

Biology in Human Welfare – I (Up to Plasmodium)

Very Short Answer Questions:

1. Distinguish between vector and a reservoir host?

Vector is an organism generally an insect which transfers the infective stages of a parasite from main host to another. **Ex.**, House Flies, Female mosquitoes

Reservoir host is the host that lodges the infective stage of a parasite in its body when the human host is not available. The parasite does not develop in this host.

E.g., Monkey For Plasmodium, Antelope (Gnu) for Trypanosoma gambiense.

2. Distinguish between definitive host and intermediate host?

A.

Definitive Host	Intermediate Host
It is the host that harbors the adult stage or sexually mature stage of a parasite Ex: Man for Wuchereria bancrofti Female Anopheles for Plasmodium	It is the host that harbors the developing larval or asexual stages of a parasite Ex: Man for Plasmodium Female Culex for Wuchereria

3. What is a hyper parasite? Mention the name of one hyper parasite?

A. A parasite which lives in or on the body of another parasite is called hyper parasite.

Ex: *Nosema notabilis* (a cnidosporan) is a parasite in *Sphaerospora polymorpha* (a cnidosporan) which lives as parasite in the urinary bladder of the toad fish.

4. What do you mean by parasitic castration? Give one example?

A. Some parasites cause the degeneration of gonads of the host making it sterile.

This effect is called parasitic castration.

Eg: *Sacculina* (root headed barnacle, a crustacean) causes the degeneration of gonads in the crab *Carcinus maenas*.

5. Entamoeba histolytica is an obligatory anaerobe. Justify?

A. Mitochondria are absent in the endoplasm of Entamoeba histolytica.

The absence of mitochondria indicates obligate anaerobic nature of Entamoeba histolytica.

6. Define Neoplasia. Give one example?

A. Abnormal growth of the host cells in a tissue to form new structures is known as neoplasia. It leads to cancers.

E.g. Avian sarcoma occurs due to virus.

7. Distinguish between primary amoebiasis and secondary amoebiasis?

A. **Primary Amoebiasis:** The trophozoites cause ulcers in large intestine and it leads to formation of “abscesses” in the wall of large intestine, ultimately it results in stool with blood and mucous.

Secondary Amoebiasis: The trophozoites may rupture the wall of capillaries enter the blood stream and primarily reach the liver where it may cause abscesses.

8. Define incubation period. What is its duration in the life cycle of Plasmodium vivax?

A. The period between the entry of Plasmodium in the blood in the form of sporozoite and the first appearance of symptoms of malaria in man is called incubation period it is approximately 10 to 14 years.

9. What are Schuffner's dots? What is their significance?

A. Small red coloured dots appear in the cytoplasm of the RBC known as Schuffner's dots. These are believed to be the antigens released by Plasmodium (Malaria) parasite.

10. What is exflagellation and what are the resultant products called?

A. Male gametes of Plasmodium show lashing movements like flagella and get separated from the cytoplasm of microgametocyte. This process is called exflagellation and resultant products are called Male (or) Microgametes. It occurs in the lumen of crop of female Anopheles.

11. Why is the syngamy found in plasmodium called anisogamy?

A. Since two gametes are dissimilar in size, the syngamy found in Plasmodium called anisogamy.

12. What is the significance of hypnozoites with reference to malaria fever?

A. Some of the stages of macro – metacryptozoites may survive for a long period in live as dorman stages called hypnozoites. Reactivation of these hypnozoites leads to the initiation of fresh erythrocytic cycle resulting in the new attacks of malaria. This is referred to as relapse of malaria.

13. On the advice of a doctor, a patient has gone to a clinical laboratory for the examination of a sample of faeces. The lab technician on observing the stool of the patient diagnosed that the patient was suffering from amoebiasis. Write any two characteristic features based on which the technician came to that conclusion?

A) i) The characteristic features of stool are presence of blood and mucous.
ii) Stool contains tetranucleate cysts of **Entamoeba histolytica**.
iii) Tetra nucleate cysts are characterized by food vacuoles with erythrocytes, fragments of epithelial cells and bacteria.

14. What is ookinete? Based on the sets of chromosomes, how do you describe it?

A) i) Ookinete is a long, slender, motile, vermiform stage formed from zygote in the lumen of crop of female **Anopheles**.
ii) It is in diploid state.

15. Distinguish between mechanical vector and biological vector?

A) i) In mechanical vector, the parasite does not undergoes any change. This vector merely transfers the infective stages of a parasite.

E.g. houseflies and cockroaches in the case of Entamoeba.

ii) In biological vector, the parasite undergoes some development before it gets transferred to another host.

E.g. Female Anopheles in the case of Plasmodium.

16. **What are the parasitic adaptations shown by Fasciola hepatica for endoparasitic mode of life?**

A) Endoparasites like **Fasciola hepatica** (sheep liver fluke) show complex life cycle involving many developmental stages and intermediate hosts to increase the chances of reaching a new definitive host.

