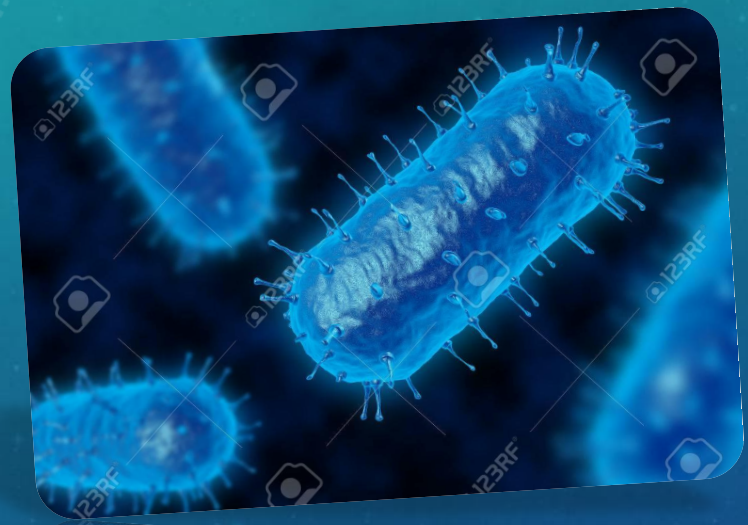
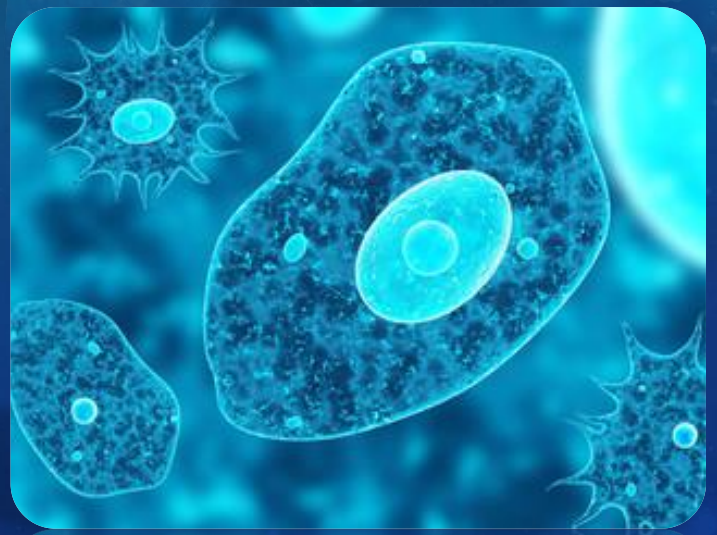
General characteristics of medical parasitology





- COURSE STUDENT
  - Abhishek Upadhyay
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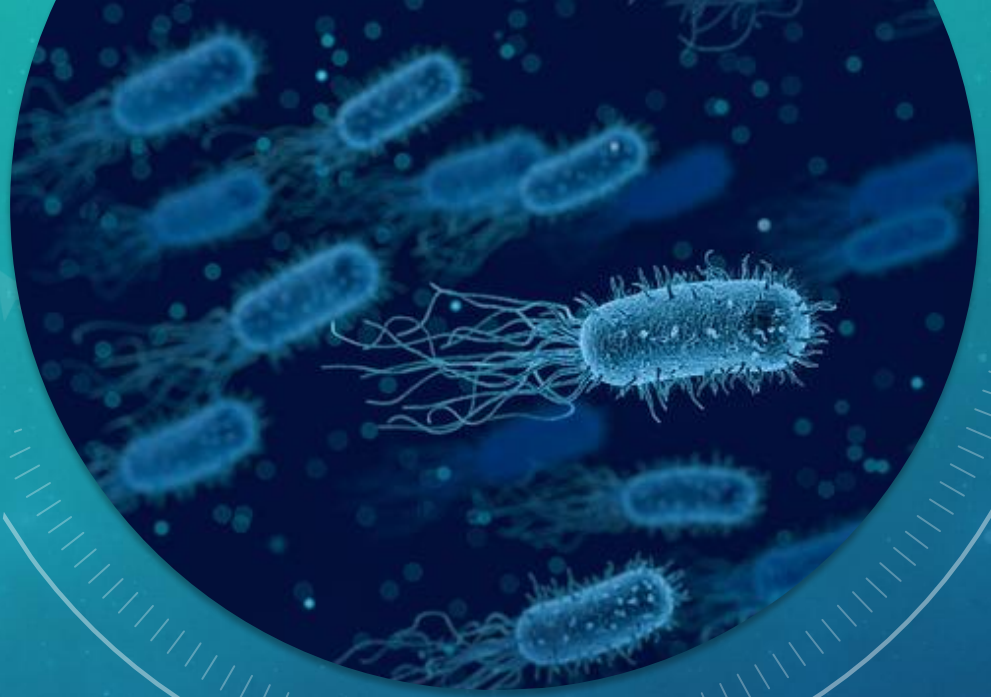
DEPARTMENT OF MEDICAL BIOLOGY



MEDICAL PROTOZOOLOGY (SUBKINGDOM PROTOZOA)

