



Varsity 'Ka' Admission Program-2020

BIOLOGY

Lecture : B-01

Chapter 4 : Microorganisms (1st Paper)



Important Topics of This Chapter:

- Virus ✓ ~~✗~~
- Economical Importance of Virus ~~✗✗✗~~
- Diseases caused by viruses ~~✗✗~~
- Bacteria ~~✗✗~~
- Economic importance of Bacteria ~~✗✗✗~~
- Malarial parasite ~~✗✗~~

What is virus?

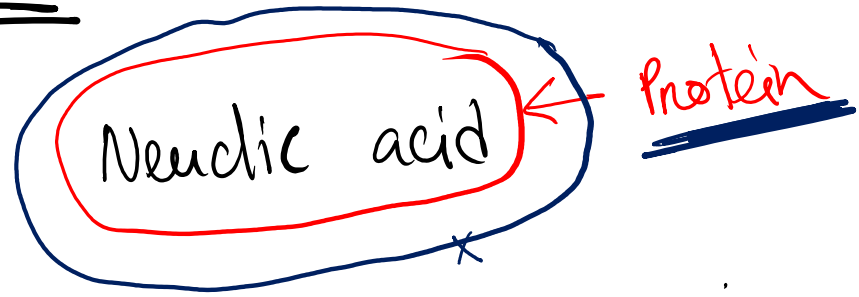
Virus is an acellular, ultra microscopic, obligate parasite which is composed of centrally located nucleic acid and covered by protein, capable of causing disease inside the living body but remains inactive outside living cells

History of discovery of virus

MCS

- In 1796 **Edward Jenner** mentioned about the **first viral disease Small Pox**
- TMV was the first discovered virus. Scientist **Adolf Meyer** mentioned it as Tobacco Mosaic Disease
- **DIMITRY IVONOVOSKY** proved that the pathogen behind tobacco mosaic disease cant be separated after being filtered by bacteria preventing filter. He is known as the **FATHER OF VIRUS DISCOVERY**
- **STANLEY** separated virus as crystal and for this achievement he was awarded **NOBEL PRIZE** in **1946**

TMV



Non-living/Chemical Characteristics

- Virus does not contain cellular properties, like- cell wall, cell membrane and cytoplasm; that is why they are acellular and ultramicroscopic. They do not contain cytoplasm, cell membrane, cell wall, ribosome and mitochondria. They lack metabolic enzyme and property.

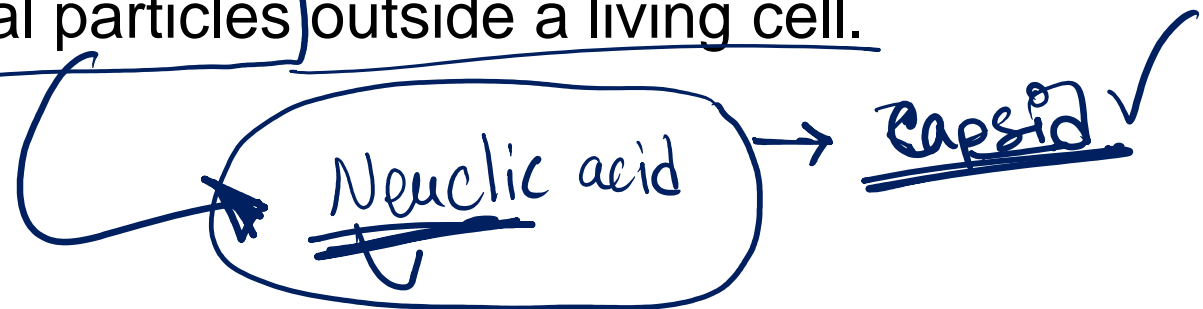
• Virus is not able to reproduce without the help of living cell.

• **Virus cannot be filtered by bacteria-proof filter.**

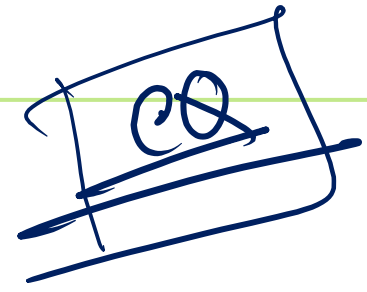
• Virus can be crystallized, centrifuged, diffused, suspended in water and precipitated.

• Viruses are inactive like chemical particles outside a living cell.

• Virus does not grow.

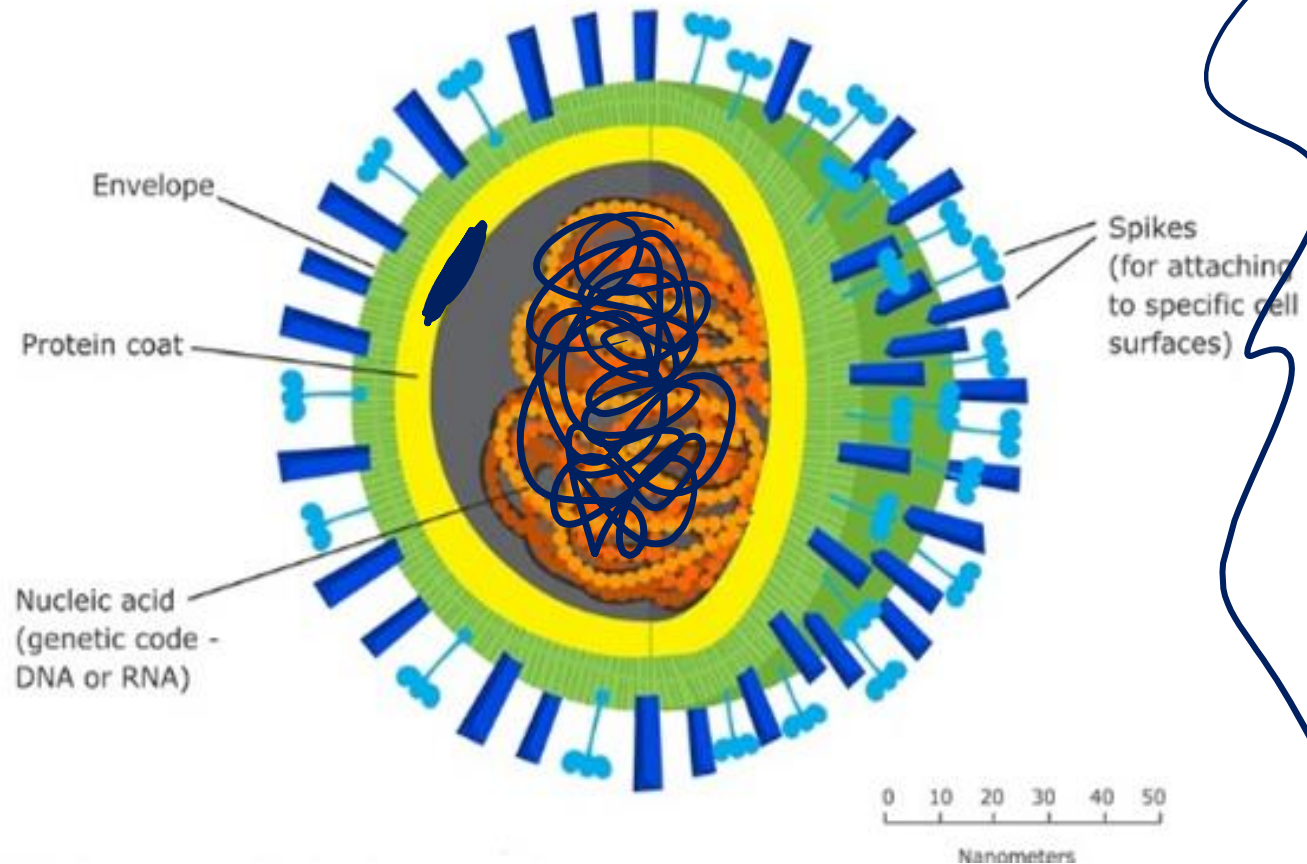


Living Characteristics:



- ❖ Virus can multiply inside host cell. ✓
- ❖ Newly formed virus contains property of ancestor virus.
- ❖ Structurally, virus contains nucleic acid (DNA or RNA).
- ❖ Virus is host-specific, obligatory parasite.
- ❖ Virus can undergo mutation and is able to create new variety.

Structure of Virus:



- i) **Nucleic Acid** (central body. Only DNA or RNA can be found)
- ii) **Protein (capsid)**. It is formed by subunit known as capsomere.
- iii) **Outer layer**

Differently shaped virus



চিত্র ৪.১ : বিভিন্ন আকৃতির ভাইরাস।

Classification of virus According to shape:

mca
super im.