17. **Distinguish between pre cystic stage and cystic stage of Entamoeba histolytica?**

A) i) Precystic stage is the non-feeding and non-pathogenic stage of Entamoeba histolytica.

It is a small, spherical or oval, non-motile form.

ii) Cystic stage is round in shape and surrounded by a thin, delicate and highly resistant cyst wall. It can survive in unfavorable conditions.

18. **What is the reserve food in the precystic and early cyst stages of Entamoeba histolytica?**

A) Glycogen granules and chromatoid bars made with ribonucleo protein act as reserve food in precystic stages and early cyst stages of Entamoeba histolytica.

19. **Define asymptomatic cyst passers with reference to Entamoeba histolytica?**

A) Some human beings do not exhibit any symptoms in spite of having cysts of Entamoeba in them. They are considered as asymptomatic cyst passers or carriers.

20. **Which stages Plasmodium vivax that infects the hepatocytes of man?**

A) Sporozoites, cryptozoites or first generation merozoites and macrometacryptozoites or 2nd generation merozoites may infect hepatocytes of liver of man.

21. **Why is the Syngamy found in Plasmodium called Anisogamy?**

A) Syngamy is the fusion of gametes. In the case of Plasmodium, as the male gamete and female gamete are dissimilar in size and nature the syngamy is considered as anisogamy.

22. **Define prepatent period and incubation periods in the life cycle of Plasmodium vivax.**

A) a) **Prepatent Period:** The interval between the first entry of Plasmodium into the blood in the form of sporozoites and second entry of Plasmodium into the blood in the form of cryptozoites is considered as prepatent period. It lasts approximately 8 days.

b) **Incubation Period:** The period between the entry of Plasmodium into the blood in the form of sporozoite and first appearance of symptoms of malaria in man is called incubation period. It is approximately 10-14 days.

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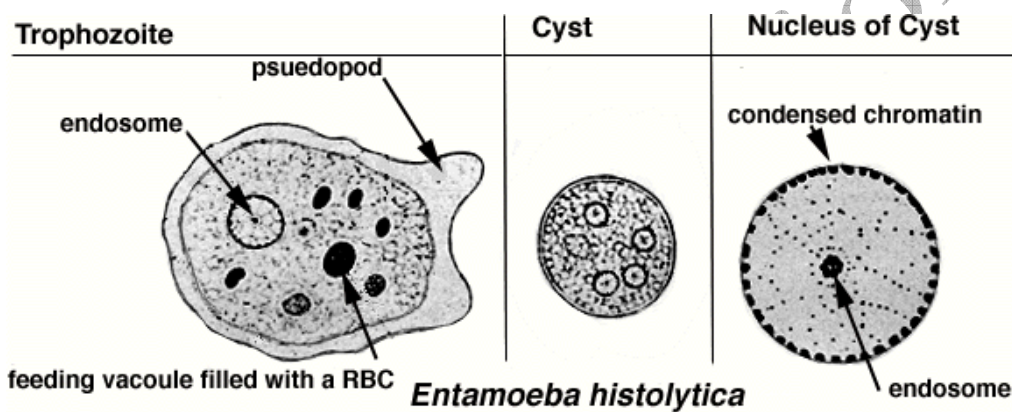
Short Answer Questions

1. Distinguish between hypertrophy and hyperplasia with an example for each.

A.

Hypertrophy	Hyperplasia
It is an abnormal increase in the volume/size of the infected host cell caused by parasite	It is an increase in the number of cells caused by parasites
E.g. : R.B.C of man infected by plasmodium	E.g.: Fasciola hepatica in the bile duct of sheep

2. Describe the structure of a trophozoite of *Entamoeba histolytica*?



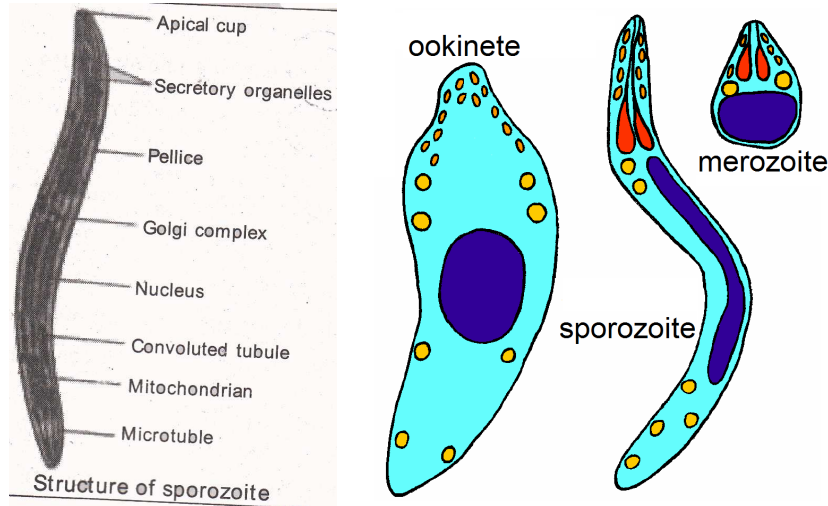
A. Trophozoite is the most active, motile, feeding and pathogenic stage that lives in the mucosa of large intestine.

