metabolism = Fermentation $\xrightarrow[O_2]{NO}$ Glycolysis } 2 ATP

Aerobic ~~Metabolism~~ = Respiration O_2 → Glycolysis, TCA, E- transport } 32 ATP

Fig. 8.20



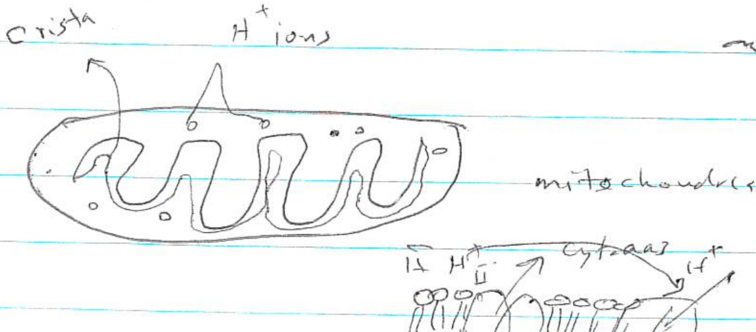
anaerobic respiration

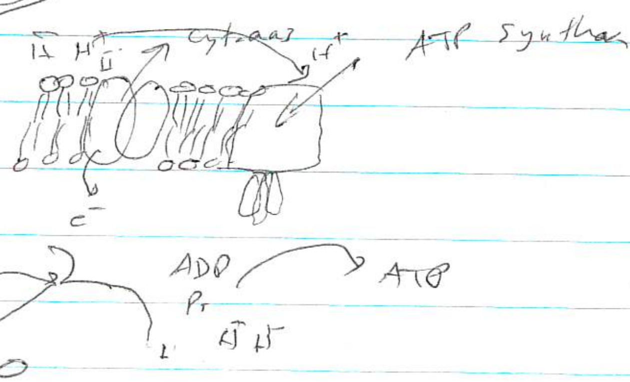
Some bacteria have evolved an anaerobic respiratory system utilizes Oxygen-containing salts, rather than O_2 as the final electron acceptor.

$$NO_3^- + NADH \longrightarrow NO_2^- + H_2O + NAD^+$$

$$NO_2^- \xrightarrow{\text{Nitification}} NO_3^- \quad \text{(nitrate)}$$

$\longrightarrow$ Plants, algae and bacteria





Micro (20) Microbial Genetics

chap 9

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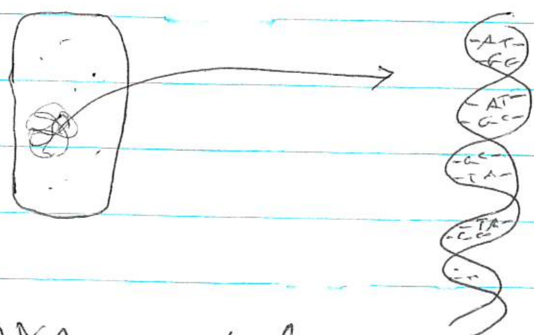
Micobial Genetics → Provides a greater understanding of human genetics

The genetic material is a long molecule of DNA



Molecular leve double stranded DNA

DNA made from

4 - Nucleotide : Adenine = A

Thymine = T

Guanine = G

Cytosine = C

Always Adenine base pair with Thymine

" Guanine " " " Cytosine

A = T 2 H - bonds

G ≡ C 3 H - bond (stronger)

Simple illustration

A - T - G - C - A - C - T

T - A - C - G - T - G - A

location and forms of genome in cells.

Genome = Genetic material of a cell

or: DNA, RNA

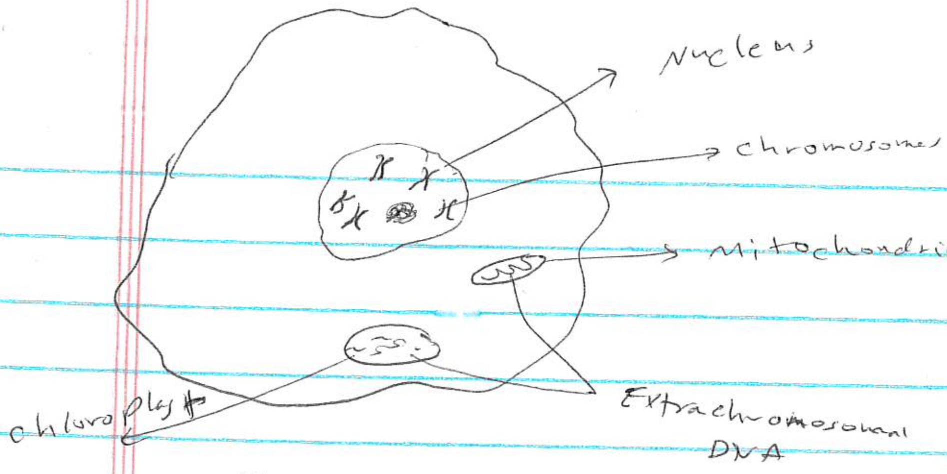
DNA is double stranded

RNA is single stranded,

In RNA : Nucleotides are:

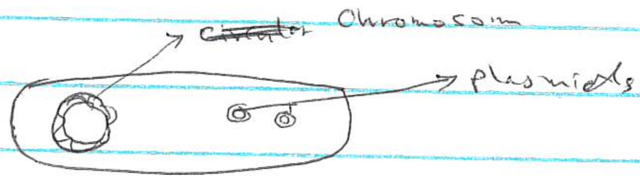
Adenine (A), Uracil (U), Guanine (G), Cytosine (C).

- A - U - C - U - G - U - A -



Eucaryotic cell

Chromosom	N°
Bacteria	1
Human	46
Dog	78
fruit fly	8
Potato	48



Bacteria

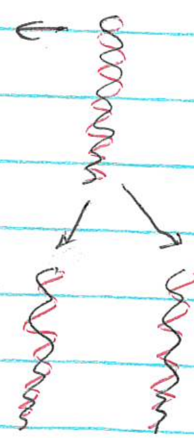
Viruses

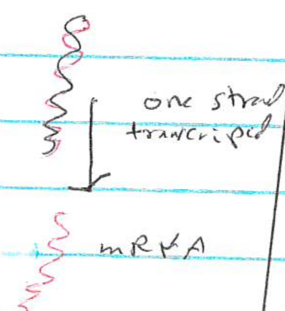
Flow of genetic information in cells.