দ্ব্যাক্ষরিক / Rod
দাঁত ছাড়া ও মসৃণ ত্বক্কো

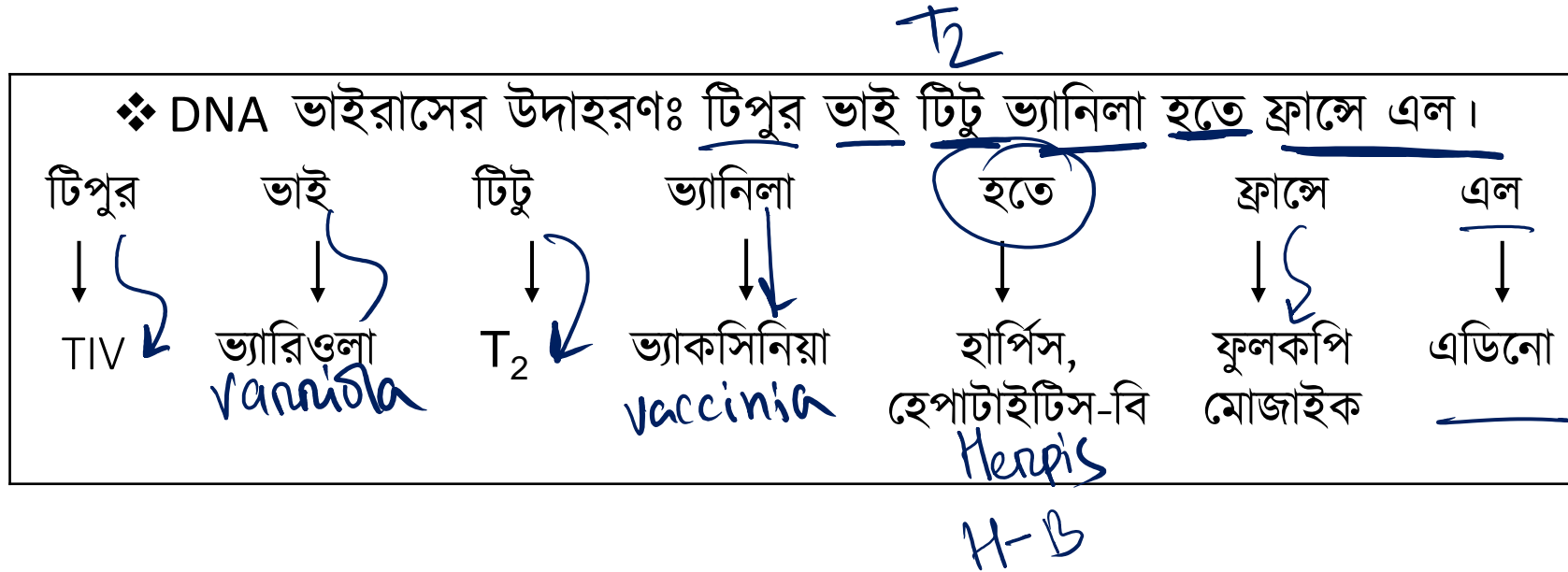
(i) Rod-shaped	Tobacco Mosaic Virus, Alpha Mosaic, TMV, Mumps Virus.
(ii) SPHERICAL	Polio virus, Dengue virus, HIV, TIV.
(iii) Cubic/bread size/polygonal	Herpes virus, Vaccinia virus.
(iv) Tadpole	T ₂ , T ₄ , T ₆ virus.
(v) Oval	Influenza virus. ✓
(vi) Cylindrical/Filamentous	Ebola Virus, Motor's Streak Virus.

ইহুত্ব মসৃণ সিমিত্র

Acoording to type of nucleic acid present

(i) DNA virus	<ul style="list-style-type: none">● Vaccinia virus, T_2 virus, TIV, Adenoherpes Simplex, Variola etc.
(ii) RNA virus	<ul style="list-style-type: none">● TMV, HIV, Dengue, Polio, Mumps, Rabies etc.● RNA of Reoviridae family virus (Reo virus and virus of dwarf disease of paddy) is double stranded.

Pnemonic for DNA virus

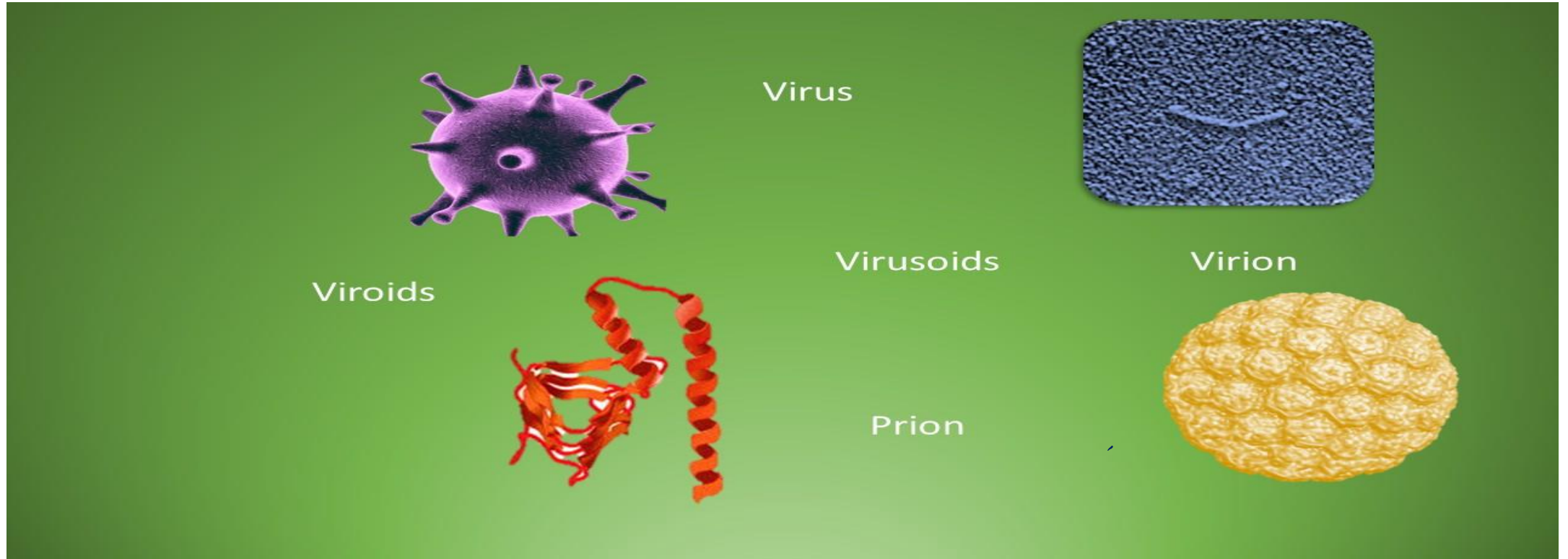


According to outer coating

(i) Non-enveloped virus/naked virus	● TMV, T ₂ virus,
(ii) Enveloped virus	● Influenza, Herpes, HIV virus (lipovirus etc).

RNA VIRUS VS DNA VIRUS

Traits	RNA virus	DNA virus
1. Shape	● They are usually rod shaped or stranded.	● They are usually spherical, tadpole shaped and bread shaped.
2. Nucleic acid	● Their nucleic acid core is RNA.	● Their nucleic acid core is DNA.
3. Infected organisms	● Most plant viruses and cyanophage are RNA virus.	● Most animal viruses and bacteriophage are DNA virus.
4. Stand	● RNA of most viruses are single stranded; except paddy dwarf disease virus and reo virus RNA are double stranded.	● DNA of most viruses are double stranded; except- ΦX_{174} and M_{13} coliphage virus DNA are single stranded.
5. Disease	● Most RNA viruses cause disease in the plant.	● Most DNA viruses cause disease in the animal.
6. Envelop	● Generally envelope is not present.	● Generally envelope is present outside of capsid.
7. Example	● Tobacco Mosaic Virus (TMV), Potato X Virus, Sugarcane Mosaic, Turnip Mosaic, Alpha-Alpha mosaic, Rabies, Polio, Dengue, Yellow fever, Mumps, Measles, Influenza-B, Encephalitis etc. RNA Virus.	● T_2 Virus, Vaccinia, Variola, TIV (Tipula Iridescent Virus) Adenoherpes Simplex, virus etc. are DNA Virus.



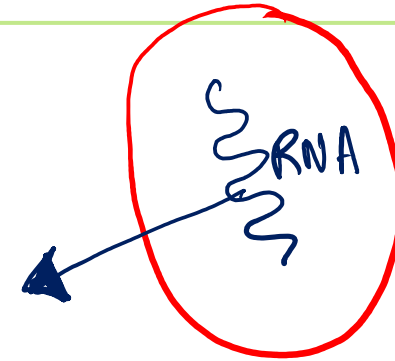
Virion: The complete, infective form of a virus with a core of nucleic acid surrounded by capsid is called virion.

Nucleocapsid: The non-infectious virus is called nucleocapsid.

Viroid:

Viroid

Single stranded, circular RNA..
It can cause disease only in plants.



Prion:

It is a nucleic acid less protein shell.

Prion causes **Kuru and Creutzfeldt** disease of **central nervous system of humans and** Scrapie disease of sheep and goat.