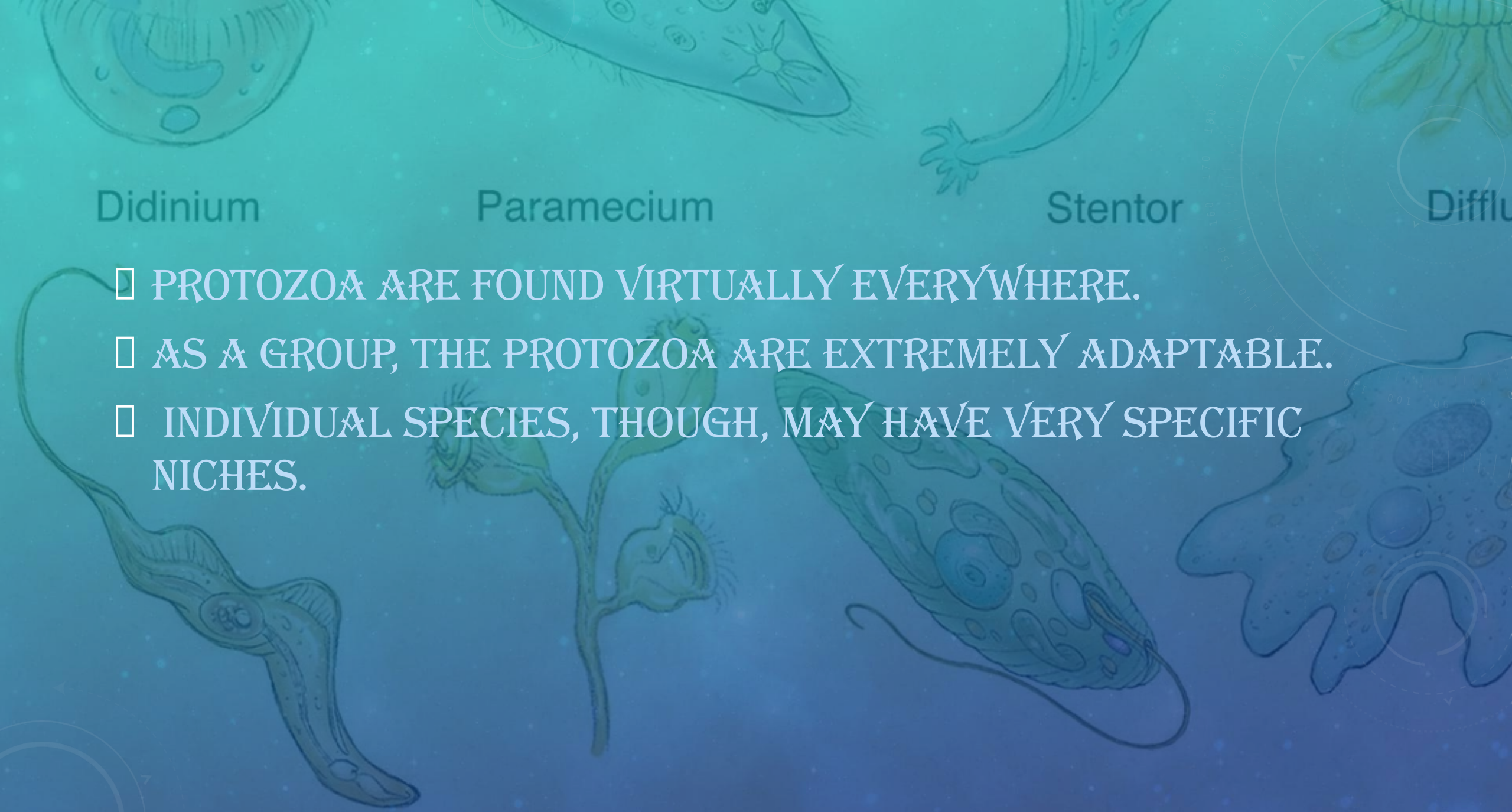
MEDICAL PROTOZOOLOGY (SUBKINGDOM PROTOZOA) DEALS WITH THE STUDY OF PROTOZOA OF MEDICAL IMPORTANCE. DECIPHERING THE GREEK ROOTS RESULTS IN DEFINING «PROTOZOA» AS «FIRST» (PROTO) «ANIMALS» (ZOA). ALTHOUGH MOLECULAR PHYLOGENETIC STUDIES INDICATE THAT PROTOZOA ARE AMONG THE EARLIEST BRANCHING EUKARYOTES, SUCH A DEFINITION DOES NOT PROVIDE MUCH DESCRIPTIVE INFORMATION.

Protozoa exhibit a wide variety of morphologies

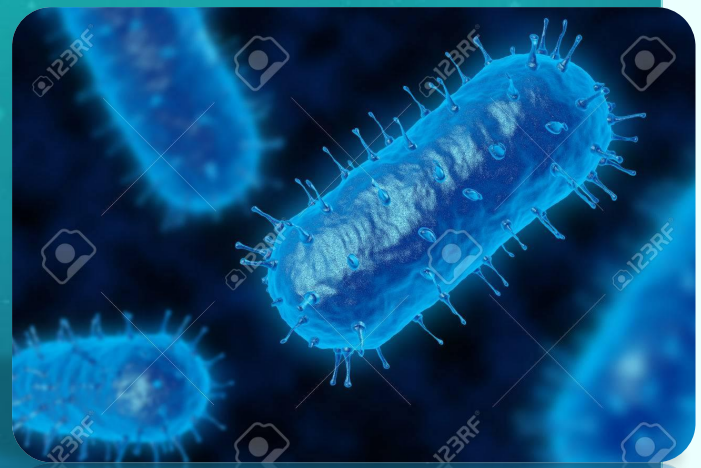
There is no one shape or morphology, which would include a majority of the protozoa. Shapes range from the amorphous and ever-changing forms of amoeba to relatively rigid forms dictated in part by highly ordered cytoskeletons or secreted walls or shells. Many protozoan species exhibit complex life cycles with multiple stages. Sonetimes the different life cycle stages are so dissimilar that they have been mistaken for completely different species.

THE VAST MAJORITY OF PROTOZOA ARE MICROSCOPIC.

- HOWEVER, THEY DO EXHIBIT AN INCREDIBLY LARGE RANGE OF SIZES. EXTANT SPECIES RANGE IN SIZE FROM < 1 UM (10° METER) TO SEVERAL MM. FOSSILIZED FORMINIFERIDA OF SEVERAL CM HAVE BEEN IDENTIFIED. MOST OF THE ORGANISMS DISCUSSED IN PARAZITOLOGY WIFT BE 3 - 50 UM. THIS SMALL SIZE NECESSITATES THE USE OF A MICROSCOPE TO DETECT PROTOZOA. AN ELECTRON MICROSCOPE IS NEEDED FOR DETAILED MORPHOLOGICAL STUDIES.