i) It moves with the help of pseudopodium (lobopodium) which is formed anteriorly. The body of the trophozoite is surrounded by plasmalemma. Its cytoplasm is differentiated into an outer clear, viscous, non – granular ectoplasm and inner fluid like granular, endoplasm. Ribosomes, food vacuoles and vesicular cart wheel shaped nucleus are present.

ii) Absence of mitochondria indicates obligate anaerobic nature of *Entamoeba histolytica*. It produces proteolytic enzyme called histolysin which dissolves mucosa and sub – mucosa of the gut wall and releases blood, tissue debris which are ingested by the trophozoite.

iii) Hence food vacuoles are loaded with R.B.C and fragments of cells, bacteria. Presence of R.B.C in food vacuole and cart wheel shaped nucleus are the characteristic features of the trophozoite of *Entamoeba histolytica*.

3. Describe the structure of sporozoite of *Plasmodium vivax*?

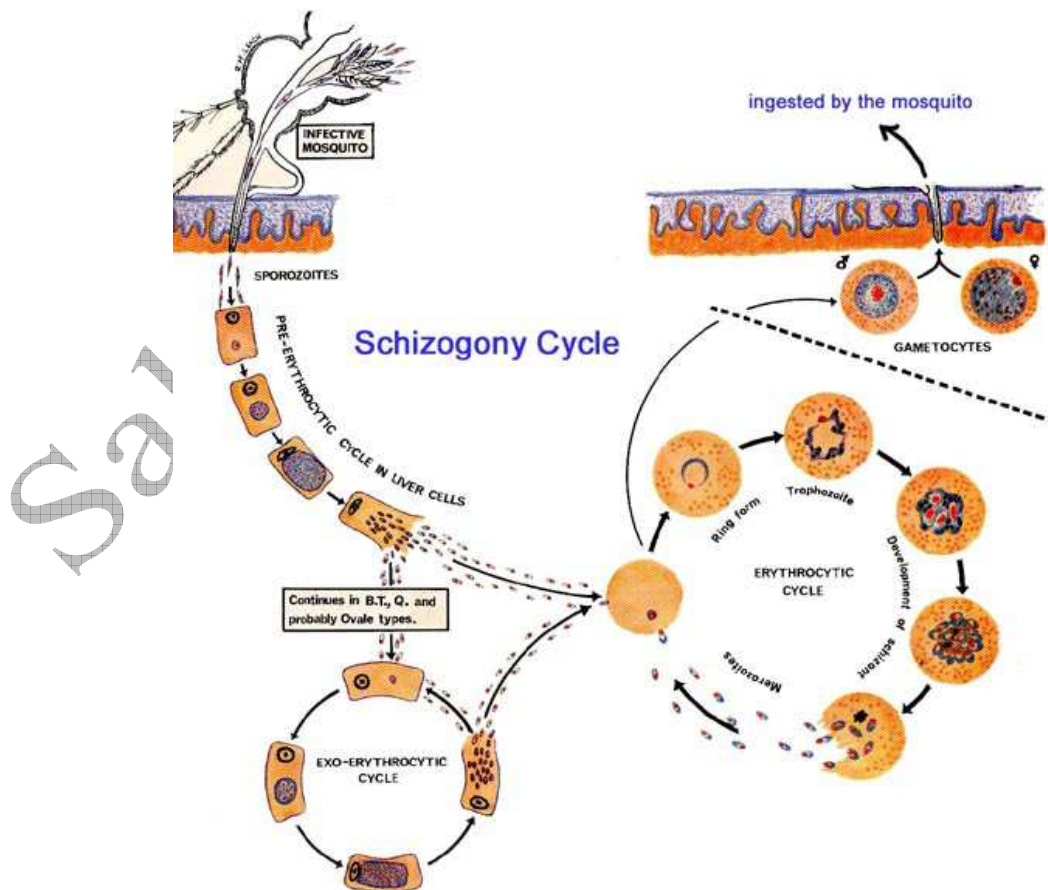


- A. i) The ultra structure of the sporozoite of *Plasmodium vivax* was studied by Garnham. It is sickle shaped with a swollen middle part and pointed at both ends of its body. It measures about 15 microns in length and one micron in width.
- ii) The body is covered by an elastic pellicle with microtubules which help in the curigling movement of the sporozoite. The cytoplasm contains cell organelles such as Golgi complex, E.R, mitochondria and a nucleus. Cytoplasm also shows many convoluted tubules of unknown function throughout the body.
- iii) It contains a cup like depression called apical cup at the anterior end into which a pair of secretory organelles open. They secrete cytolytic enzyme which helps in the penetration of sporozoite into the live cell.