DNA → RNA → protein

Replication	Transcription	Translation

each strand duplicate one set goes to daughter cells



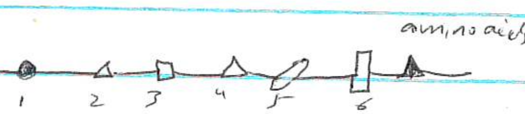


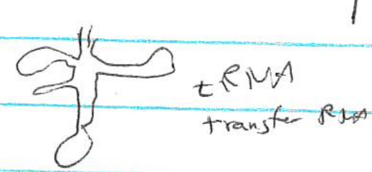
– A – T – G – C – A – G – DNA
– T – A – C – G – T – C

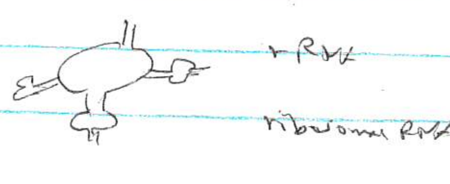
↓ one strand copied (copy of one strand)

– U – A – C – G – U – G mRNA

↓





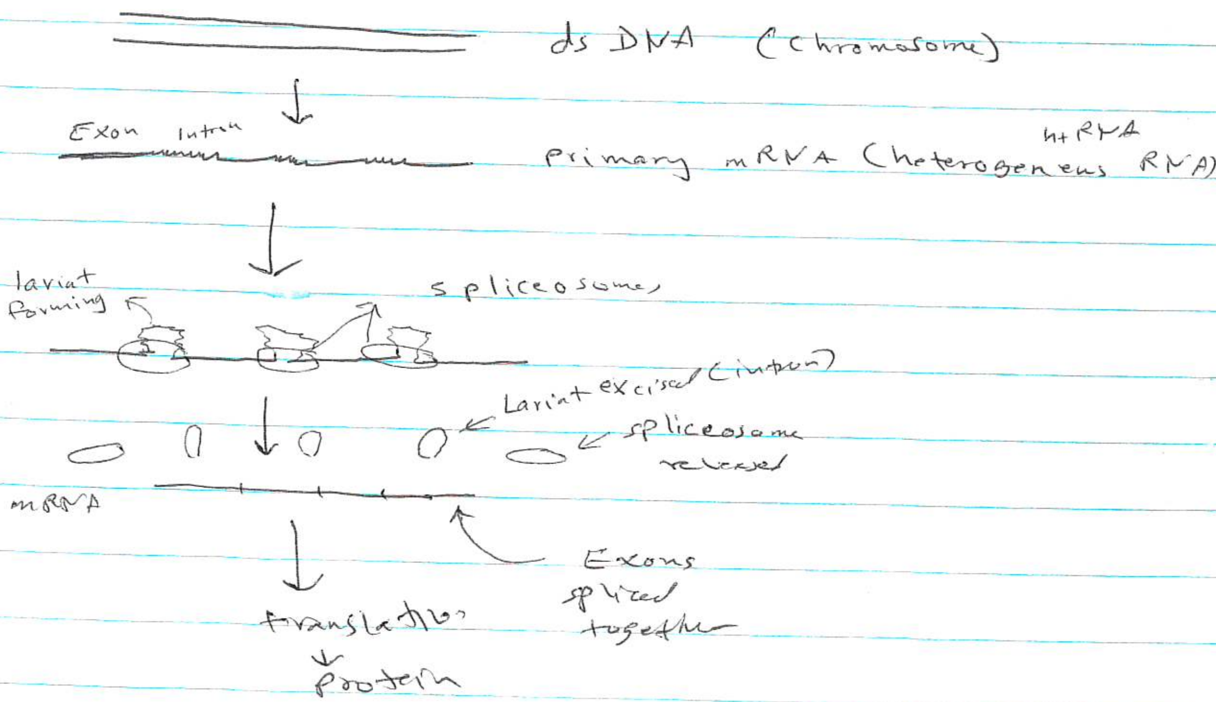


Variations in the order and types of aa will dictate the shape and function of the Protein

Types of ribonucleic acid (RNA).

RNA type	contains codes for	Function in cell	Translated
Messenger (mRNA)	Sequence of amino acids in proteins	Carries the DNA master code to the ribosome	yes
transfer: tRNA	A cloverleaf tRNA to carry amino acids	Bring aa, to ribosome during translation	No
Ribosomal (rRNA)	Several large structural rRNA molecules	Forms the major part of a ribosome and participates in protein synthesis	NO
Micro (mi RNA) Small interfering (siRNA)	Regulatory RNAs	Regulation of gene expression and coiling of chromatin	No
Primer	an RNA that can begin DNA replication	primes DNA	No
Ribozymes	RNA enzymes, parts of splicer enzymes	Remove introns from other RNA, in eucaryotes	No

Exon: coding region
Intron: non-coding



Micro (24)
7/27/04
Chap. 6

The Viruses

Viruses are a group of biological entities known to infect every type of cell ; bacteri, algae, fugi, protozoa, plants and animals.

- Are they alive?

  they are not alive, yet they are able to redirect the metabolism of living cells to reproduce virus particles.

  - Viral replication inside a cell usually cause death or disease of that cell.

- Nuclein acids of viruses

DNA or RNA but not both

DNA → ds DNA, ss DNA

RNA → ss RNA, ds RNA

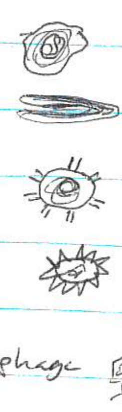
Size Range:

Streptococcus 1 μm

Rickettsia 0.3 μm

E. coli 2 μm long

Yeast cell = 7 μm



1 – Herpes 150 nm = 0.15 μm

2 – Rabies 125 nm = 0.125 μm

4 – HIV 110 nm = 0.11 μm

5 – Influenza 100 nm = 0.10 μm

6 – T2 – bacteriophage 65 nm = 0.065 μm

7 – Yellow fever 21 nm = 0.021 μm

Protein Molecule e.g: Hemoglobin = 15 nm = 0.015 μm

Viral constitnents :

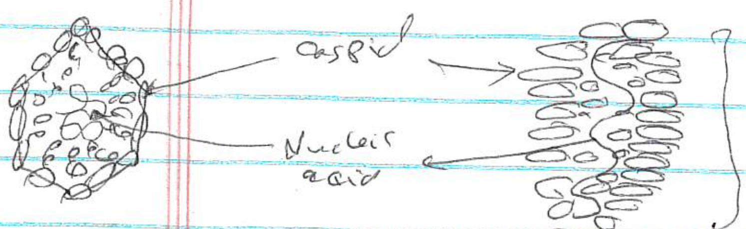
a) caspids b) Nucleic acids c) Envelops

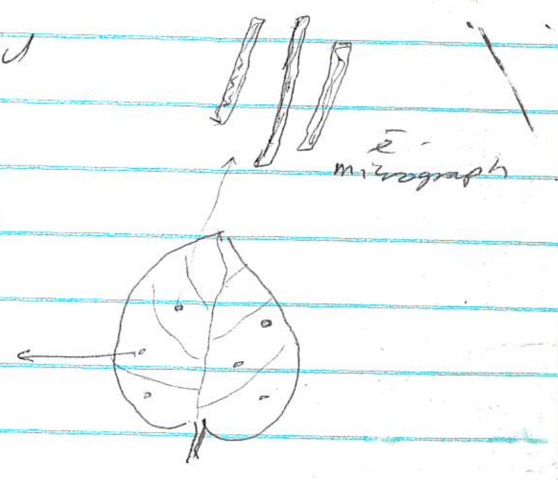
Virus particle
- Covering
  - caspid
  - Envelop (not found in all viruses)
- Central core
  - Nucleic acid molecule DNA or RNA
  - Matrix proteins (enzymes).