- Protozoa are found virtually everywhere.
- As a group, the protozoa are extremely adaptable.
- Individual species, though, may have very specific niches.



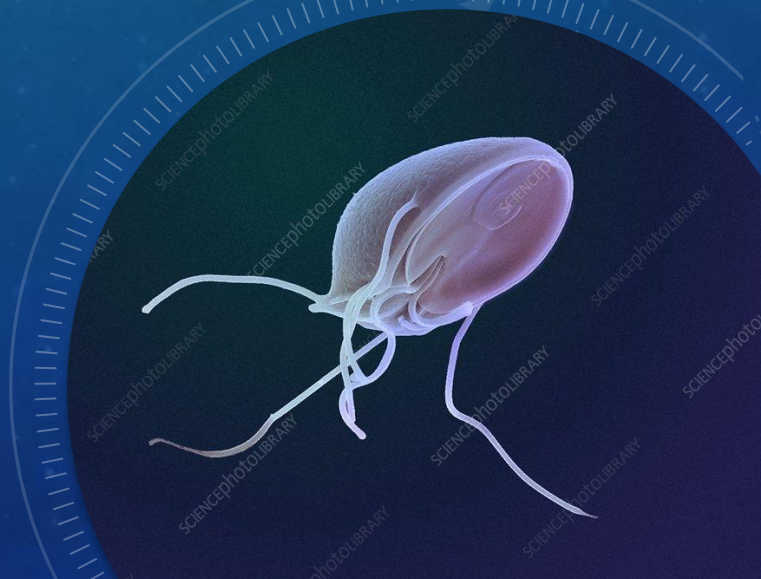
BIOLOGICAL CLASSIFICATION

PHYLUM: PROTOZOA

CLASS: Amoebae (Rhizopoda) SARCODINA	CLASS: Zoomastigophora FLAGELLATA	CLASS: Telosporidea SPOROZOA	CLASS: Ciliatae INFUZORIA
✓Entamoeba histolytica, ✓E. coli, ✓E. hartmanni, ✓E. gingivalis, ✓Negleria fowleri, ✓Acanthamoeba castellani.	✓Tripanosoma brucei gambiense, ✓T.b.rhodesiense, ✓T. crusi, ✓Leishmania tropica minor, ✓Leishmania tropica major, ✓L. mexicana, ✓L.donovani, ✓L.brasiliensis, ✓Lamblia intestenalis, ✓Trichomonas vaginalis, ✓Tr. hominis, ✓Tr tenax.	✓Toxoplasma gondii, ✓Plasmodium vivax, ✓Pl. malariae, ✓Pl. falciparum, ✓Pl. ovale, ✓Pneumocystis carinii, ✓Sarcocyctis homimis.	✓Balantidium coli.

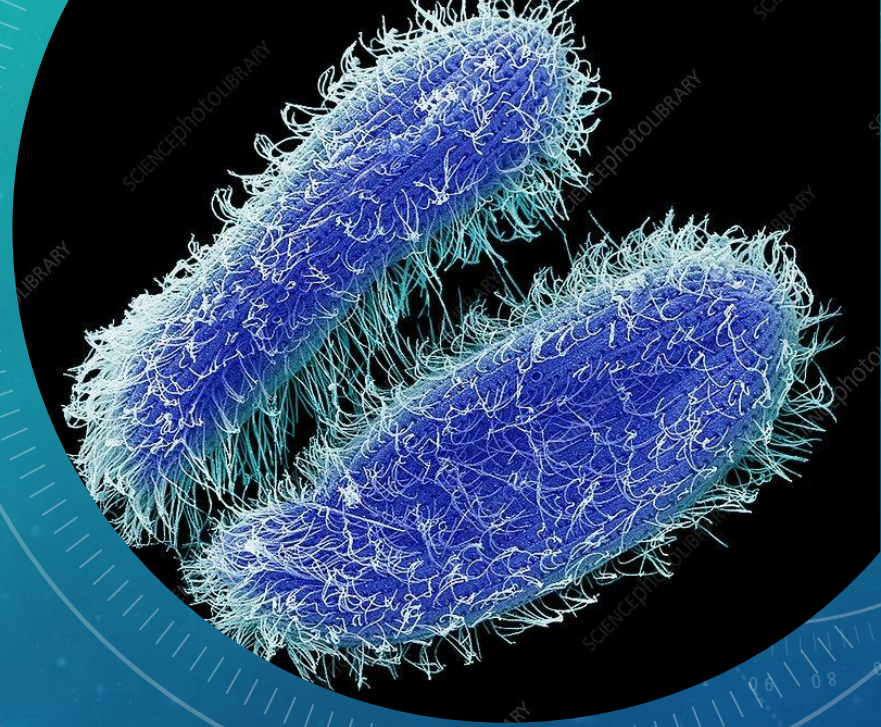
Like all other organisms, protozoa must be able to acquire