4. Describe the cycle of Golgi in the life history of *Plasmodium vivax*?

- A) i) Life cycle of *Plasmodium vivax* in erythrocytes of man was described by Camillo Golgi. So it is called as Golgi cycle.
- ii) Golgi cycle is started by either cryptozoites of pre-erythrocytic cycle or the micrometacryptozoites of exo-erythrocytic cycle.

- iii) In fresh RBC, plasmodium gets spherical shaped trophozoites. It develops a small vacuole which enlarges in size and pushes the cytoplasm and nucleus to periphery.
- iv) Plasmodium looks like a finger ring. So this stage is known as signet ring stage.
- v) It loses vacuole and develops pseudopodia and becomes amoeboid stage or late trophozoite stage. It feeds on contents of RBC with pseudopodia and increases in size. It results the doubling of the Size of RBC. This condition is known as hypertrophy.
- vi) Plasmodium digests the globin part of ingested haemoglobin and converts the soluble haem into an insoluble haemozoin (malaria pigment).
- vii) Small red colored dots appear in the cytoplasm of the RBC known as Schuffner's dots. They are Antigens formed by parasite.
- viii) Plasmodium loses pseudopodia and increases in size, occupies the entire RBC and becomes a Schizont.
- ix) It undergoes schizogony (a type of multiple fission) and produces 12-24 erythrocytic merozoites. They are arranged irregularly in RBC.
- x) Erythrocyte bursts and releases the merozoites along with haemozoin into the blood.
It is completed in 48 hours/2 days.



5. Explain the life cycle of *Entamoeba histolytica*?

A) *Entamoeba histolytica* is a monogenetic parasite which completes life cycle in man.

* Trophozoite undergoes binary fission in the wall of large intestine and produce a number of daughter entamoebae. They feed upon bacteria and tissues of host and multiply.

* After repeated binary fissions, some of the young ones enter the lumen of large intestine and transform into precystic stages.

* Precystic stages transform into cystic stages.

* Nucleus of cystic stages divides mitotically for two times and form 4 daughter nuclei and thus form tetranucleate cysts.

*Tetranucleate cysts come out along with faecal matter and remain alive for 10 days.

* Tetranucleate cysts reach new host through contaminated food and water.

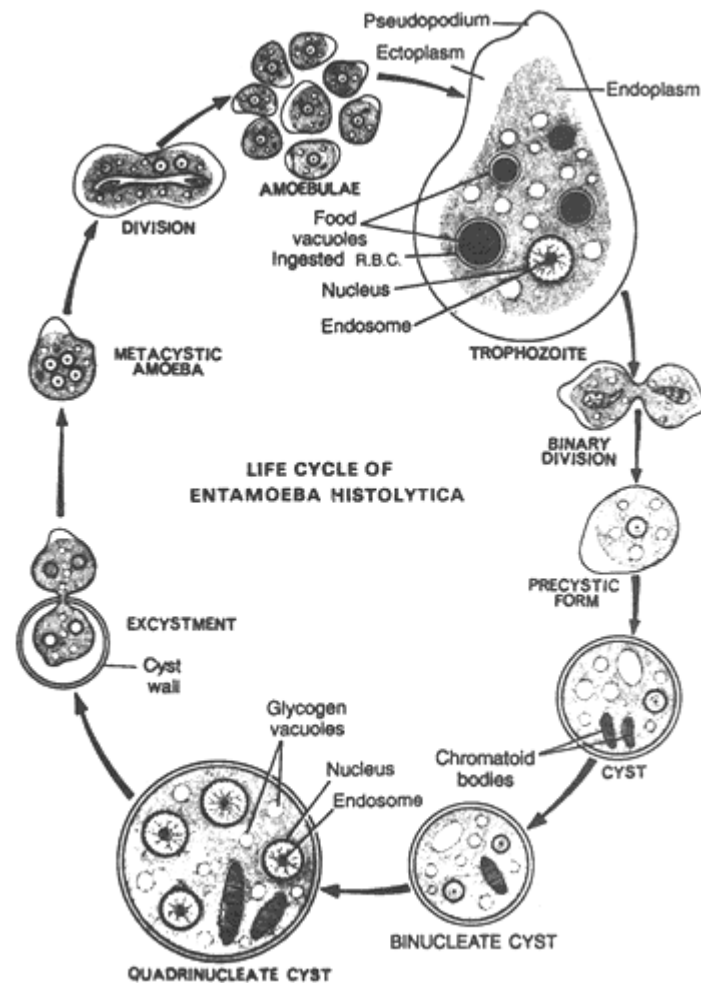
*Tetranucleate cysts reach the small intestine where the cyst wall is ruptured by the action of enzyme Trypsin (excystment) which results the releasing the tetranucleate amoebae.