- Caspid = a protein form as a shell or box surrounding the nucleic acid in the central core

Structure of virus

a) Naked : Nucleocaspid virus

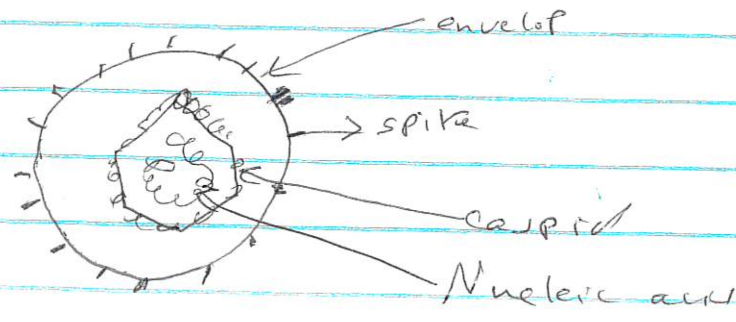




e.g. tobacco mosaic virus

mottled lessions on a tobacco leaf that give tobacco mosiac disease it's name

b) Enveloped virus



e.g: influenza virus

Function of the viral caspid / Envelopes:

Covering a virus is indispensable to viral function:

a) Protects the nucleic acid from

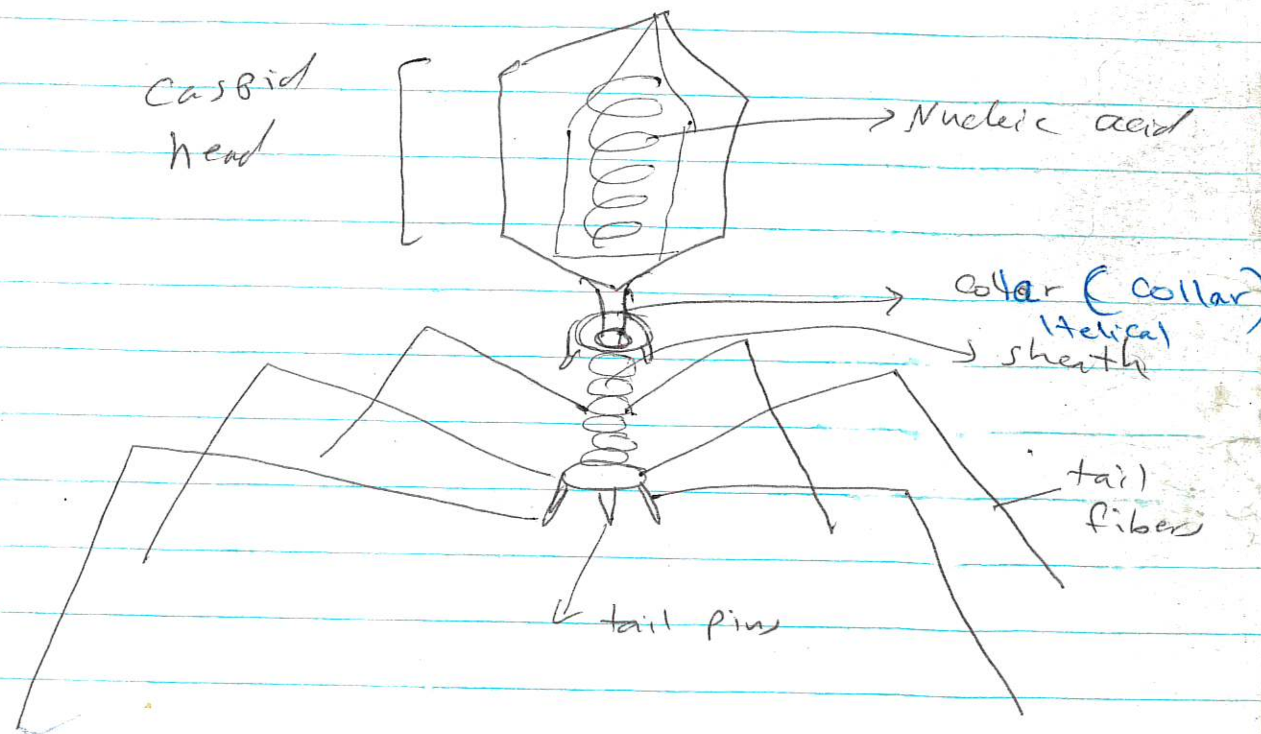
1) various enzymes & chemicals, e.g.: resistant to the acid & digesting enzymes of gastrointestinal tract e.g.: Polio or hepatitis A.

b) Binding to cell surface to pentrate cell host and introduction the viral DNA or RNA (spikes)

— parts of viral caspids → stimulate the immune system to produce antibodies that can neutralize viruses and protect the host cells against future viral infection.

e.g.: flu - shot.

Complex Viruses:



Bacteriophage: polyhedral head, helical tail and fibers to attach to host cells.