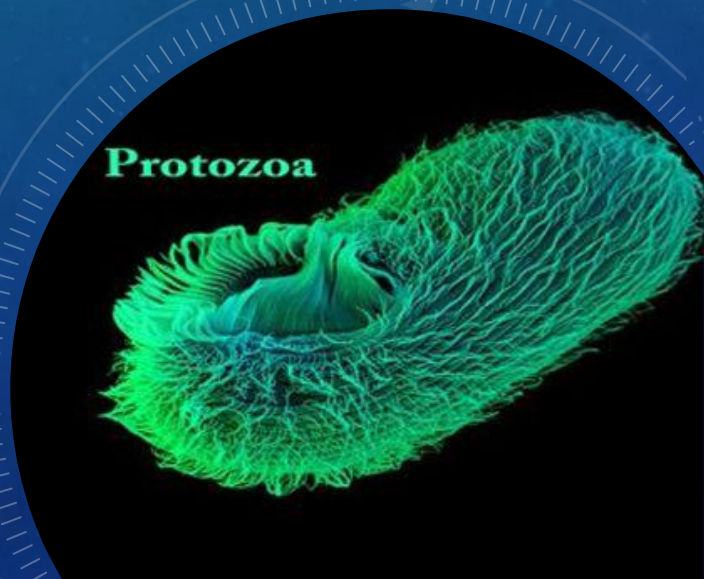
- Like all other organisms, protozoa must be able to acquire and metabolize nutrients from their environment. Many protozoa simply absorb solutes (i.e., osmotrophy) from their media, while some are scavengers that ingest solid material (i.e., phagotrophy). Predatory protozoa either actively hunt down or passively ambush other organisms (typically bacteria or other protozoa). Some protozoa are photosynthetic and can capture the energy of the sun and convert it to usable chemical energy (i.e., autotrophic or phototrophic). Many protozoa are not restricted to a single feeding mechanism and can utilize combinations of the above (i.e., heterotrophic, mixotrophic).



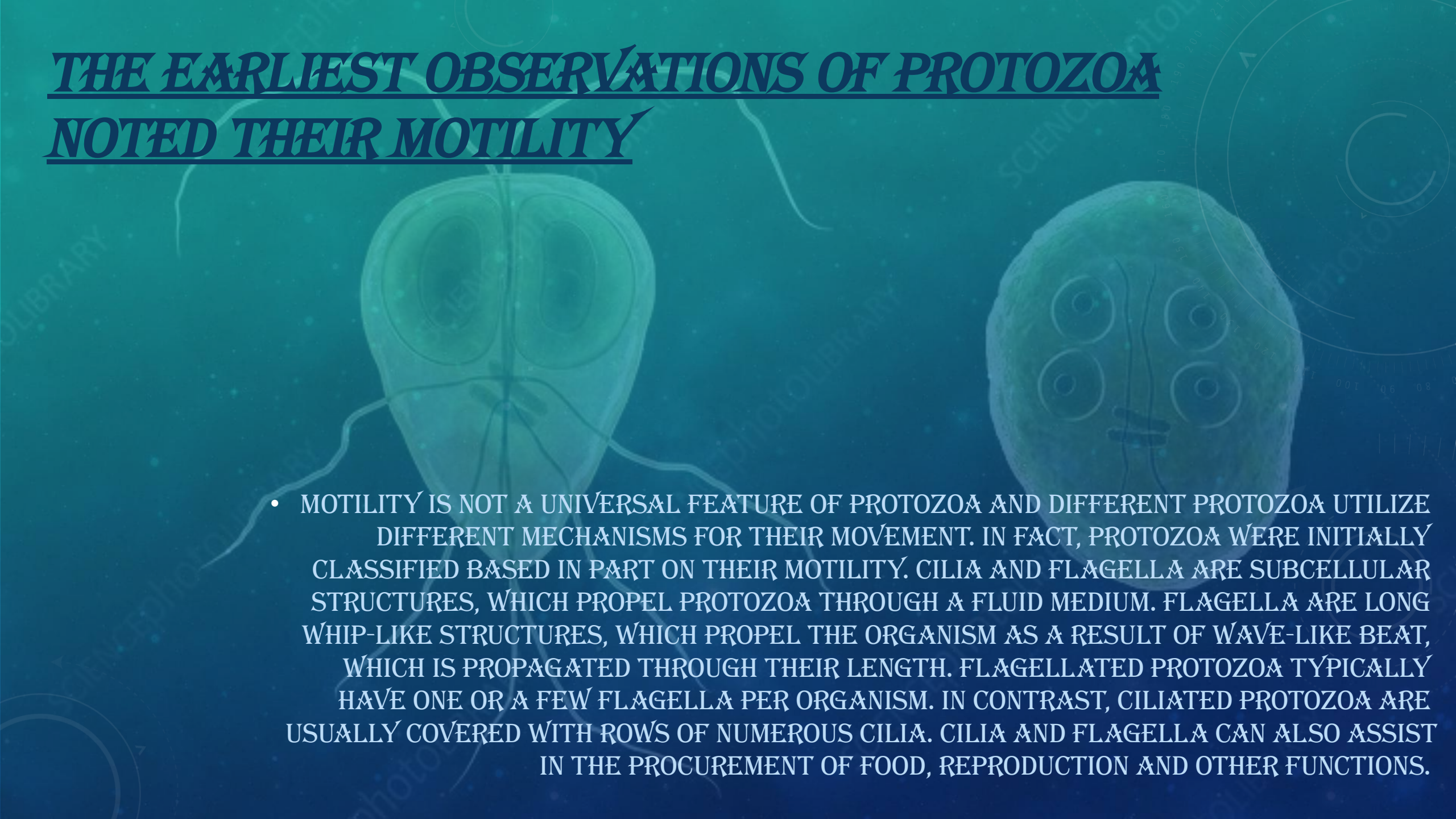
PROTOZOA ARE CONVENIENTLY DIVIDED INTO FREE-LIVING AND SYMBIOTIC WITH A FEW THAT ARE FACULTATIVE SYMBIONTS.