*These tetranucleate excystic amoebae are considered as Metacysts.

*Four nuclei of metacyst undergoes mitotic divisions and produce 8 nuclei.

*Each nucleus gets a bit of cytoplasm and thus 8 daughter entamoebae or metacystic trophozoites are formed.

* They develop into feeding stages known as trophozoites. Trophozoites invade mucous membrane of large intestine and grow into mature trophozoites.



Entamoeba histolytica : Reproductive and life history

6. Explain the pathogenicity of Entamoeba histolytica?

Ans.

1. Entamoeba histolytica causes amoebiasis or amoebic dysentery or intestinal amoebiasis or tropical amoebiasis.
2. Trophozoites dissolve the mucosal lining by histolysin. It causes ulcers. These ulcers contain cellular debris, lymphocytes, RBC and bacteria.
3. It leads into formation of abscesses in the wall of large intestine. It results in stool with blood and mucous.
4. Some persons do not exhibit any symptoms inspite of having cysts. They are called as carriers or asymptomatic cyst passers.

5. Trophozoites rupture the wall of capillaries enters the blood stream and reach the liver where they cause abscesses (secondary amoebiasis). From there they go to lungs, heart, brain, kidneys gonads and cause abscesses in them.

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Long Answer Questions

1. Explain the structure and life cycle of *Entamoeba histolytica* with the help of neat and labeled diagrams.

Ans.

- ❖ **Entamoeba histolytica** causes amoebic dysentery or amoebiasis in man.
- ❖ It passes through three stages in life cycle. They are trophozoite stage, precystic stage and cystic stage.
- ❖ a) **Trophozoite Stage:** it is the active, motile, feeding and pathogenic stage. It lives in the mucosa and sub-mucosa of large intestine of man.
 - b) It has single blunt finger like lobopodium type of pseudopodium. The body is covered by plasmalemma. Cytoplasm has outer ectoplasm and inner endoplasm.
 - c) Endoplasm contains ribosomes, food vacuoles and a vesicular cartwheel like nucleus.
 - d) Contractile vacuole, endoplasmic reticulum, golgi apparatus and mitochondria are absent.
 - e) Absence of mitochondria indicates the obligate anaerobic nature of parasite.
 - f) It produces histolysin as proteolytic enzyme which dissolves mucosa and sub-mucosa of gut wall.
 - g) Food vacuoles contain erythrocytes, fragments of epithelial cells and bacteria.

Mode of nutrition is Holozoic.

Presence of RBC in food vacuoles, cartwheel like nucleus are the characteristic features of the trophozoites of parasite.

II) Precystic Stage:

- i) it is the non-feeding stage and non-pathogenic stage present in the lumen of large intestine.
- ii) It is non-motile form. Cytoplasm contains glycogen granules and chromatoid bars which act as reserve food.

III) Cystic stage.

- i) It is present in lumen of large intestine. It is round in shape and surrounded by thin, delicate and highly resistant cyst wall.
- ii) After encystment, the nucleus undergoes two successive series of mitotic divisions to form 4 daughter nuclei. These stages are known as tetranucleate cysts or mature cysts which are infective stages to man.

Life Cycle of Entamoeba Histolytica:

Entamoeba histolytica is a monogenetic parasite which completes life cycle in man.

* Trophozoite undergoes binary fissions in the wall of large intestine and produce a number of daughter entamoebae. They feed upon bacteria and tissues of host and multiply.

* After repeated binary fissions, some of the young ones enter the lumen of large intestine and transform into precystic stages.

* Pre cystic stages transform into cystic stages.

* Nucleus of cystic stages divides mitotically for two times and form 4 daughter nuclei and thus form tetra nucleate cysts.

*Tetra nucleate cysts come out along with faecal matter and remain alive for 10 days.

* Tetra nucleate cysts reach new host through contaminated food and water.

*Tetra nucleate cysts reach the small intestine where the cyst wall is ruptured by the action of enzyme Trypsin (excystment) which results the releasing the tetra nucleate amoebae.

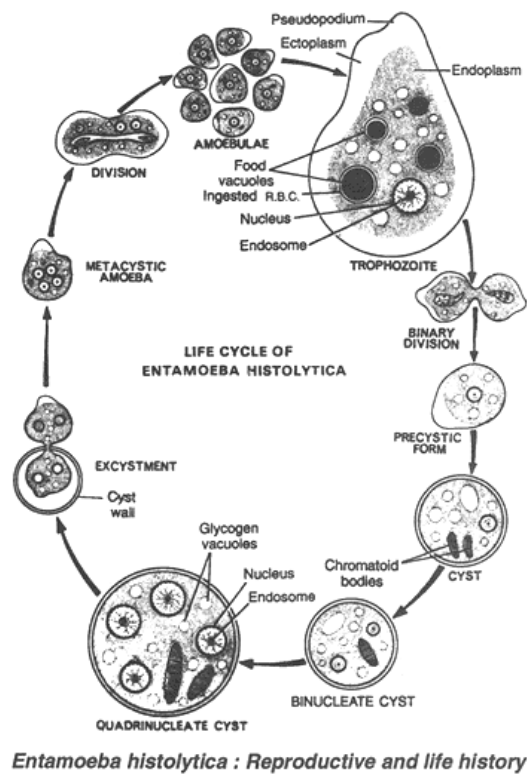
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* They develop into feeding stages known as trophozoites.