Association of prion with the widely discussed "**Mad Cow**" disease of cow has been found.

Super important

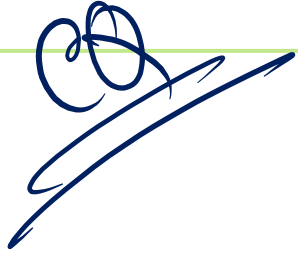
Severe acute respiratory syndrome

Emerging Virus: Virus that can cause disease from primary host to new host. Example: **HIV, SARS, Nile virus, Ebola etc.**

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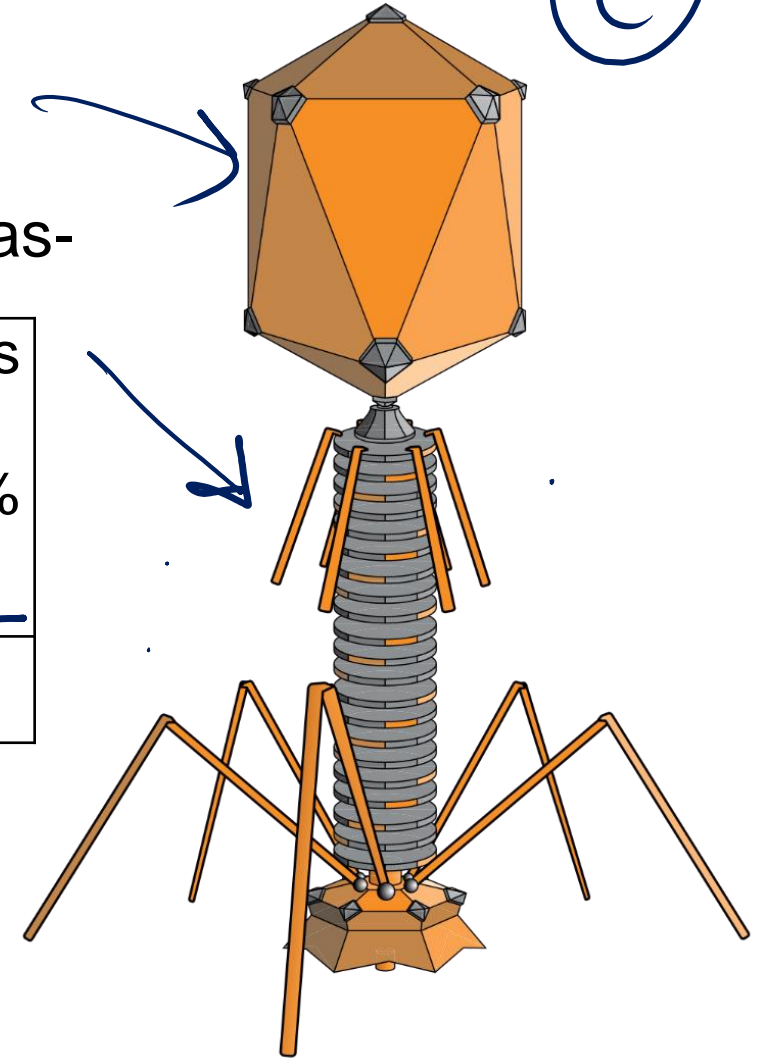


T2 Bacteriophage:



- T2 virus particle can be divided into two parts. Such as-

Head	<ul style="list-style-type: none">• Length is almost 93-100nm and width is 65nm.• DNA is composed of 60,000 base pairs (50% of total weight) and it contains 150 gene.
Tail	<ul style="list-style-type: none">• Length is 95-110nm and width is 15-25nm.



Replication cycle of virus:

Lytic cycle ✓

~~CO*~~

- Step-1: Attachment/ Landing: T_2 bacteriophage attacks *E. coli*.
- Step-2: Entry of phage DNA (Penetration)
- Step-3: Replication
- Step-4: Assembly of virus particles (Assemble)
- Step-5: Release of new virus (Release)