- GENERALLY FREE-LIVING ORGANISMS ARE FOUND IN THE SOIL OR AQUEOUS ENVIRONMENTS, WHEREAS SYMBIONTS LIVE IN CLOSE ASSOCIATION WITH ANOTHER ORGANISM. SYMBIOSIS IMPLIES A PHYSIOLOGICAL DEPENDENCY ON ANOTHER ORGANISM FOR ITS NUTRITION. DIFFERENT FORMS OF SYMBIOSIS CAN BE DISTINGUISHED ON THE NATURE OF THE ASSOCIATION BETWEEN THE DISSIMILAR ORGANISMS





THE EARLIEST OBSERVATIONS OF PROTOZOA NOTED THEIR MOTILITY



- MOTILITY IS NOT A UNIVERSAL FEATURE OF PROTOZOA AND DIFFERENT PROTOZOA UTILIZE DIFFERENT MECHANISMS FOR THEIR MOVEMENT. IN FACT, PROTOZOA WERE INITIALLY CLASSIFIED BASED IN PART ON THEIR MOTILITY. CILIA AND FLAGELLA ARE SUBCELLULAR STRUCTURES, WHICH PROPEL PROTOZOA THROUGH A FLUID MEDIUM. FLAGELLA ARE LONG WHIP-LIKE STRUCTURES, WHICH PROPEL THE ORGANISM AS A RESULT OF WAVE-LIKE BEAT, WHICH IS PROPAGATED THROUGH THEIR LENGTH. FLAGELLATED PROTOZOA TYPICALLY HAVE ONE OR A FEW FLAGELLA PER ORGANISM. IN CONTRAST, CILIATED PROTOZOA ARE USUALLY COVERED WITH ROWS OF NUMEROUS CILIA. CILIA AND FLAGELLA CAN ALSO ASSIST IN THE PROCUREMENT OF FOOD, REPRODUCTION AND OTHER FUNCTIONS.

- In contrast to the swimming exhibited by flagellates and ciliates, amoeba are protozoa that crawl along a solid substratum in a fashion known «amoeboid movement». The amoeba projects out as pseudopod, or false foot, and then pull the rest of the body forward.

The most common form of reproduction in protozoa is asexual binary fission

- A single organism will divide into two equal organisms. A slight modification of this binary fission, called budding, is when one of the newly formed cells is smaller than the other typically the larger cell is called the mother and the smaller is the daughter. Some protozoa will form an intracellular bud and essentially give birth. Another variation of binary fission is a multiple fission or segmentation. In this situation, several rounds of nuclear replication occur without cytokinesis. This multinucleated cell will then form multiple progeny simultaneously.

GENERAL MORPHOLOGY OF PROTOZOA

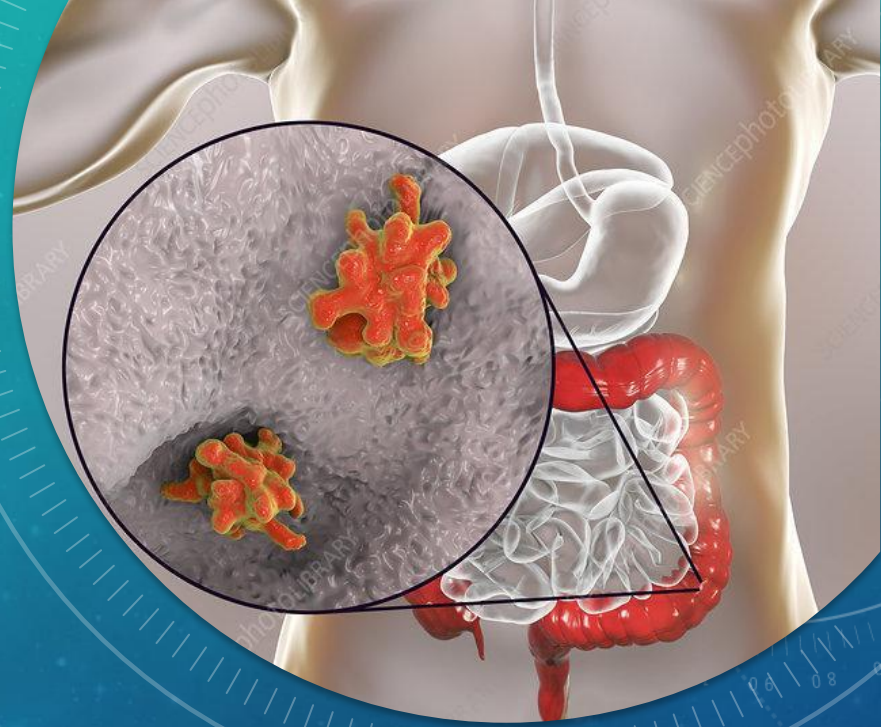
- 1. PROTOZOA ARE UNICELLULAR ORGANISMS (SINGLE CELL) SOMETIMES CALLED NON-CELLULAR OR ACELLULAR, BEING NOT DIVIDED INTO CELLS.
- 2. EACH PROTOZOON PERFORMS ALL FUNCTIONS OF LIFE.
- 3. THE PROTOZOON IS MADE OF A MASS OF PROTOPLASM DIFFERENTIATED INTO CYTOPLASM AND NUCLEOPLASM.
- 4. THE CYTOPLASM CONSISTS OF OUTER THIN HYALINE ECTOPLASM AND INNER VOLUMINOUS GRANULAR ENDOPLASM.
- 5. THE ECTOPLASM FUNCTIONS IN: PROTECTION, LOCOMOTION, INGESTION OF FOOD, EXCRETION AND RESPIRATION.
- 6. THE ENDOPLASM IS CONCERNED WITH METABOLISM. IT ENCLOSES:
- A) FOOD VACUOLES: CONTAINING FOOD DURING DIGESTION,
- B) VOLUTIN GRANULES: STORED FOOD IN THE FORM OF CARBOHYDRATE (GLYCOGEN VACUOLES) OR PROTEIN (CHROMATOID BODIES),
- C) EXCRETORY VACUOLES: COLLECT WASTE PRODUCTS AND DISCHARGE THEM TO THE EXTERIOR BY BURSTING THROUGH THE ECTOPLASM
- D) THE NUCLEUS.
- 7. THE NUCLEUS FUNCTIONS IN REPRODUCTION AND MAINTAINING LIFE. IT IS MADE OF NUCLEAR MEMBRANE, NUCLEAR SAP, CHROMATIN. IN THE VESICULAR NUCLEUS THE CHROMATIN IS CONCENTRATED IN A MASS (THE KARYOSOME) OR DISTRIBUTED BETWEEN THE KARYOSOME AND THE INNER SURFACE OF THE NUCLEAR MEMBRANE (PERIPHERAL CHROMATIN). IN THE MASSIVE NUCLEUS THE CHROMATIN IS DISTRIBUTED DIFFUSELY.