Infect E - coli

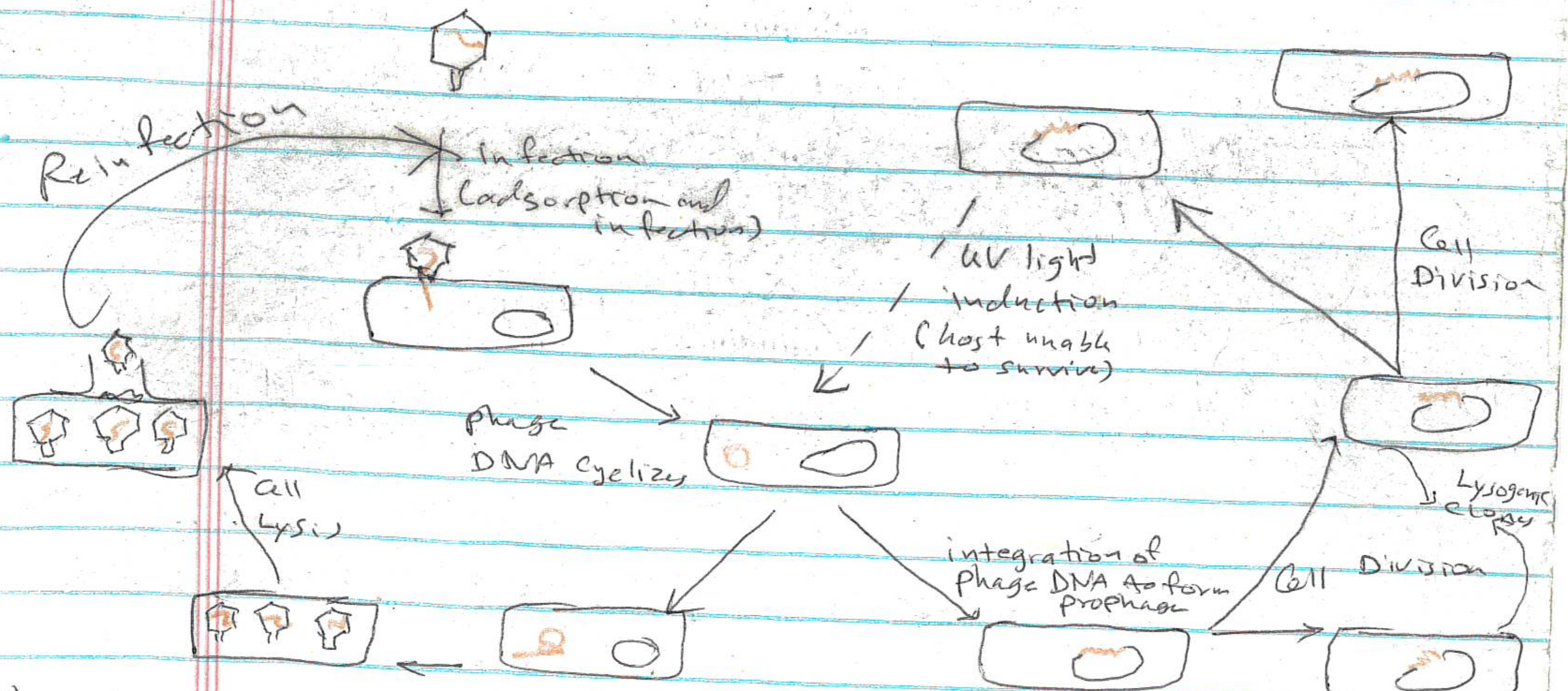
E coli = 4,000 genes, virus = 4 genes to 100 genes
Human = 40,000 (25,000 genes).

Micro (26)

Temperate Bacteriophages and lysogeny:

Lytic cycle : destruction of infected cells
Lysogeny " : No destruction " " "
— — Infected cells → may grow and divide for long periods.
Lysogeny : a relationship between the Phage and its host.
Temperate phage: phages able to enter into lysogeny relation.
Prophage: The latent form of the virus genome that remains within the host but does not destroy it called Prophage

a) Lytic infection   b) Lysogenic infection

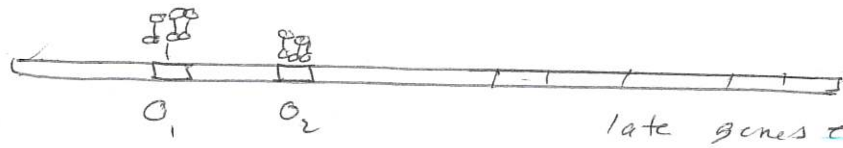


phages heads, tails, and DNA assemble into progeny phage   Phage DNA replicates

Lytic versus Lysogenic infection by Phage Lambda (λ)

Lytic cycle = a protein : gpcro (inducer) is made
lysogenic " = a protein : λ repressor is made
If gpcro is made, then it inhibits the repressor

repressor



operator 1 & 2

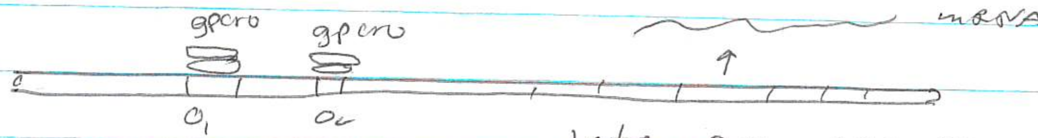
late genes expression blocked

↓

leads to lysogeny cycle.

gene product = gp

C (inducer)



late gene expression

↓

This lead to lytic cycle.

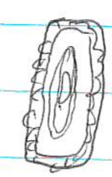
Animal Viruses

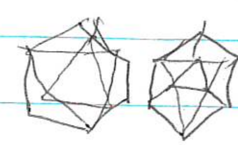
Classification: ① DNA viruses ② RNA viruses

DNA viruses

- Double stranded
  - Enveloped
    - Herpes
      - Type I:
        - Human fever blisters,
        - respiratory infection,
        - encephalitis
      - Type 2
        - genital infections
    - Orthopoxvirus
      - Human smallpox
  - Naked → adenovirus
    - Human respiratory infection
- Single stranded
  - naked
  - e.g.: Parvovirus
  - Human gastroenteritis

Herpes





RNA virus

① DS: e.g. Rotavirus: causes human diarrhea

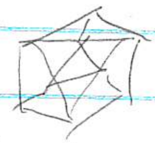
② SS divided into

a) positive ss (+)

e.g: a large family (retroviruses)

— HIV

— Enterovirus :
↓
human polio , Rhinovirus : human common cold

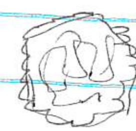


b) (−)ve : Negative ss

Examples:

Influenza virus , Pneumovirus :

Human , Swine Human pneumonia



RNA animal virus reproductive strategies:

Examples: (1) Retroviruses

+ RNA —Reverse transcriptase→ RNA / DNA —Ribonuclease H, degradation of RNA→ DNA —RT→ ds DNA —Transcription→ + RNA → protein

+ RNA → Virion

(2) Negative ss RNA

(causing mumps, measles, influenza)

− RNA —RNA-dependent RNA transcriptase→ + RNA —Translation→ Protein

− RNA —RNA-dependent RNA polymerase ~~(viral replicase)~~ (Viral replicase)→ ds RNA (+,−) → (−) RNA (Virion)

micro (25)
7/28/04

Bacteriophages = Bacterial viruses:

classifications:

1) DNA viruses:

Ds DNA ← → ss DNA

- Most known: bacteriophages
- Most complex forms are the phages with contractile tails: the T-even phage of E. coli, from the family Myoviridae.