*Trophozoites invade mucous membrane of large intestine and grow into mature trophozoites.



2. Describe the life cycle of Plasmodium vivax in man?

Ans. Life cycle of Plasmodium vivax in man:

In man, Plasmodium reproduces by asexual reproduction known as schizogony. It occurs in hepatocytes of liver as hepatic schizogony and erythrocytes (RBC) as erythrocytic schizogony.

Hepatic Schizogony: it was explained by Shortt and Garnham. Sporozoites of Plasmodium enter into the blood of man from female Anopheles and reach the hepatocytes within half an hour and undergo pre-erythrocytic and exo-erythrocytic cycles in the following manner.

A) Pre-erythrocytic cycle:

- i) sporozoites transform into trophozoites and feed on the contents of hepatic cells and attain maximum size and becomes Schizont stage.
- ii) Nucleus divides for many times mitotically which is followed by cytoplasmic divisions and thus form 12,000 cryptozoites or 1st generation merozoites.
- iii) cryptozoites enter the sinusoids of liver. It takes place in 8 days.
- iv) Some of them enter RBCs and majority of them enter fresh liver cells.

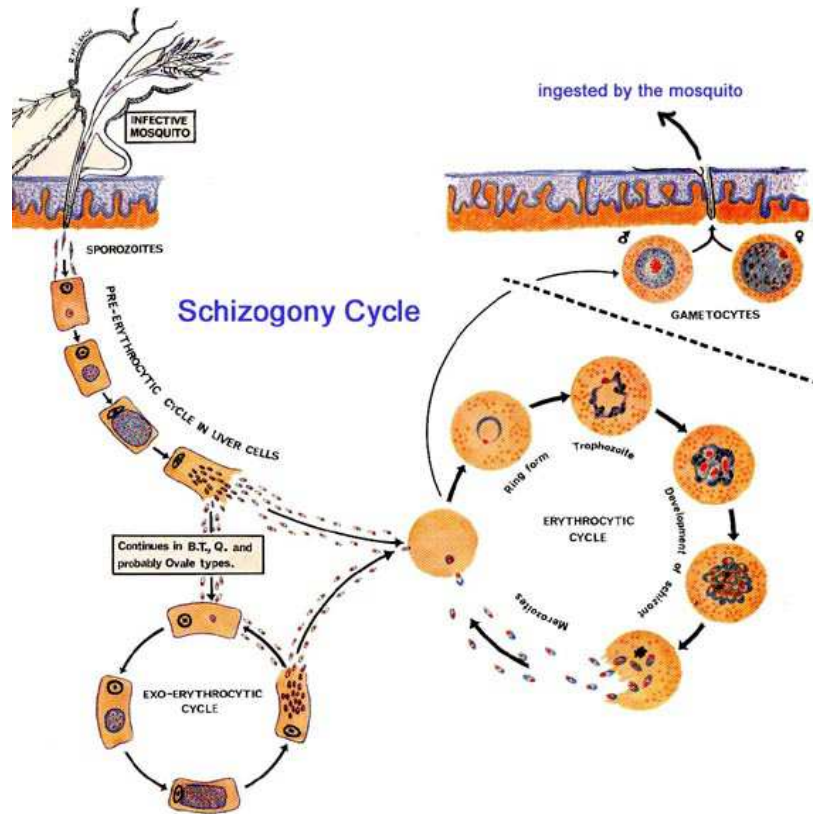
B) Exo-erythrocytic cycle:

- i) cryptozoites after entering the liver cells undergo same changes of pre-erythrocytic cycle and form into second generation merozoites or Metacryptozoites.

- ii) Metacryptozoites are of two typesa) Smaller micro-metacryptozoites
 - b) Larger Macro-metacryptozoites.
- iii) Macro-metacryptozoites attack fresh liver cells and continue another exo-erythrocytic cycle.
- iv) Micro-metacryptozoites enter RBC to continue erythrocytic cycles and produce merozoites.

C) Erythrocytic cycle: i) life cycle of Plasmodium vivax in erythrocytes of man was described by Camillo Golgi. So it is called as Golgi cycle.