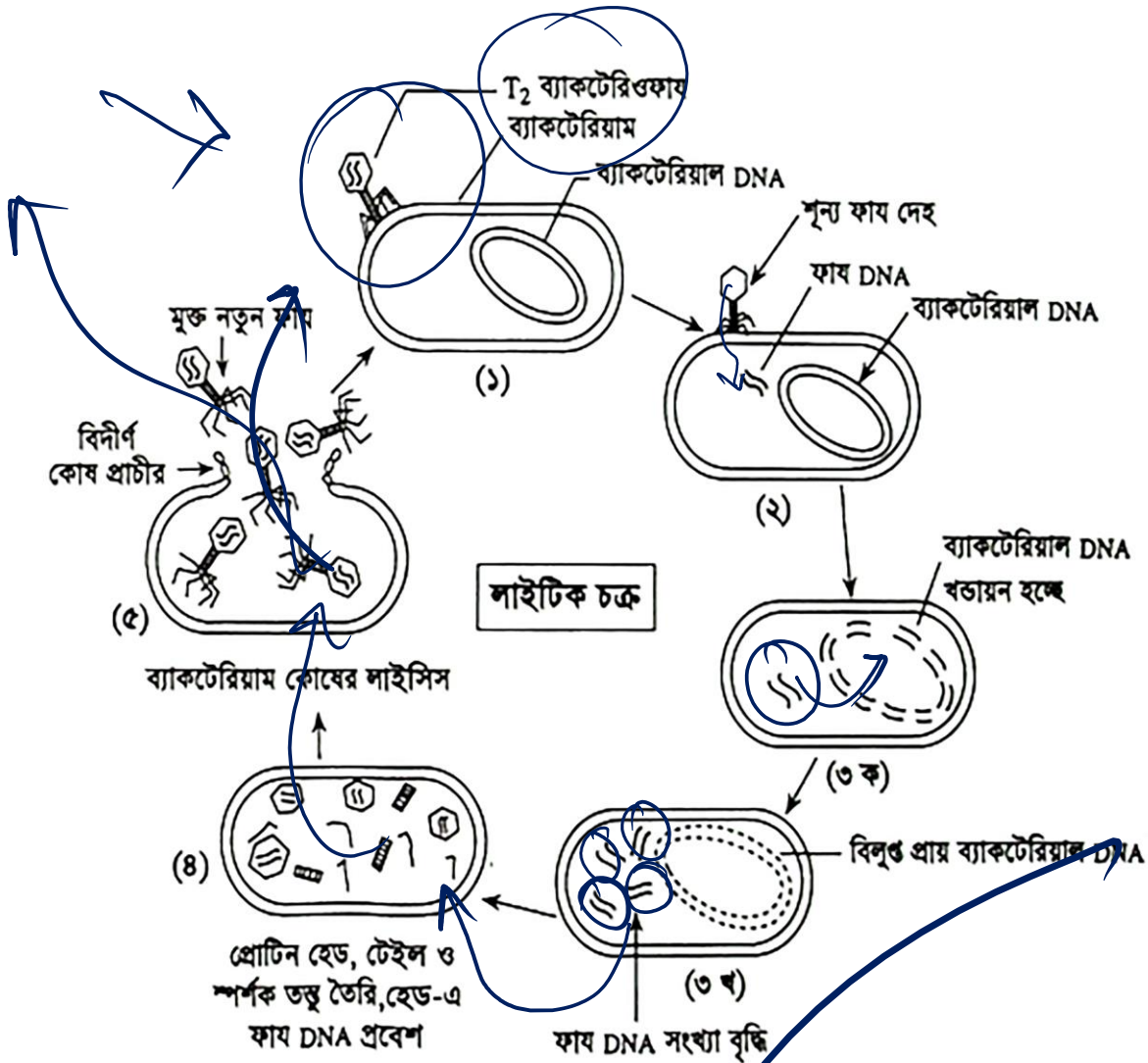
Steps only for MCA

Lysogenic cycle ✓

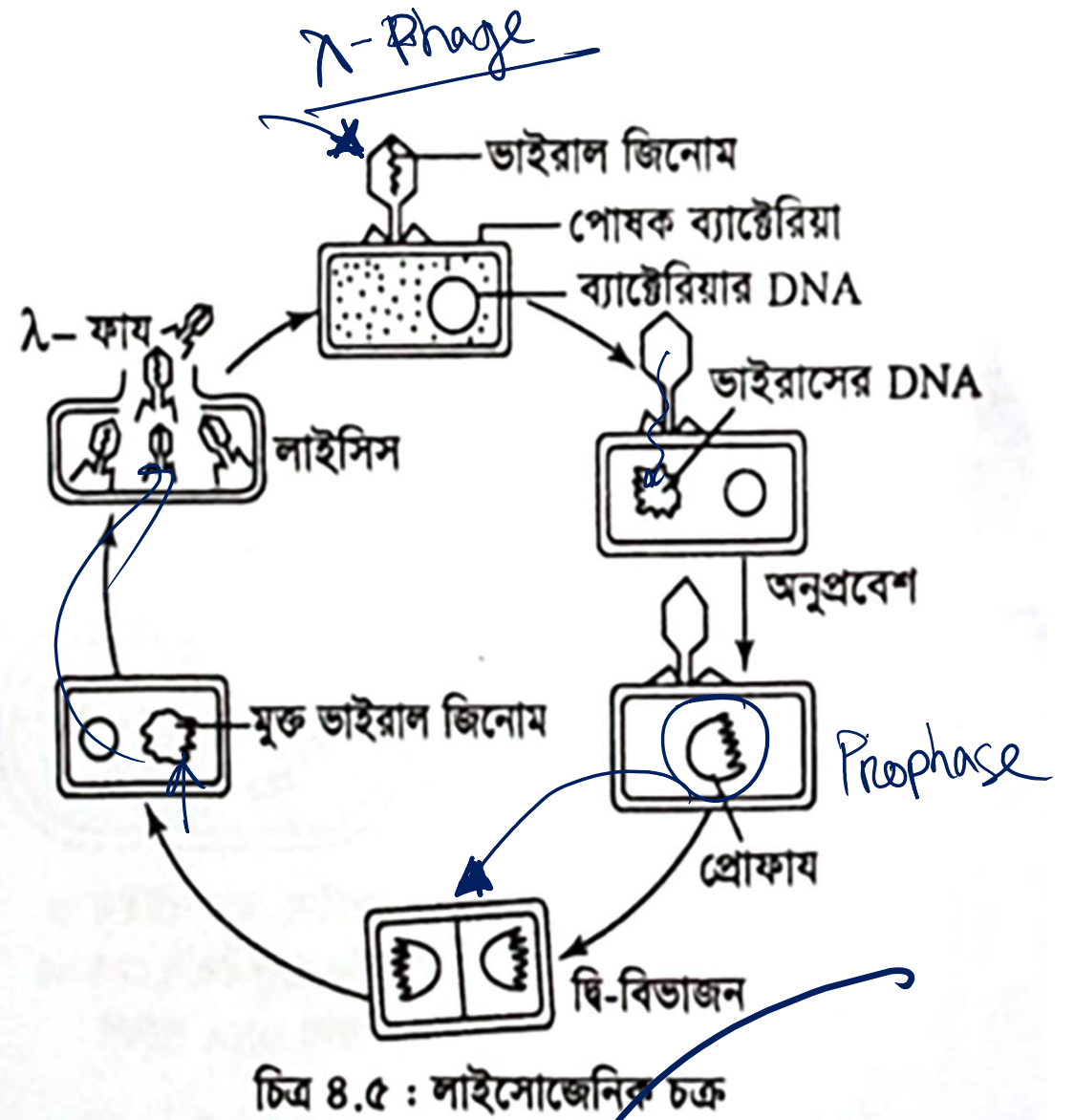
It is seen in lambda phage that infects *E. coli*.

In this cycle, phage DNA enters *E. coli*. Rather than destroying host DNA, it gets integrated into *E. coli* DNA.

Phage



চিত্র ৪.৪ : T₂ ব্যাকটেরিওফায়-এর লাইটিক চক্র।



Poll Question: 01

Which one is a DNA Virus?

- (a) Hepatitis-B
- (b) Chikungunya
- (c) Tobacco mosaic
- (d) Dengue

Benefits of Virus:

(i) As vaccine	● Vaccines of <u>pox</u> , <u>polio</u> , <u>rabies</u> , <u>plague</u> , <u>hepatitis/jaundice</u> disease are produced.
(ii) As medicine	● Production of medicines of <u>Cholera</u> , <u>typhoid</u> , <u>dysentery</u> , <u>plague</u> etc.
(iii) To enhance beauty	● White spots are seen on red tulip flowers when attacked by virus. It is called a broken tulip.
(iv) As an insecticide	● In the United States NPV (Nuclear Polyhydrosis Virus) is applied as insecticide.
(v) Rabbit control	● Myxovirus is used in Australia.
(vi) Genetic Engineering	● The virus is used as a carrier.
(vii) Controlling harmful bacteria	● <u>Bacteriophage</u> is used in the virus.

Disadvantages of Virus:

mca

Name of the disease	Virus
AIDS	HIV
Dengue	Flavi virus of dengue virus
Neonatal Microcephaly	Zika Virus
Chikungunya	Chikungunya Virus
Bird flu	Influenza (H_5N_1) virus

Name of the disease	Virus
SARS	Nipah virus
Rabies	Rabies virus
Smallpox	Variola virus
Chickenpox	Varicella Zoster virus
Cell lysis	Ebola virus

Viral Hepatitis

- ❖ Viral hepatitis is an inflammatory disease of liver..
- ❖ HAV and HEV spread by water. The rest spread by blood.
- ❖ Most hepatitis is caused by HBV.
- ❖ **HCV is called silent killer.**
- ❖ Liver cirrhosis, liver cancer is caused by hepatitis B and C virus.

Characteristics of Hepatitis Virus

Characteristics	HAV	HBV	HCV	HDV	HEV
Virus group	Enterovirus	Hepadna virus	Flavi virus	Incomplete virus	Calici virus
Nucleic acid	RNA	DNA	RNA	RNA	RNA
Size	27 nm	42 nm	30-38 nm	35 nm	27 nm
Latent period	14-28 days	45-180 days	14-180 ays	21-49 days	21-56 days

Bangladesh

BD

Dengue Fever:

Aedes aegypti, *Aedes albopictus* (RNA Virus) and also **Flavi**
Virus

i) <u>General dengue fever</u>	<ul style="list-style-type: none">● Symptoms include rash, back pain, high fever and pain in eye orbit● serology test features the presence of IgM antibody
ii) <u>Hemorrhagic dengue fever</u>	<ul style="list-style-type: none">❖ Bleeding is seen in nose, mouth, jaw and skin of patient.❖ Platelets reduce drastically in blood and blood cannot clot.
iii) <u>Dengue shock syndrome</u>	

Some disease caused by virus:

Chikungunya: It is an RNA virus. Its carrier include *Aedes aegypti*, *A. albopictus*. This virus was first discovered in Tanzania of Africa.

Symptoms: High fever, joint pain, body rash, headache, weakness etc.

Papaya ringspot or mosaic disease: Papaya ringspot virus or PRSV. This virus has two serotypes. (P type & W type)

PRSV-P
PRSV-W
mca

Nipah virus caused disease: It is an RNA virus of family Paramyxoviridae. Its carrier is bat. This virus can spread into human body through raw date juice.

Zika virus caused disease: It is an RNA virus. Its carrier include *Aedes aegypti*, *A. albopictus*. It can cause microcephali in newborn by infecting pregnant mother.

Poll Question: 03

Which virus cause dengue?

- (a) Flavi
- (b) Ebola
- (c) Adeno
- (d) Poty

Bacteria:

- Single celled, prokaryotic, smallest simple microscopic life form containing cell wall.
- Prokaryotic.
- Primary component of cell wall is peptidoglycan/mucoprotein along with muramic acid and teichoic acid.
- They are very sensitive to phage virus.
- Some of them are obligate anaerobes, meaning cannot survive in presence of oxygen. Ex: *Clostridium*. Some are facultative anaerobes, meaning can survive even in presence of oxygen. Some are obligate aerobes, meaning cannot survive without oxygen. Ex: *Azotobacter beijerinckia*.
- They can thrive from -17° to 80° C.
- They can survive up to 50 years in adverse condition by forming endospores.
- Mitosis and meiosis do not occur as they have no chromosome. = amitosis

Structure of Bacteria:

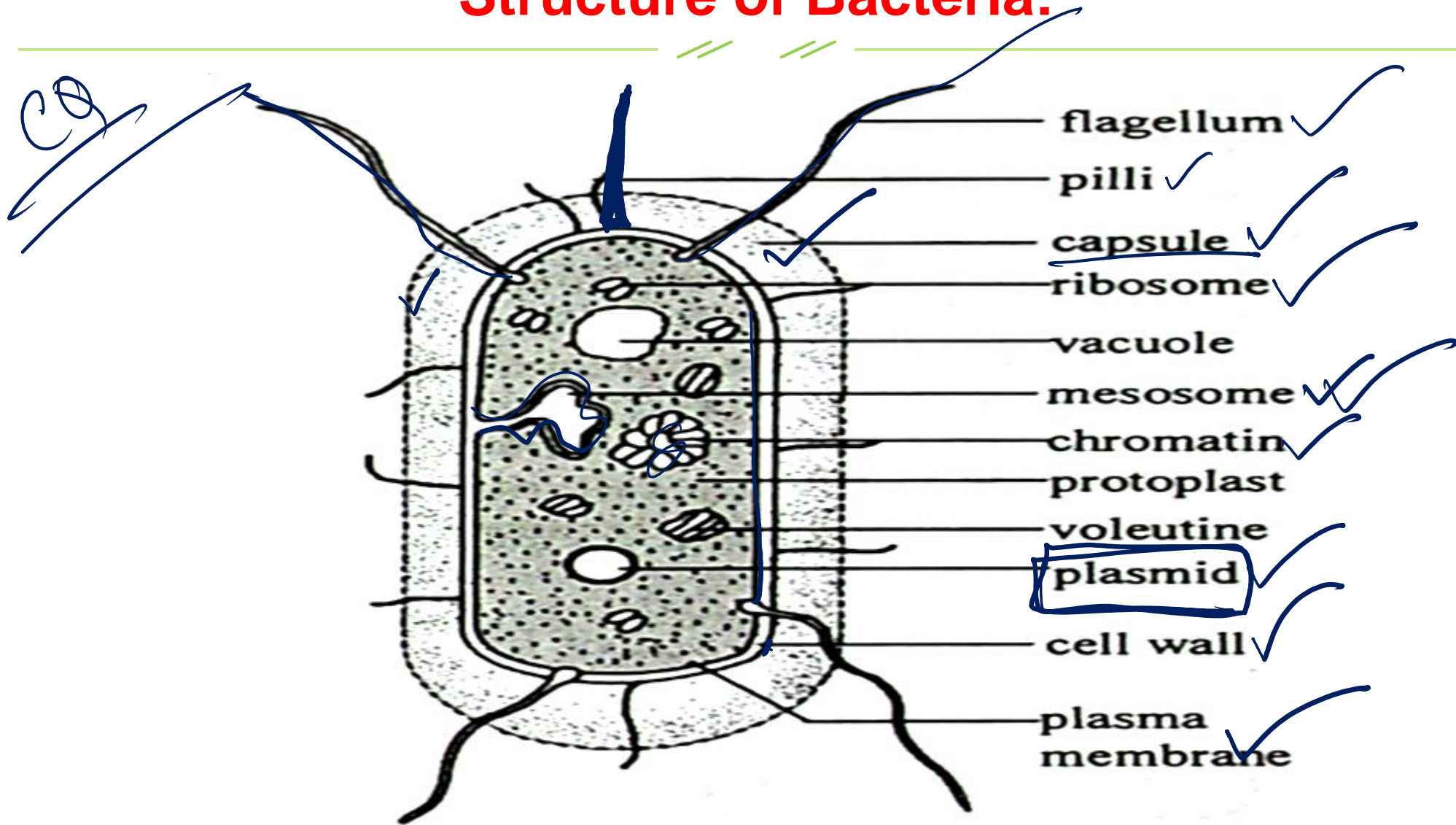
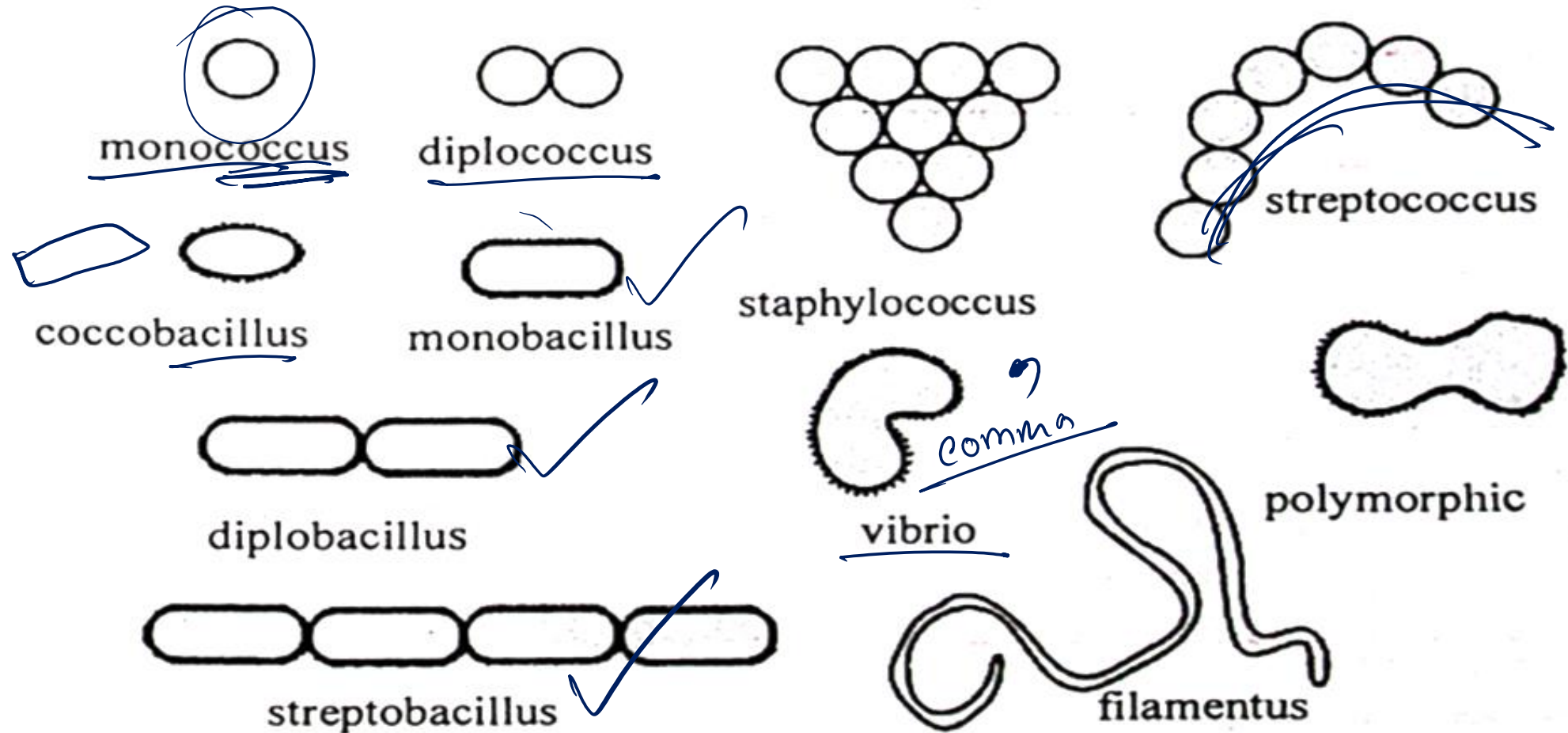


Fig 4.10 Structure of a typical bacterium

Classification of Bacteria:



(a) Based on shape:

1. Coccus	Micrococcus: Micrococcus denitrificans , M. flavus Diplococcus: <u>Diplococcus pneumoniae</u> ✓ Tetracoccus: Gaffkya tetragena Streptococcus: Streptococcus lactis Staphylococcus: Staphylococcus aureus
2. Bacillus	Monobacillus: Bacillus albus, E. coli. Diplobacillus: Moraxella lacunata Streptobacillus: Bacillus tuberculosis, Streptobacillus monilliformis Coccobacillus: Salmonella, <u>Mycobacterium</u> ✓ Palisade bacillus: Lampropedia sp.
3. Spirillum	Spirillum minus
4. Vibrio	Vibrio cholera ✓ <u>Comma</u>
5. Pleomorphic	Rhizobium sp.
6. Stellate	Stella sp.
7. Square	Haloquadratum walsbyi
8. Filamentous	Candidatus. Savagella
9. Hypha	Streptomyces scabies