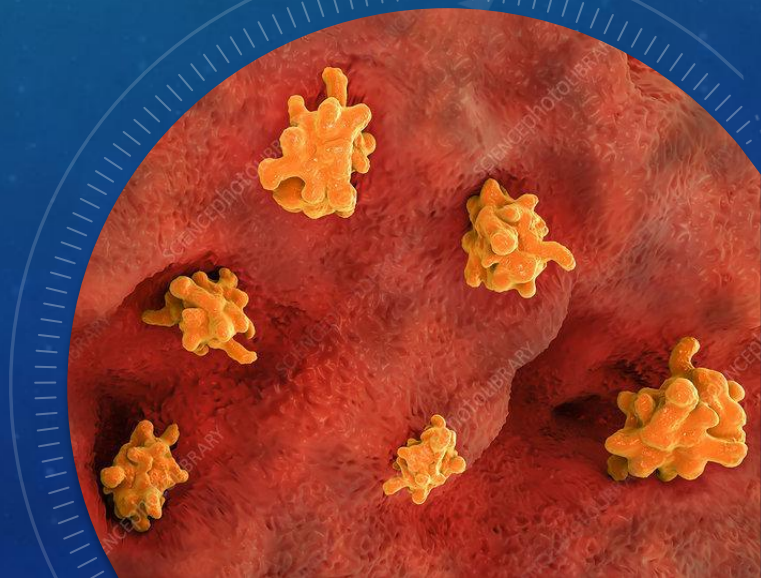
GENERAL BIOLOGY OF PROTOZOA

- *1. Nutrition either by: absorption of liquid food through the body surface, or ingestion of solid particles by the help of pseudopodia or through the cytostome.*
- *2. Excretion either by: diffusion through the body surface, or excretory vacuoles.*
- *3. Secretions: digestive enzymes, toxins, and material for cyst wall, enzyme to liquefy tissues.*
- *4. Respiration either: aerobic or anaerobic.*
- *5. Locomotion either by:*
- *a) Pseudopodia (amoeboid movement).*
- *b) Flagella: whip-like filaments arise from the kinetoplast+ blepharoplast + parabasal body).*
- *c) Cilia: like flagella but smaller and more numerous covering most of the body.*
- *6. Cyst formation: encystment of some protozoa is essential for survival outside the body of the host and during transmission from host to host.*
- *7. Reproduction may be asexual or sexual.*
- *a) Asexual reproduction (simple fission): division of the nucleus by amitosis the chromatin into chromosomes); division of the cytoplasm by simple fission into two (binary fission) or more (multiple fission).*
- *b) Sexual reproduction: the formation of 2 cells (male and female gametes) by reduction division, and their union (or syngamy) resulting in the formation of a zygote.*

CLASS LOBOZEA (SARCODINA)

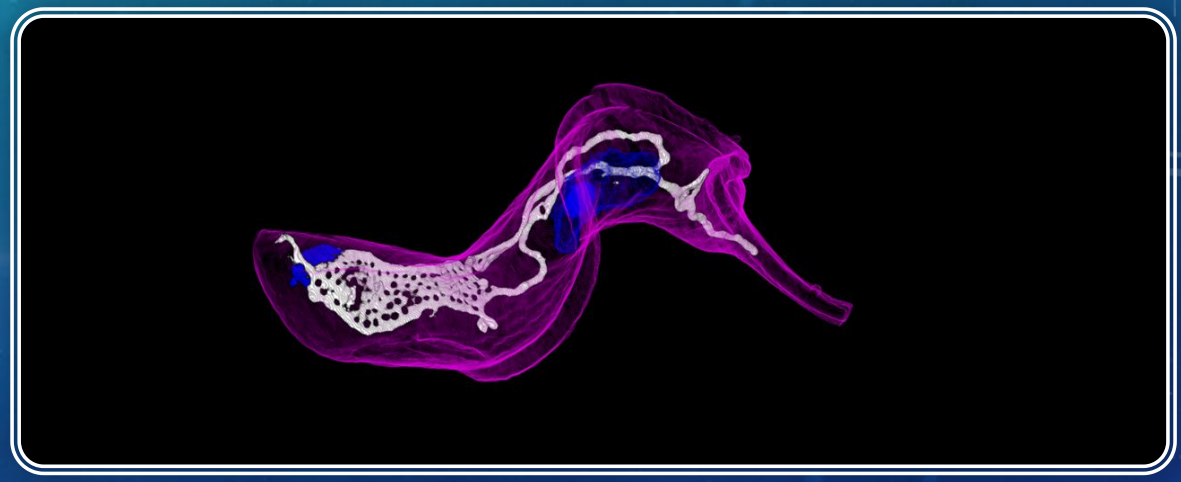
- (SARCODINA) IS TYPICALLY AMOEBOID AND IS REPRE- SENTED IN HUMANS BY SPECIES OF ENTAMOEBA, ENDOLIMAX, IODAMOEBA, NAEGLERIA, AND ACANTHAMOEHA.