2) RNA virses

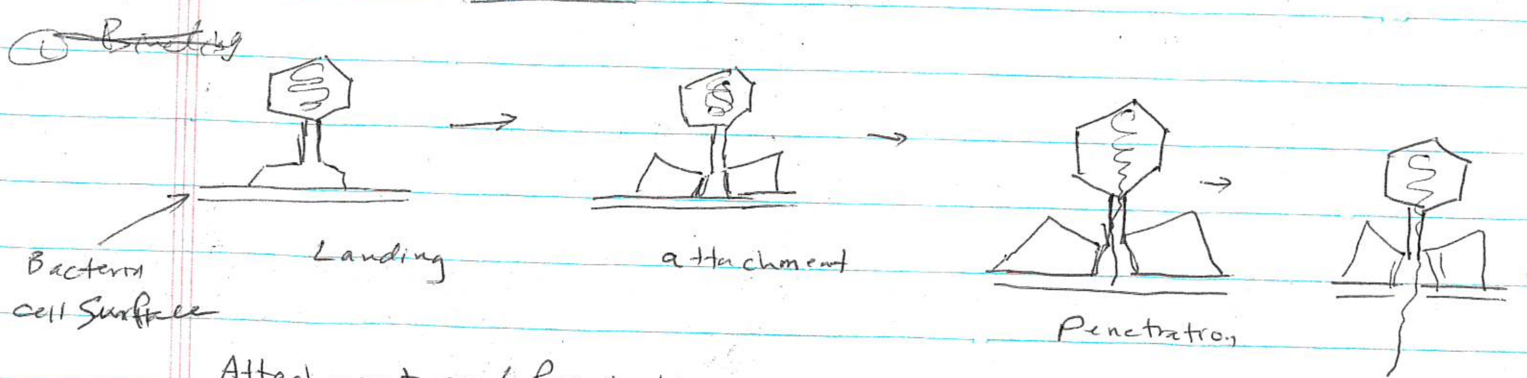
ds RNA ← → ss RNA

T-even phages of E. Coli →

Lytic cycle: E. coli bursting and releasing virions

steps of infection

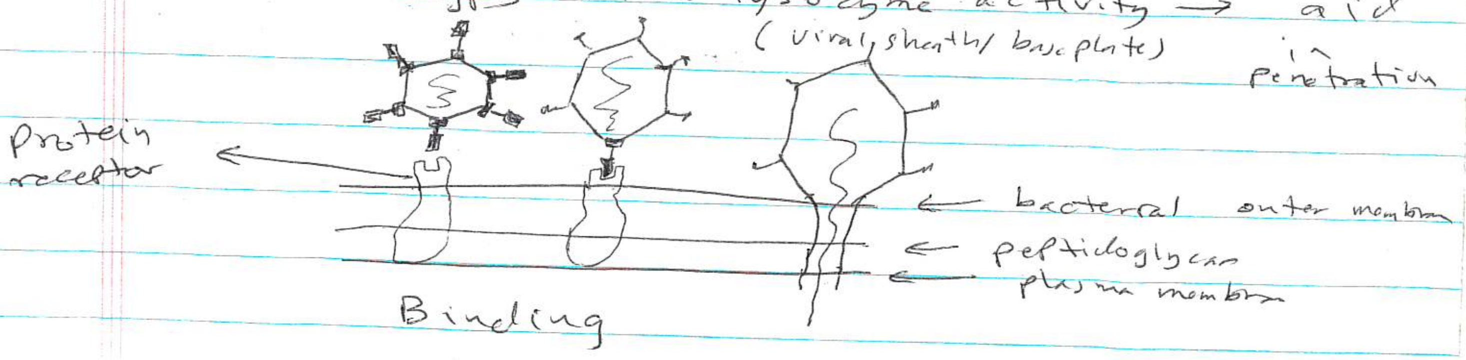
① ~~Binding~~



Attachment and Penetration:

Phage attachment begins with a tail fiber contact, the appropriate receptor site.

- protein gp5 with lysozyme activity → aid in penetration
(viral, sheath/ base plate)



DNA Delivery
(membrane transformation, peptidoglycan degradation).

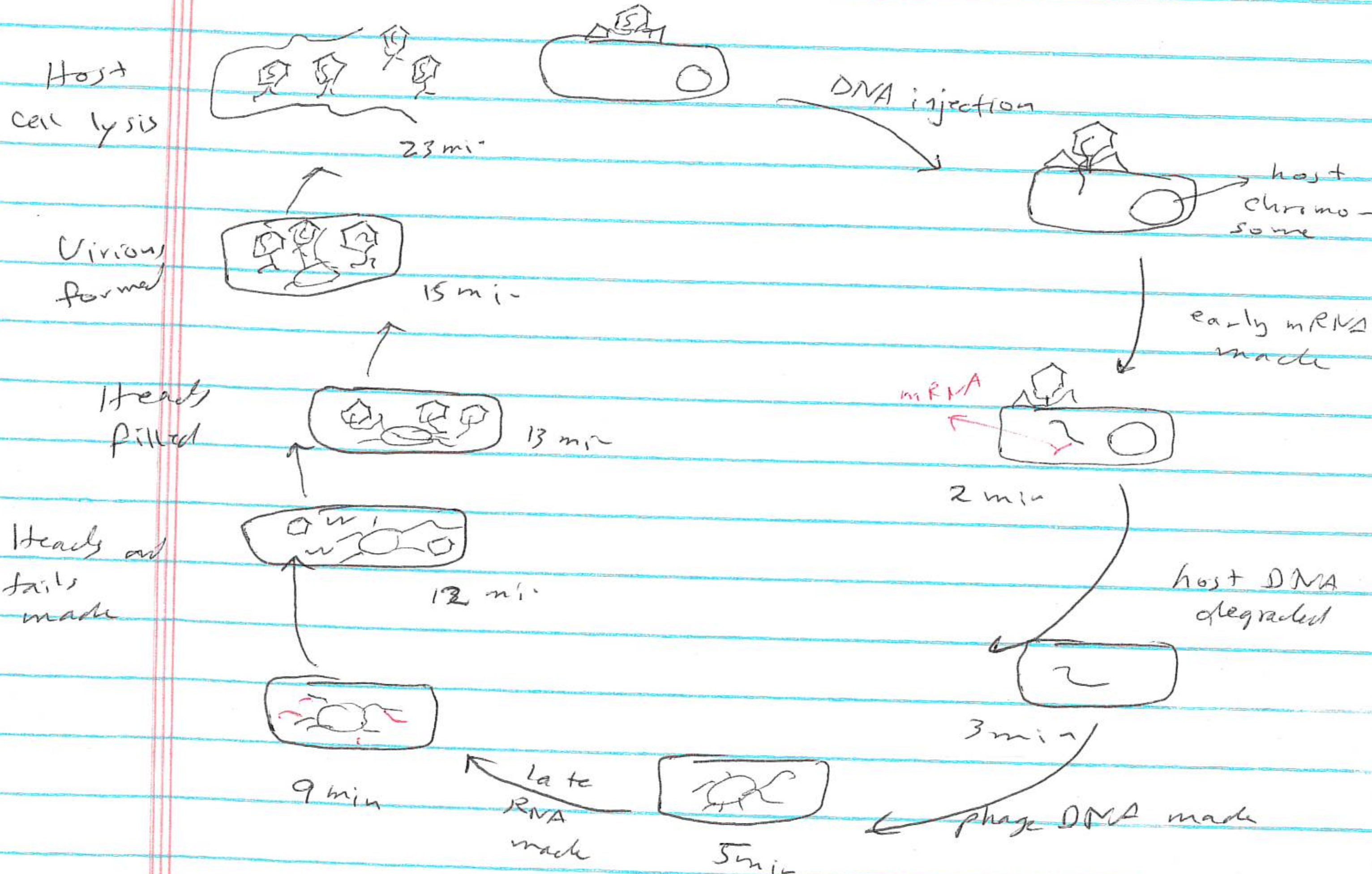
The life cycle of bacteriophages

T4 Bacteriophage of E. coli has been intensely studied, its reproduction will be used as our example.