- ii) Golgi cycle is started by either cryptozoites of pre-erythrocytic cycle or the micrometacryptozites of exo-erythrocytic cycle.
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3. Describe the life cycle of *Plasmodium* in mosquito or Ross cycle?

Ans. Gametocytes of *Plasmodium* enter into the crop of female *Anopheles* mosquito.. In mosquito the life cycle of *Plasmodium* continues in the following stages....

- a) Gametogony b) Fertilization c) Formation of ookinete & oocysts d) Sporogony

A) Gametogony: it is the formation of male and female gametes from the gametocytes.

It occurs in the lumen of crop of mosquito...

- i) Formation of male gametes: nucleus of microgametocyte divides into 8 daughter nuclei known as pronuclei. They reach the periphery. Cytoplasm is pushed out in the form of 8 flagella like processes. Each process receives one pronucleus and forms a micro gamete or male gamete male gametes show lashing movements like flagella and get separated from cytoplasm of microgametocyte. This process is known as exflagellation.
- ii) Formation of female gametes: female gametocyte undergoes a few changes and transform into a female gamete by maturation. Nucleus of female gamete moves towards the periphery and Cytoplasm at that point forms a projection known as fertilization cone.

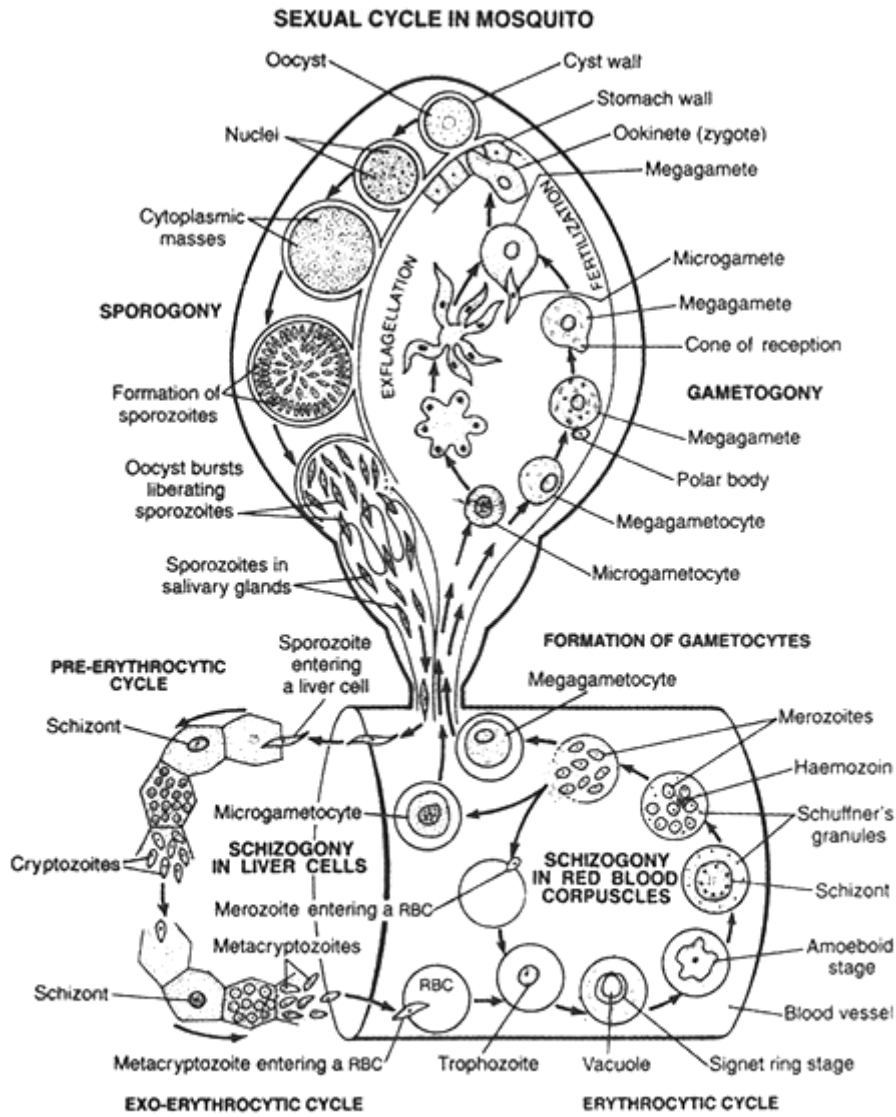
B) **Fertilisation:** fusion of male and female gametes is known as fertilization. It occurs in crop of mosquito. Actively moving microgamete comes in contact with female gamete at fertilization cone. Later pronuclei and cytoplasm of both gametes fuse and form a zygote. This type of fusion of dissimilar gametes is known as anisogamy. Female gamete with zygote is known as Zygote which is round and nonmotile.