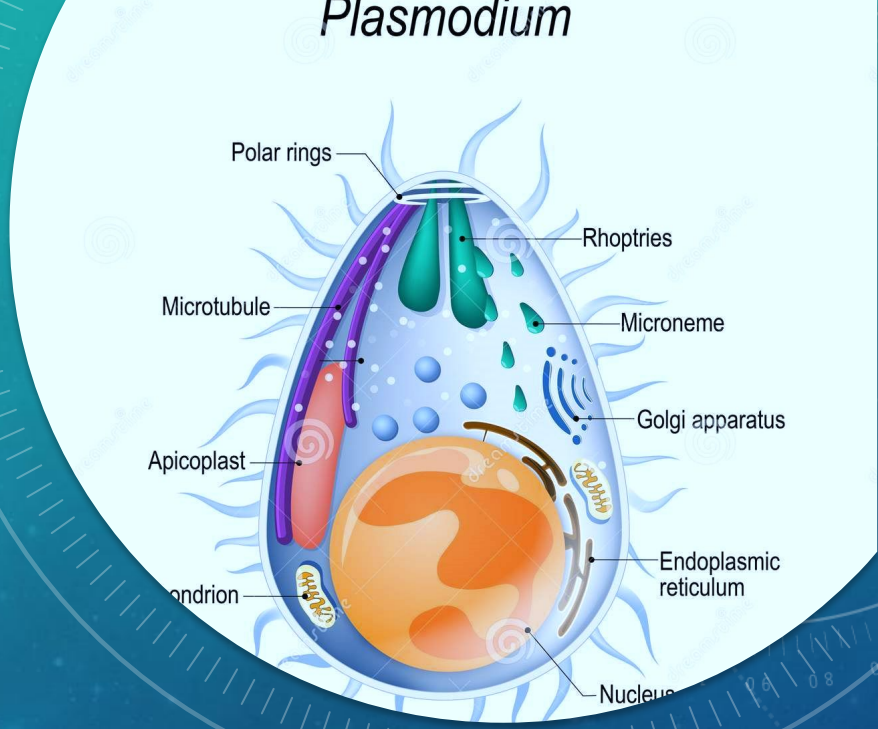
CLASS ZOOMASTIGOPHORA

- ZOOMASTIGOPHORA, THE FLAGELLATES, HAVE ONE OR MORE WHIP-LIKE FLAGELLA AND, IN SOME CASES, AN UNDULATING MEMBRANE (EG, TRYPANOSOMES). THESE INCLUDE INTESTINAL AND GENITOURINARY FLAGELLATES (GIARDIA, TRICHOMONAS, DIENTUMOEBA, CHILOMASTIX) AND BLOOD AND TISSUE FLAGELLATES (TRYPANOSOMA, LEISHMANIA).