① Soon after phage DNA injection, the synthesis of host DNA, RNA, and protein is halted

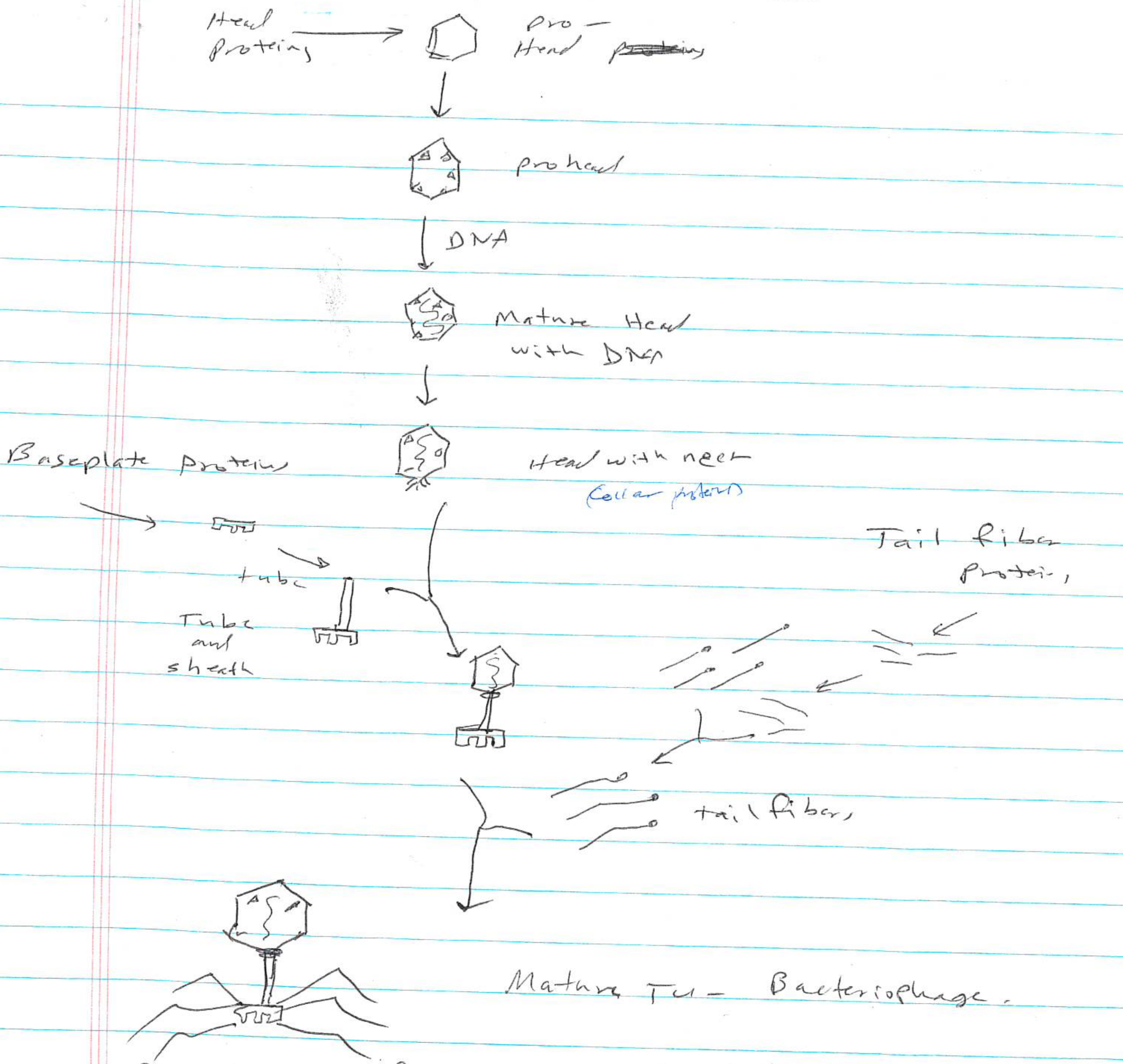
② The cell is forced to make viral constituents

③ E-coli RNA polymerase starts synthesizing phage mRNA within 2 minutes.



- Precise order in which events occur in the reproductive cycle that the expression of T4 genes is tightly regulated for efficient control life cycle.
- Early genes turned on to inhibit transcription of host genes.
- Late genes turned on to make phage head and tail fiber.

The assembly of T4 – Bacteriophage:



Reproduction of single-stranded DNA phages:

Example: phage $\phi X174$ is a small ssDNA phage using E. coli as its host

+ DNA (phage DNA must be converted to a ds)

↓ Bacteria DNA Polymerase

± DNA (RF: replicative form) — replication

Transcription → + mRNA → Translation → proteins

± DNA → + DNA (ss)

proteins + DNA (ss) → New virions.

Genetics of animal viruses:

In all viruses, viral mRNA is translated into viral protein on the host cell ribosomes using host tRNA

DNA viruses:

ds DNA → replicate (duplicate) → ds DNA

ss DNA → ds DNA → ss DNA (only one virus group)

e.g: Hepatitis B, herpesviruses, papilloma viruses = Oncogenic = initiators of cancer

RNA viruses:

(+) ss RNA → (−) ss RNA → (+) ss RNA

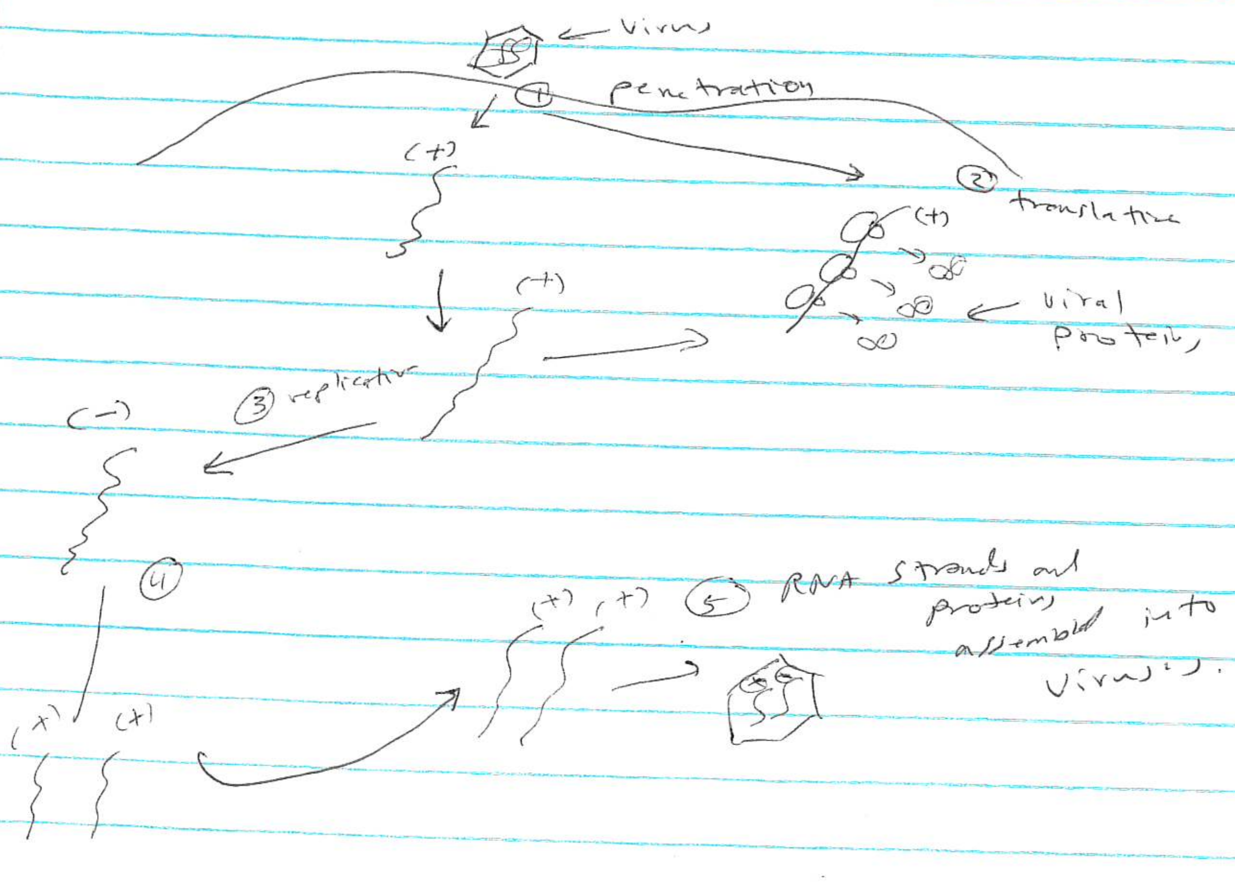
(−) ss RNA → (+) ss RNA → (−) ss RNA

ss RNA → ss DNA → ds DNA → ss RNA (retroviruses)

1) a positive-sense genome (+) that comes ready to be translated into protein,

2) a negative-sense genome (−) that must be converted to positive sense before translation

3) a positive-sense genome (+) that can be converted to DNA



Micro (23)
7/27/04

Transmission of genetic material in bacteria:

DNA transfer between baterial cells involves:

a) small piece of DNA in the form of plasmids

b) Chromosomal fragments.

Mode of transmission:

1) Conjugation 2) Transformation 3) Transduction 4) Transposons

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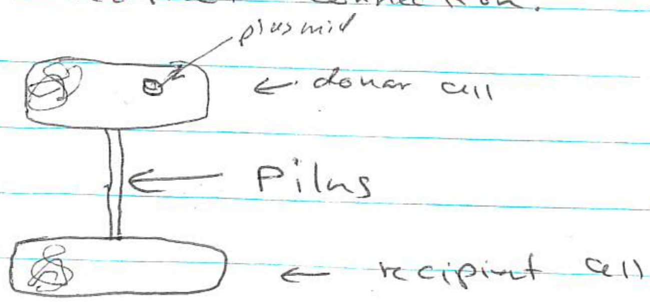
Conjugation: Bacterial sex

Sexual mating in which a plasmid or other genetic material is transferred by a donar to a recipient cell via a direct connection.



Genes transfered: Drug resistance (biomedical importance)

Transfer resistance plasmid or factor can result in resistance to antibiotics: e.g

tetracycline, chloramphenicol, streptomycin, sulfonamid, and penicillin.

- transfer synthesizing virulence factors (toxins, enzymes and adhesion molecules) → that increase the pathogenesity of the bacterial strain.

Attenuation technique:

- 1881 Louis Pasteur developed the vaccination method.

e.g: He grew Bacillus anthracis

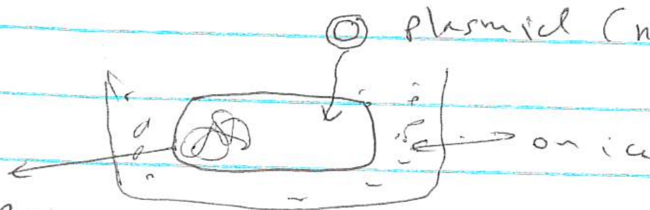
43°C → used this strain as vaccine
(below the max it could tolerate

→ growing bacteria or virus in adverse environments or unconventional host, ⟶ to weaken them ⟶ to produce protective vaccines agains many disease, Attenuation of bateria ⟶ leads to B. anthracis ~~loses~~ loses plasmids when grow at 43°C, and plasmid-free strains are effective, and safe vaccines.

Transformation:

Factors involved; a) DNA fragment / or plasmid b) live competent cell

Genes transferred; unlimited with cloning technique.