C) Formation of Ookinete and Oocysts:

Zygote remains inactive for some time and transform into a long, slender, motile, vermiform within 18-24 hours. Ookinete pierces the wall of crop and settles beneath the basement membrane. It becomes round and secretes a cyst around the body and becomes OOCYST. About 50-500 oocysts are formed on the wall of crop and appear as nodules.

D) Sporogony:

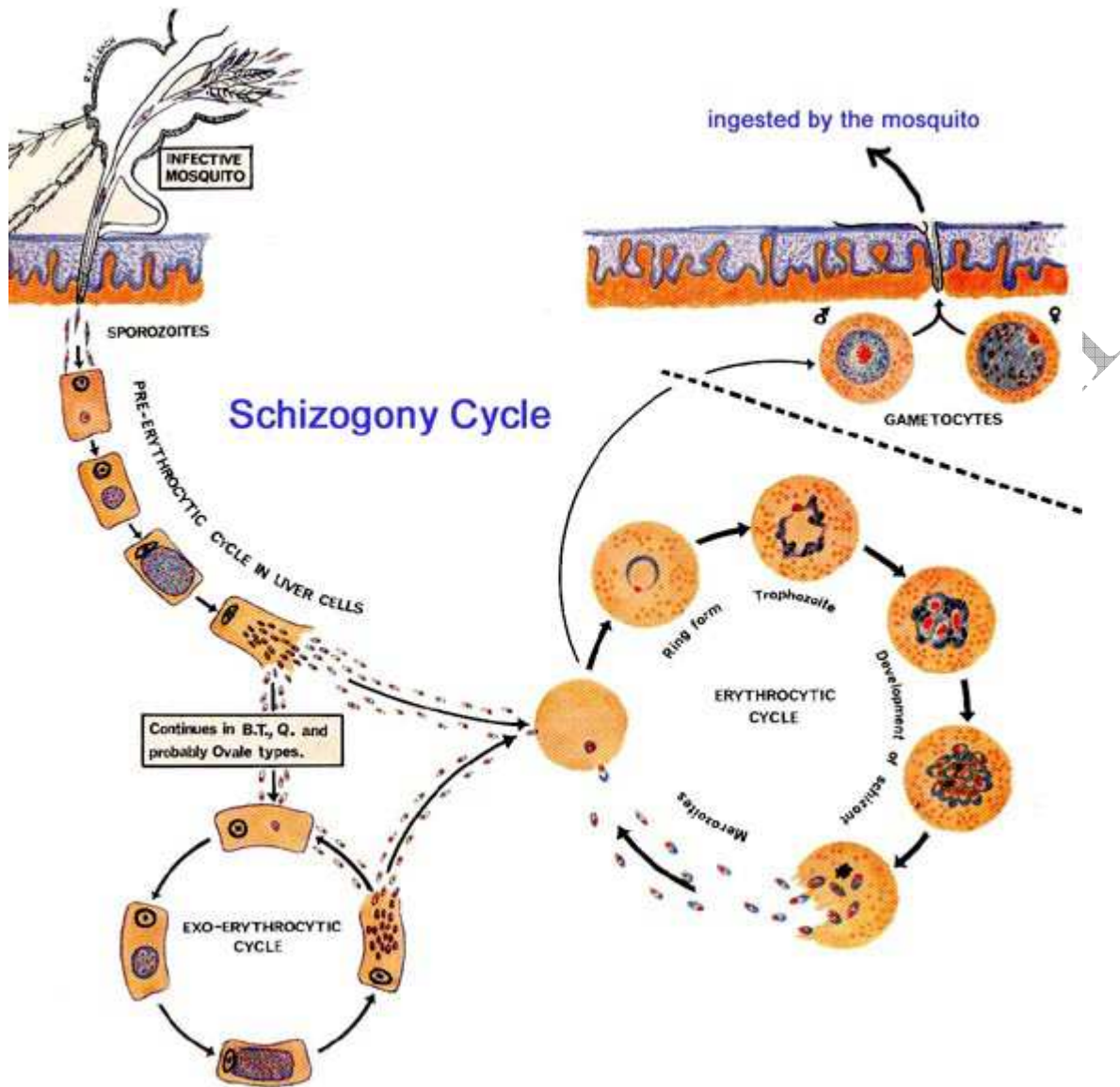
Formation of sporozoites in oocysts is known as sporogony. According to Bano, the nucleus of oocysts first undergoes reduction division followed by Repeated mitotic divisions which result in the formation of sporoblasts. Each nucleus is surrounded by a little bit of cytoplasm and transforms into sickle shaped Sporozoites. Oocysts with sporozoites is known as Sporocyst. By rupturing of sporocyst about 10,000 sporozoites are released into the haemocoel of Mosquito. They enter into salivary glands of mosquito and are ready for infection. Life cycle of *Plasmodium* in mosquito is completed in about 10-24 days.



ASEXUAL CYCLE IN MAN

Life cycle of *Plasmodium vivax*

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