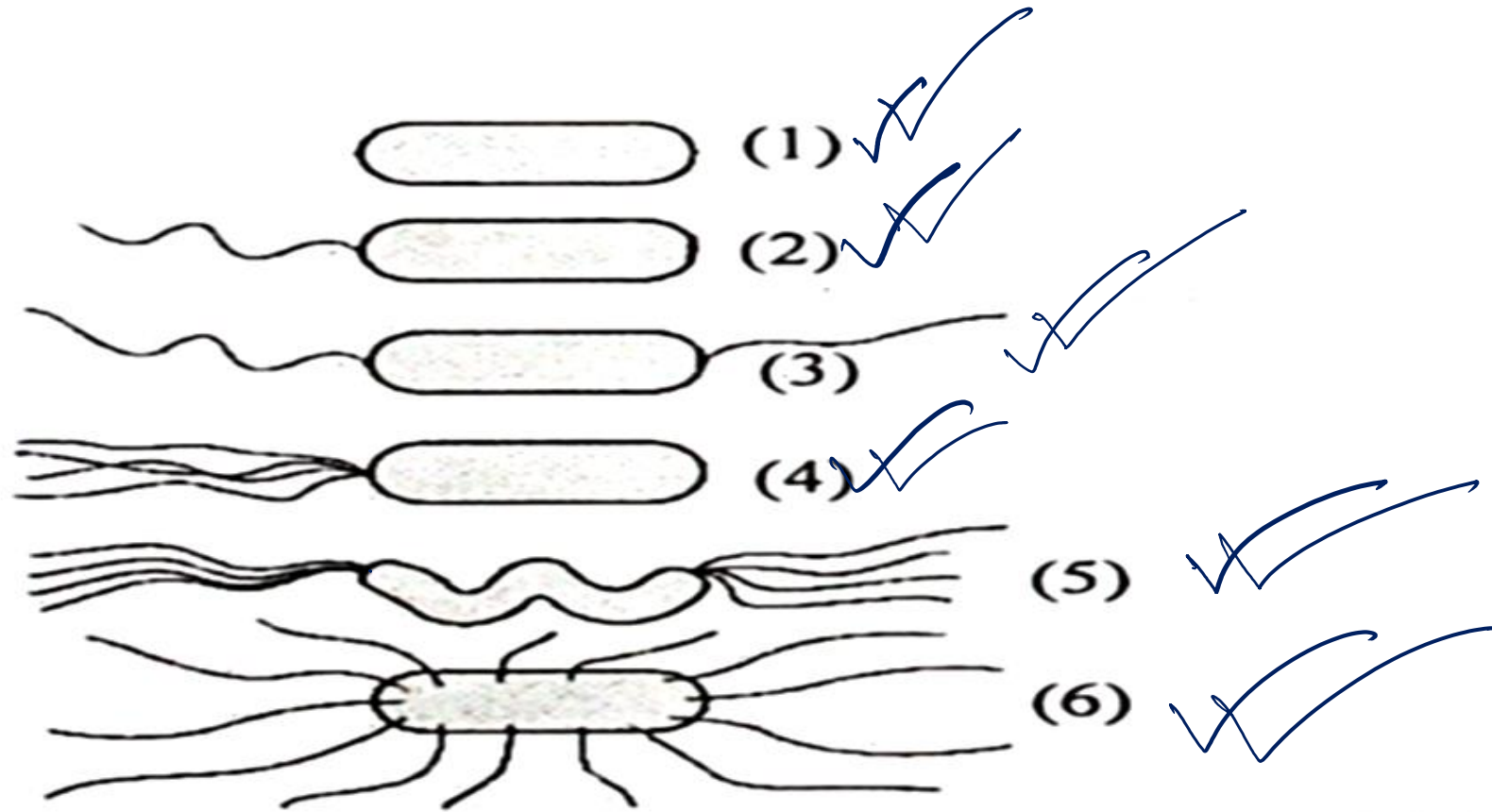


Fig 4.9. Different type of bacteria based on number and distribution of flagella.

(b) Based on presence, position and number of Flagella:

i) Atrichous ✓	• Without flagella; <i>Corynebacterium diphtheriae</i>
ii) Monotrichous ✓	• Single flagellum at one end; <i>Vibrio cholera</i> ①
iii) Lophotrichous	• Tufts of flagella at both ends; <i>Spirillum volutans</i>
iv) Amphitrichous	• Single flagellum at both ends; <i>Spirillum serpentans</i> , <i>Spirillum minus</i>
v) Peritrichous ✓	• Flagella all around; <i>Salmonella typhi</i> , <i>Bacillus typhosus</i>
vi) Cephalotrichous	• Tuft of flagella at one end; <i>Pseudomonas fluorescens</i>

(c) Pigment based classification:

i) Gram positive ✓	• Will retain violet color of Crystal Violet upon staining. • Example: <i>Bacillus subtilis</i> .
ii) Gram negative ✓	• After staining, these will lose violet color on washing and retain red color of safranin after wash. • Example: <i>Salmonella typhi</i> .

(d) Based on Oxygen Requirement:

(i) Aerobic	These do not survive without free oxygen in air; <i>Azotobacter beijerinckia</i> .
(ii) Anaerobic	These survive without free oxygen in air; <i>Clostridium</i> .

Replication of Bacteria

mcq

mcq

mcq

<u>(i) Vegetative</u>	<u>(a) Binary fission (Main reproductive process)</u> <u>(b) Budding</u>
<u>(ii) Asexual (Occurs via spores)</u>	<u>(a) Gonidia: Leucothrix</u> <u>(b) Endospore: Bacteria of Bacillaceae family</u>
<u>(iii) Sexual</u>	<u>(i) Along the conjugation tube</u> <u>(ii) Transformation</u> <u>(iii) Transduction</u>

Poll Question: 04

Which of the following bacteria can survive without free oxygen?

- (a) Azotobactor
- (b) Bacillus
- (c) Clostridium
- (d) Staphylococcus

Poll Question: 05

What is bacterial cell wall primarily made of?

- (a) Muramic acid
- (b) Chitin
- (c) Mucoprotein
- (d) Cellulose

Economic Importance of Bacteria

Beneficial effects :

In medical field	<ul style="list-style-type: none">● To make antibiotic drugs: Subtilin (from <i>Bacillus subtilis</i>), Polymyxin (from <i>Bacillus polymyxa</i>), Streptomycin (from <i>Actinomycetes</i>), Teramycin.● To prepare vaccines: Cholera, typhoid, tuberculosis, DPT (diphtheria, whooping cough or pertussis and tetanus) etc. vaccines.
In agricultural sector	<ul style="list-style-type: none">● Nitrogen fixation: <i>Azotobacter</i>, <i>Pseudomonas</i>, <i>Clostridium</i> fix N_2 to the soil.● <i>Rhizobium</i> fixes nitrogen to the nodules of the plants like green beans.● As pesticide: <i>Bacillus thuringiensis</i>.● Nitrification: <i>Nitrosomonas</i>, <i>Nitrococcus</i> & <i>Nitrobacter</i> work as nitrifying bacteria.
In industrial sector	<ul style="list-style-type: none">● Manufacturing tea, coffee and tobacco: <i>Bacillus megaterium</i>.● In dairy farm: <i>Streptococcus lactis</i>, <i>Lactobacillus</i> produce butter, cheese etc from milk.● In jute industry: <i>Clostridium</i>.● In tannery: <i>Bacillus</i>.● Chemical industry: <i>Acetobacter xylinum</i> in production of vinegar● Produces lactic acid: <i>Bacillus lacticacidi</i>.● Produces acetone: <i>Clostridium acetobutylicum</i>.
In human life	<ul style="list-style-type: none">● Cellulose digestion: Domestic animals have bacteria in their stomach for the digestion of cellulose.● Vitamin synthesis: <i>E. coli</i> and other bacteria in the human intestine synthesize vitamin B, Vitamin-K, folic acid, biotin etc.● Genetic engineering: <i>Agrobacterium</i>, <i>E. coli</i>.

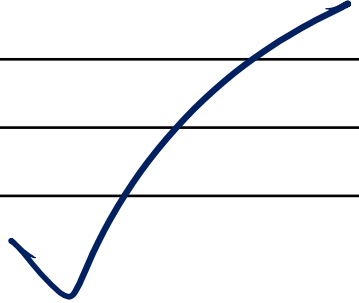
Disadvantages of Bacteria:

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S.I.

Name of Disease	Bacteria
Tuberculosis	<i>Mycobacterium tuberculosis</i>
Typhoid	<i>Salmonella typhi</i>
Dysentery	<i>Bacillus dysenteri</i>
Tetanus	<i>Clostridium tetani</i>
Diphtheria	<i>Corynebacterium diphtheriae</i>
Anthrax	<i>Bacillus anthracis</i>
Gonorrhoea ✓	<i>Neisseria gonorrhoeae</i>
Syphilis ✓	<i>Treponema pallidum</i>
Chlamydia ✓	<i>Chlamydia trachomatis</i>
Spike blight of wheat	<i>Agrobacterium tritici</i>
Blight of tobacco	<i>Pseudomonas tabacci</i>
Canker of tomato	<i>Corynebacterium michiganese</i>
Canker of lemon	<i>Xanthomonas citri</i>
Scab of potato	<i>Streptomyces scabies</i>

STD

T.p.