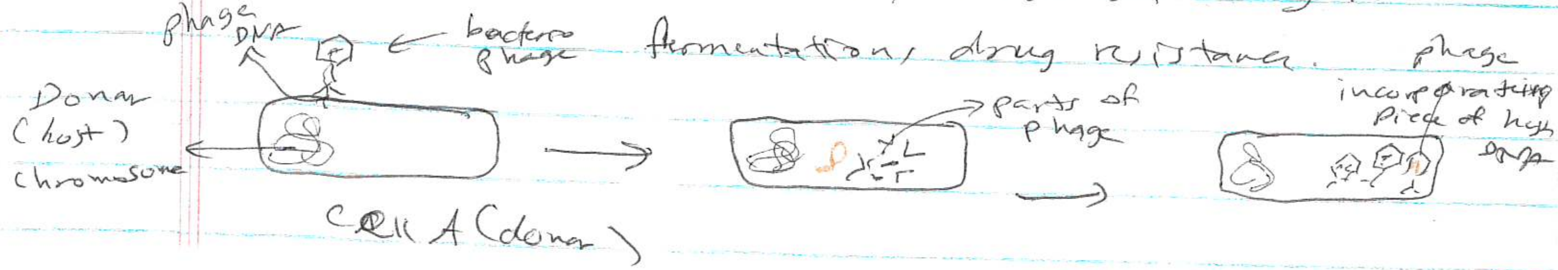


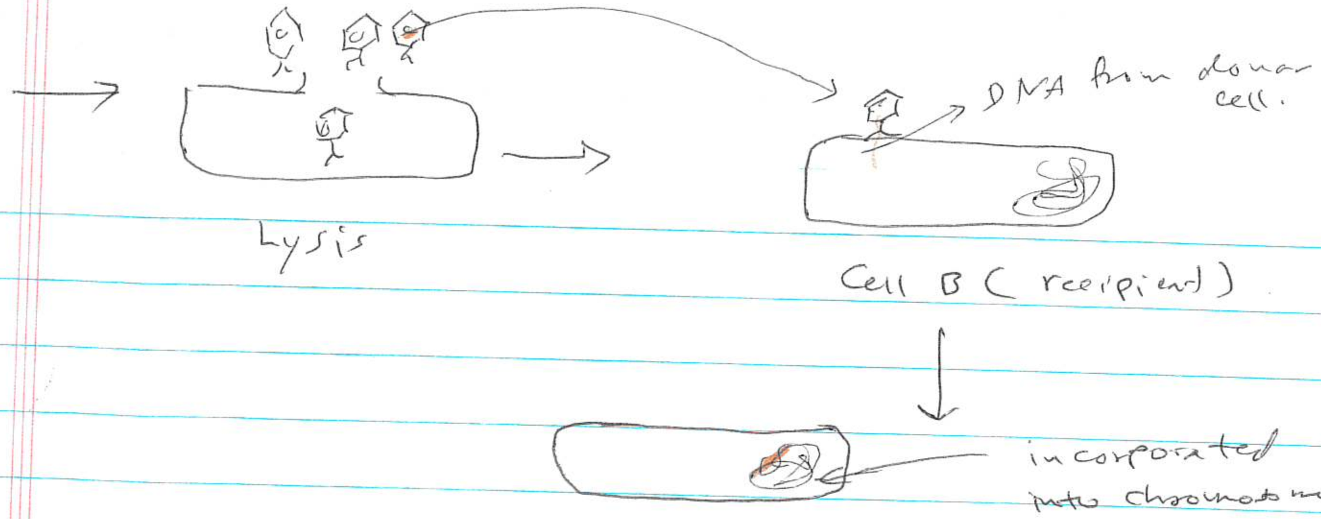
Human genes can be expressed in E.coli to produce e.g. insulin to treat diabetes. This same phenomenon in eukaryotic cells, termed transfection ⟶ genetic engineering yeasts, plants, animal cells, and mice ⟶ curing genetic diseases.

Transduction:

Factors involved. Donar is lysed bacteria cell, defective bacteriophage is the carrier of donar DNA, + live competent cell with same species as donar.

Genes transferred: Toxins, enzymes for sugar fermentation, drug resistance.

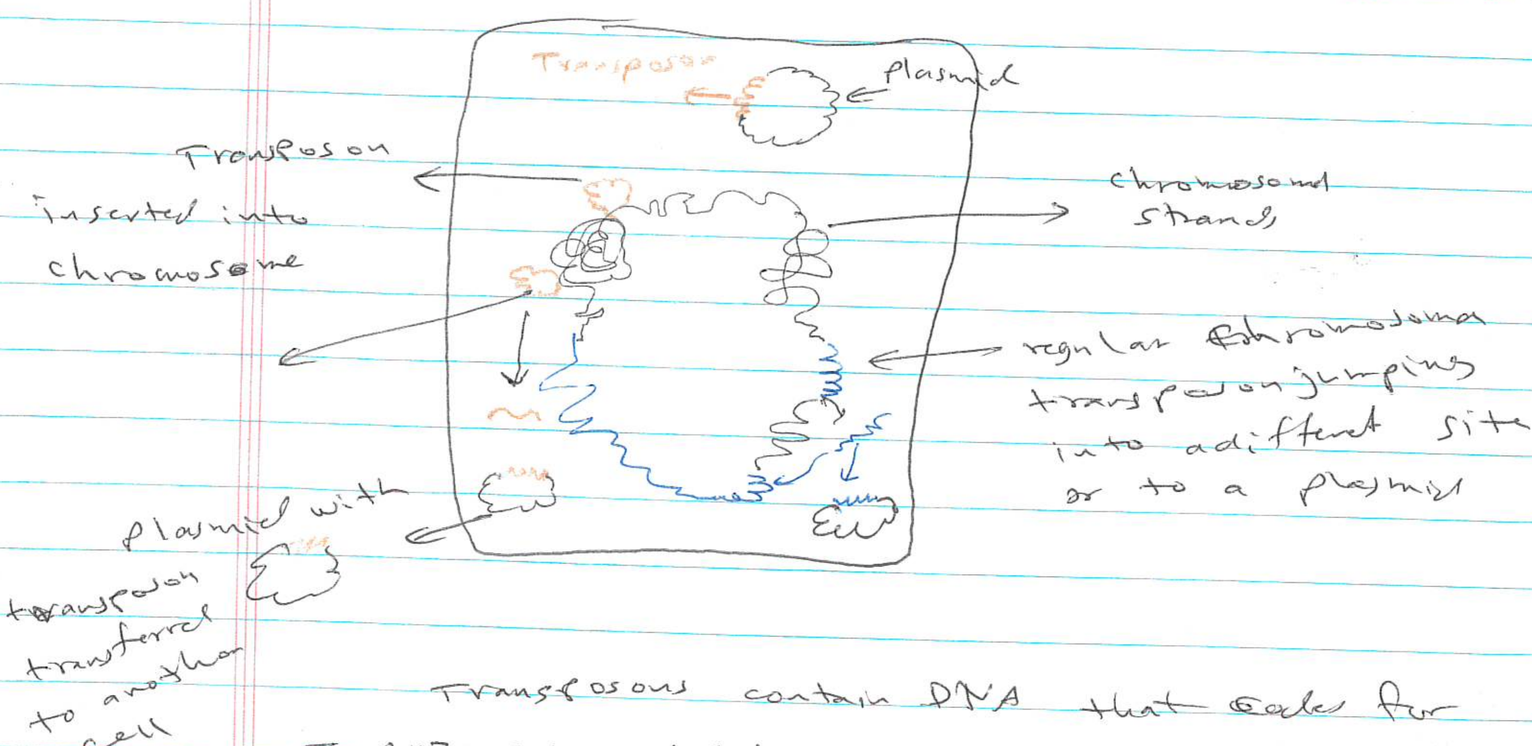




Cell survives utilizes transduced DNA

Transposons: "Gene Jumpin"

shifting from one part of the genome to another



Transposons contain DNA that codes for
- enzymes needed to remove and reintegrate the transposon at another site in the genome.
- Known to be involved.

1 - Create different genetic combinations (variations in Ab)
2 - Change in traits, e.g. pigmentation
3 - replacement of damaged DNA
4 - intermicrobial transfer of drug resistance in bacteria