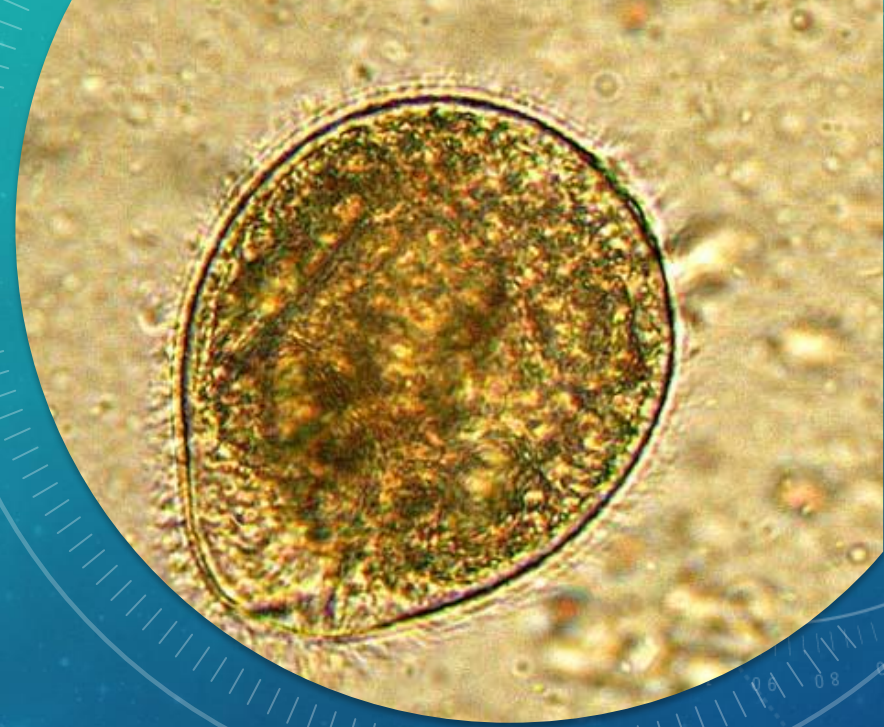
CLASS SPOROZOA

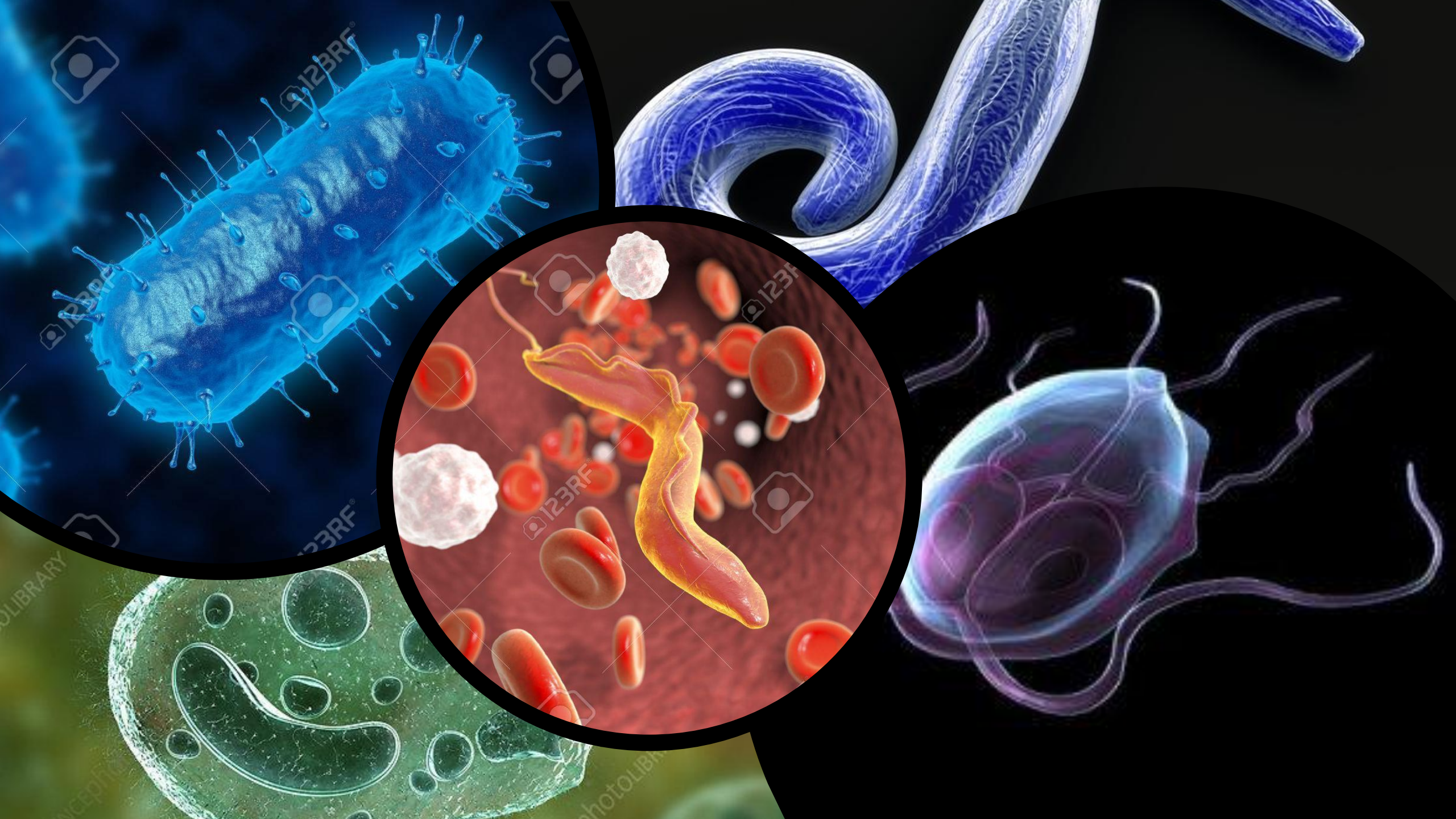
- SPOROZOA UNDERGO A COMPLEX LIFE CYCLE WITH ALTERNATING SEXUAL AND ASEXUAL REPRODUCTIVE PHASES, USUALLY INVOLVING TWO DIFFERENT HOSTS (EG, ARTHROPOD AND VERTEBRATE, AS IN THE BLOOD FORMS). THE SUBCLASS COCCIDIA CONTAINS THE HUMAN PARASITES ISOSPORA, TOXOPLASMA, AND OTHERS. AMONG THE HAEMOSPORINA (BLOOD SPOROZOANS) ARE THE MALARIA PARASITES (PLASMODIUM SPECIES).



CLASS CILIOPHORA

- CILIOPHORA IS A COMPLEX PROTOZOON BEARING CILIA DIS- TRIBUTED IN ROWS OR PATCHES, WITH TWO KINDS OF NUCLEI IN EACH INDIVIDUAL. BALANTIDIUM COLI, A GIANT INTESTINAL CILIATE OF HUMANS AND PIGS, IS THE ONLY HUMAN PARASITE REPRESENTATIVE OF THIS GROUP.





FOR BETTER UNDERSTANDING

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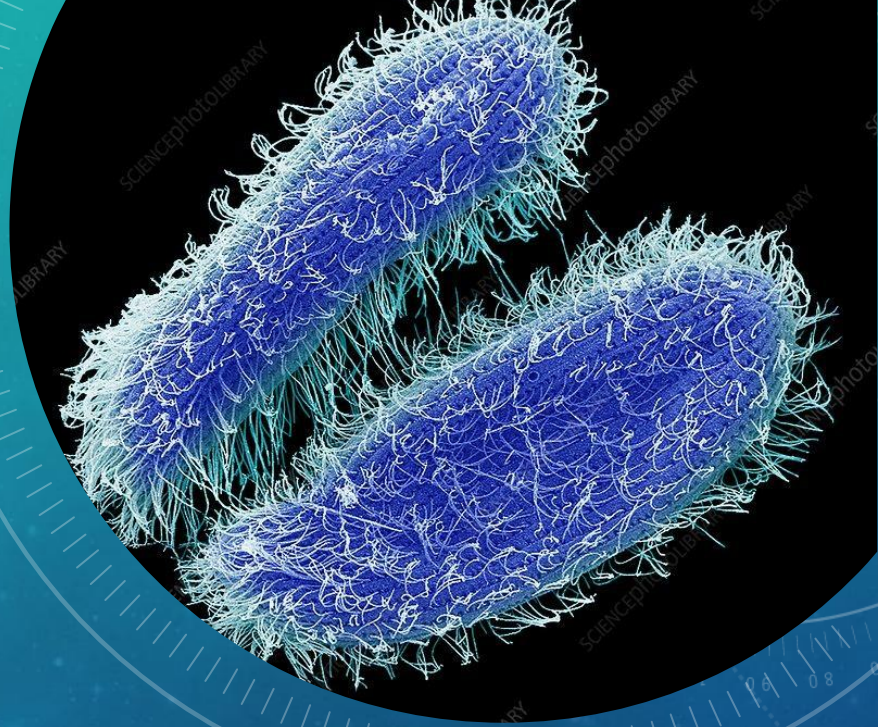


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