CHOLERA

- causative agent is ***Vibrio cholera***. Its a comma shaped bacteria
- It has a flagellum at one end.
- Robert Koch discovered this
- It attacks the mucose of small intestine and secretes an **endotoxin** known as **CHOLERAGEN TOXIN**
- This disease causes electrolyte imbalance in the host.
- **ORS SALINE** is the best treatment procedure

Which of the following vitamin is not synthesized by *E. coli*? (DAT: 18-19)

(a) Vitamin - B_2

(b) Vitamin - E

(b) (c) Vitamin - K

(d) Vitamin - B_{12}

Which bacteria is responsible for sexually transmitted disease? (DAT: 16-17)

(a) *Vibrio cholerae*

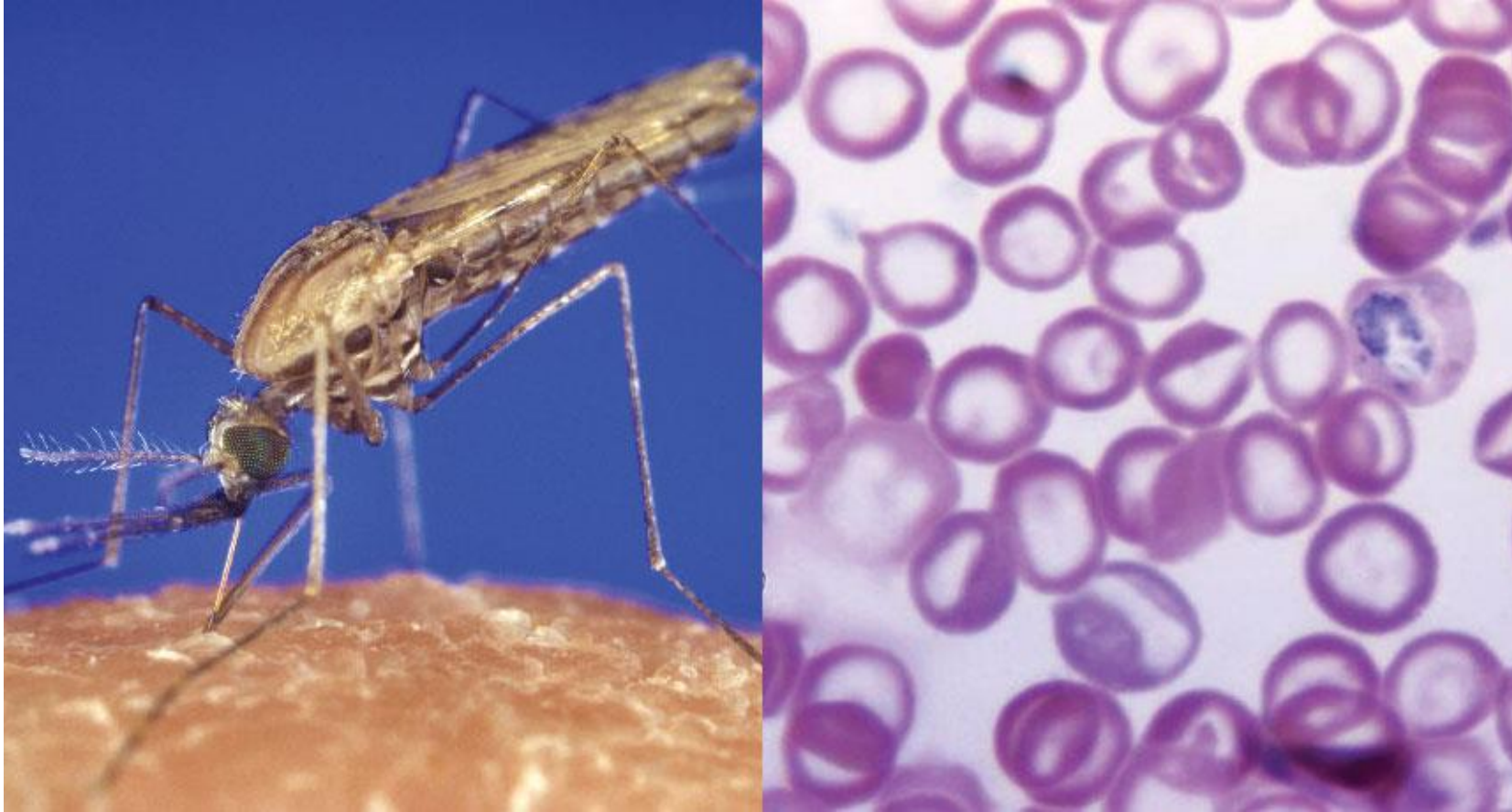
(b) *Clostridium tetani*

(c) *Diplococcus pneumoniae*

(d) *Chlamydia trachomatis*

Gram-positive
Gram - (-ve)

Malarial Parasite



Different species of Malarial Parasite and names of fever:

Name of malarial parasite	Name of disease	Nature of fever	Latency period
<i>Plasmodium falciparum</i>	Malignant tertian malaria	Fever comes after 36-48 hours	8-15 days
<i>Plasmodium malariae</i>	Quartan malaria	Fever comes after 72 hours	18-40 days
<i>Plasmodium vivax</i>	Benign tertian malaria	Fever comes after 48 hours	12-20 days
<i>Plasmodium ovale</i>	Mild tertian malaria	Fever comes after 48 hours	11-16 days

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Hepatic schizogony = Liver

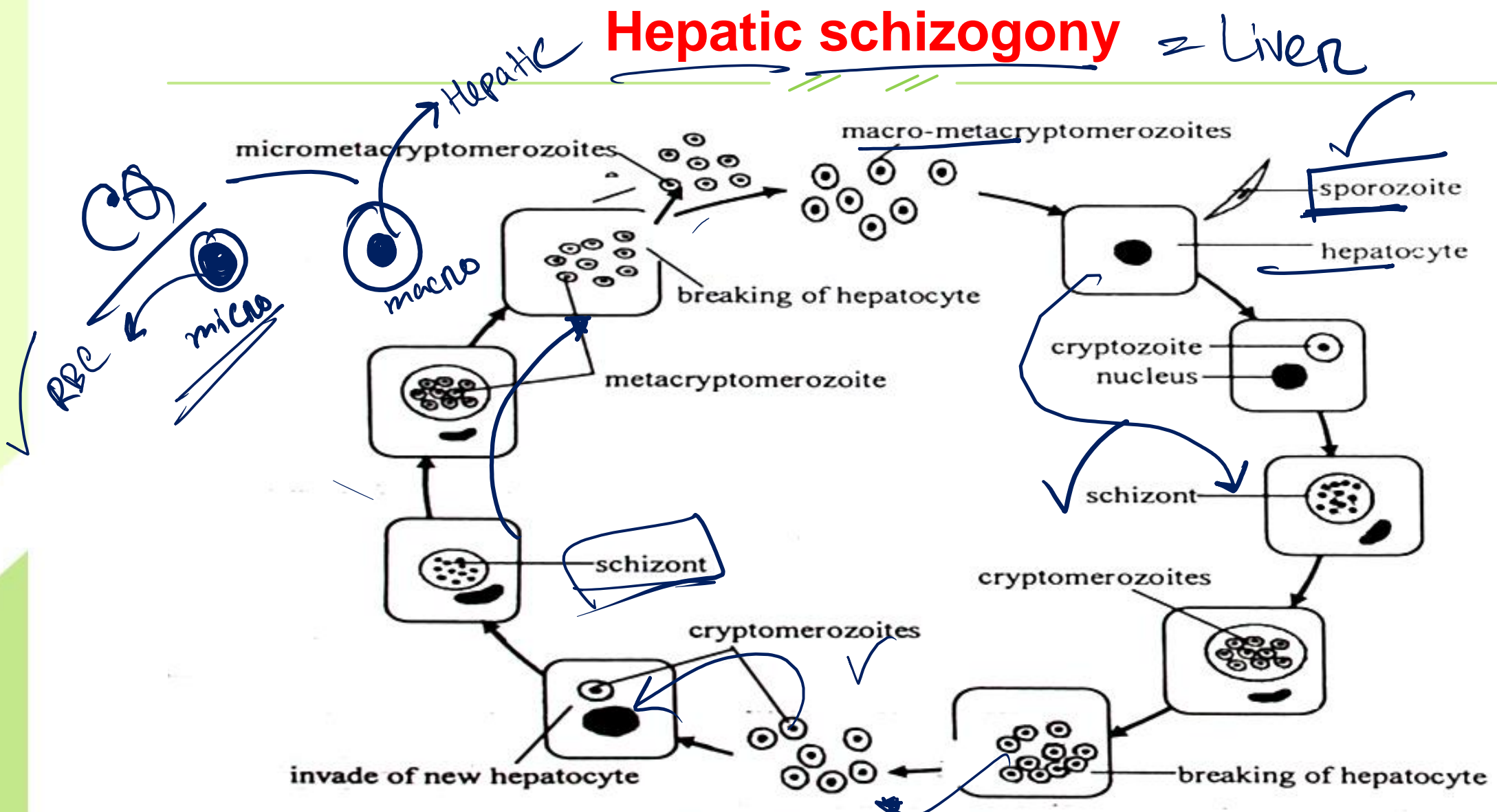
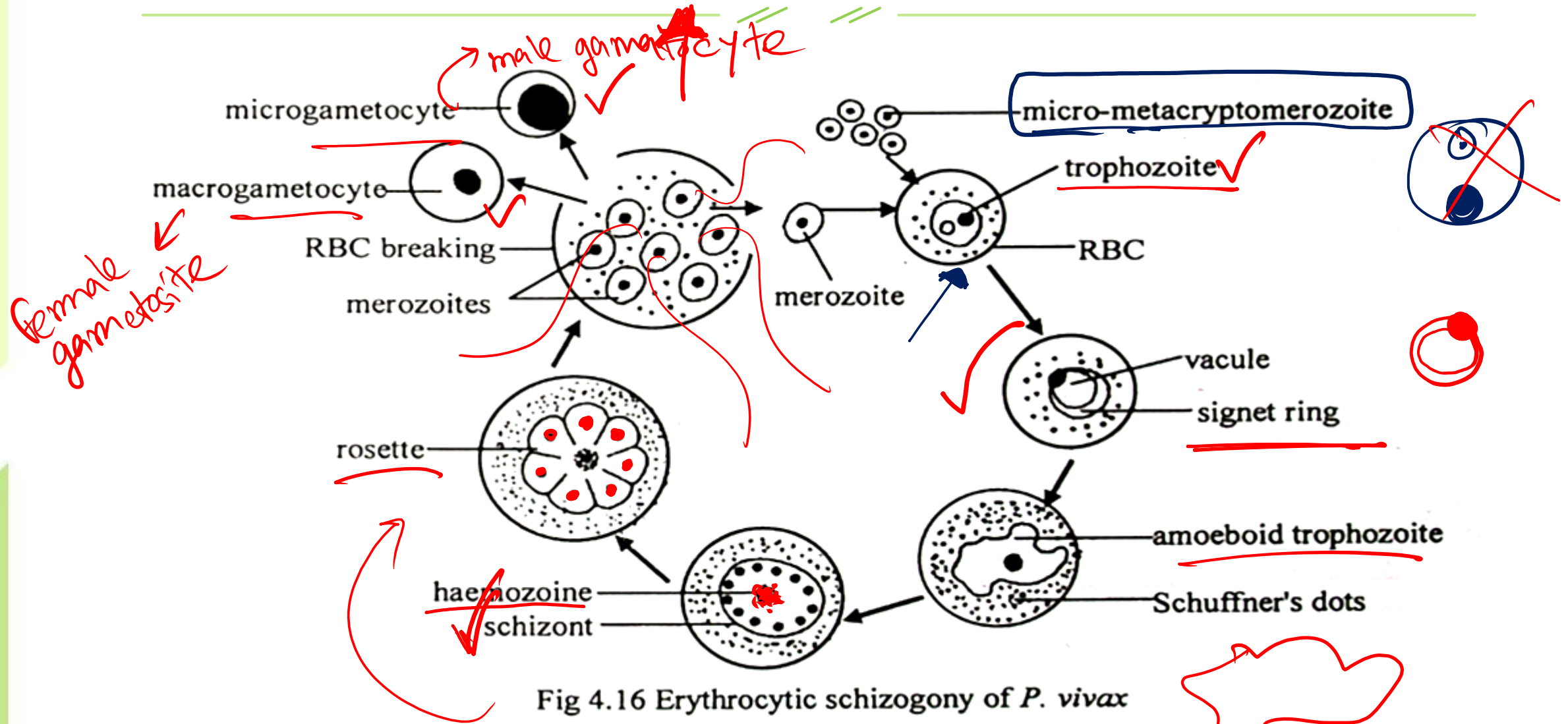


Fig 4.15 Hepatic schizogony of *P. vivax*

Erythrocytic schizogony



Sexual reproductive cycle of parasite in mosquito

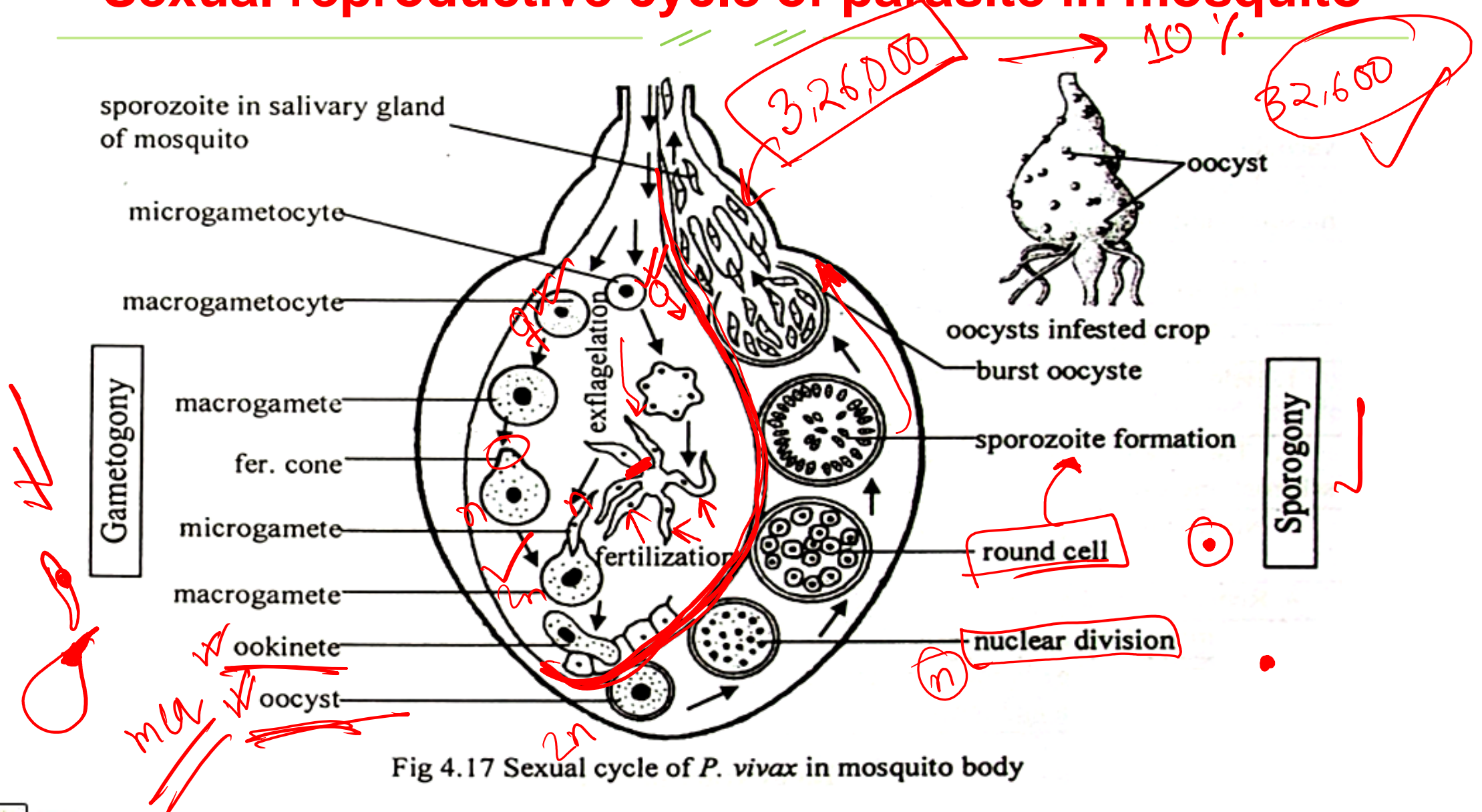


Fig 4.17 Sexual cycle of *P. vivax* in mosquito body

Hepatic or liver schizogony:

Summary

- ❖ 8,000-20,000 merozoites are formed from each schizont in pre-erythrocytic schizogony
- ❖ Takes about 7-10 days.

Erythrocytic Schizogony:

- ❖ Trophozoite
- ❖ Signet ring
- ❖ Amoeboid trophozoite: Malaria is diagnosed by the presence of Schuffners dots in RBC.
- ❖ Schizont (hemozoin)
- ❖ Merozoite: Rosette phase can be seen.
- ❖ Gametocyte: 2 types: a) Micor/male; b) Macro/female

Difference between Hepatic and Erythrocytic Schizogony:

Criteria	Hepatic schizogony	Erythrocytic schizogony
1. Where occurs	<ul style="list-style-type: none">In human liver	<ul style="list-style-type: none">In human erythrocyte.
2. Intermediate steps	<ul style="list-style-type: none">Steps include cryptozoite, cryptomerozoite and metacryptomerozoite.	<ul style="list-style-type: none">Steps include trophozoite, signet ring, schizont and merozoite.
3. Hemozoin	<ul style="list-style-type: none">Is not produced.	<ul style="list-style-type: none">Formed at the end.
4. Host reaction	<ul style="list-style-type: none">Patient does not encounter fever in this phase.	<ul style="list-style-type: none">Patient encounters fever with chills during this cycle.
5. Schuffner's dots	<ul style="list-style-type: none">Cannot be seen.	<ul style="list-style-type: none">Can be seen outside schizont.
6. Fever	<ul style="list-style-type: none">No fever.	<ul style="list-style-type: none">Fever with chills.

Malaria Vaccine:

- ❖ First vaccine of malaria in the world is called Mosquirix, which is also known as RTS,S.
- ❖ Doses- 4 which is able to produce active antibody against *P. falciparum*.

Poll Question: 06

During which schizogzony is malarial fever seen-

- (a) Pre-erythrocytic
- (b) Exo-erythrocytic
- (c) Hepatic
- (d) Erythrocytic

Poll Question: 07

Malignant tertian malarial fever occurs after every-

- (a) 48 – 56 hours
- (b) 72 – 100 hours
- (c) 36 – 48 hours
- (d) 24 – 48 hours

লেগে থাকো সৎ ভাবে,
স্বপ্ন জয় তোমারই হবে।



উদ্ভাস

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