Introduction to Protozoology

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Teaching Learning Outcomes (TLOs)

1. Classify protozoan parasites of medical importance

- Types of classification
- Description of classification

2. Describe characteristics of protozoa for its identification

- Morphology, Stage, Reproduction,
- Motility structure, Life cycle, Transmission, Prevention

3. Differentiate protozoa from artifacts

- Artifacts
- Characteristics of artifacts

1. Classify protozoan parasites of medical importance

- Types of classification
  - Taxonomy (Phylum)
  - Motile structure

PHYLUM	PARASITE	DISEASE
1. Sarcomastigophora		
Subphylum Sarcodina	*Entamoeba histolytica*/ dispar* *E. coli* *Endolimax nana* *Iodamoeba buetchlii* *Blastocystis hominis* *Acanthamoeba sp.* # *Naegleria fowleri*#	Amoebiasis Blastocystosis Acanthamoeba keratitis Primary amebic meningoencephalitis Granulomatous amebic encephalitis
Subphylum Mastigophora	*Giardia lamblia/ intestinalis** *Chilomastix mesnili* *Enteromonas hominis* *Dientamoeba fragilis** *Trichomonas vaginalis* *Leishmania sp.* * *Trypanosoma sp.* *	Giardiasis Trichomoniasis Leishmaniasis Trypanosomiasis
2. Ciliophora	*Balantidium coli*#	Balantidiasis

1. Classify protozoan parasites of medical importance

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  - Taxonomy (Phylum)
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PHYLUM	PARASITE	DISEASE
3. Apicomplexa		
Sporozoa	Coccidia *Cryptosporidium parvum* *Isospora belli/ Cystoisopora belli* *Cyclospora cayetanensis* Blood & Tissue *Plasmodium spp.* *Babesia microti* Tissue *Toxoplasma gondii*	 Cryptosporidiasis Isosporiasis/ Cystoisoporiasis Cyclosporiasis Malaria Babesiosis Toxoplasmosis
4. Microspora	*Microsporidium* spp. *Enterocytozoon bieneusi*	Microsporidiosis

Source: 1. Heelan, J.S. & Ingersoll F.W. (2004). Essential of Human Parasitology. Thomson Delmar Learning.

1. Classify protozoan parasites of medical importance

- Types of classification
  - Taxonomy (Phylum)
  - Motile structure

Example: Taxonomy of a pathogenic parasite found in human

CLASSIFICATION	NAME	EXAMPLE (*Genus* sp.)
Kingdom	**Protista**	
Subkingdom	**Protozoa**	
Phylum	**Sarcomastigophora**	
Subphylum	**Sarcodina**	
Class	**Lobosea**	
Order	**Amoebida**	
Family	**Endamoebidae**	
Genus	***Entamoeba***	
Species	***histolytica***	***Entamoeba histolytica***

1. Classify protozoan parasites of medical importance

- Types of classification
  - Taxonomy (Phylum)
  - Motile structure

MOTILE STRUCTURE	PARASITE	DISEASE
1. Pseudopods (Amoeba)	**Examples of amoebae or sarcodina:** *Entamoeba histolytica/ dispar* *E. coli* *Endolimax nana* *Iodamoeba buetchlii* *Blastocystis hominis** *Acanthamoeba sp.* *Naegleria fowleri*	 Blastocystosis Acanthamoeba keratitis Primary amebic meningoencephalitis Granulomatous amebic encephalitis
2. Flagella (Flagellate)	**Examples of flagellate or mastigophora:** *Giardia lamblia/ intestinalis* *Dientamoeba fragilis* *Trichomonas vaginalis* *Leishmania sp.* *Trypanosoma sp.*	Giardiasis Trichomoniasis Leishmaniasis Trypanosomiasis
3. Cilia (Cilliate)	**Examples of cilliate:** *Balantidium coli*	Balantidiasis
4. Gliding motility (microfilament and microtubule based cytoskeletal systems) **(Sporozoa)**	*Cryptosporidium parvum* *Isospora belli/ Cystoisopora belli* *Cyclospora cayetanensis* *Plasmodium spp.* *Babesia microti* *Toxoplasma gondii*	Cryptosporidiasis Isosporiasis/ Cystoisoporiasis Cyclosporiasis Malaria Babesiosis Toxoplasmosis

1. Classify protozoan parasites of medical importance

- Description of classification (Taxonomy)

PHYLUM	DESCRIPTION
1. Sarcomastigophora	• Amaoebae: cytoplasmic protrusions (pseudopods/ false feet); shapeless; • Flagellates: whip-like appendages (flagella) • Asexual reproduction (most) • Pathogenic* (some) • Free-living# (some)
2. Ciliophora	• Cilliates: thread-like extensions/ hair-like (cillia), shorter, numerous than flagella, arise from small basal granules • 2 different sorts of nuclei: a small, diploid micronucleus (reproduction) and a large macronucleus (general cell regulation) • Free-living & non-pathogenic (most) • Pathogenic (*B. coli*)

1. Classify protozoan parasites of medical importance

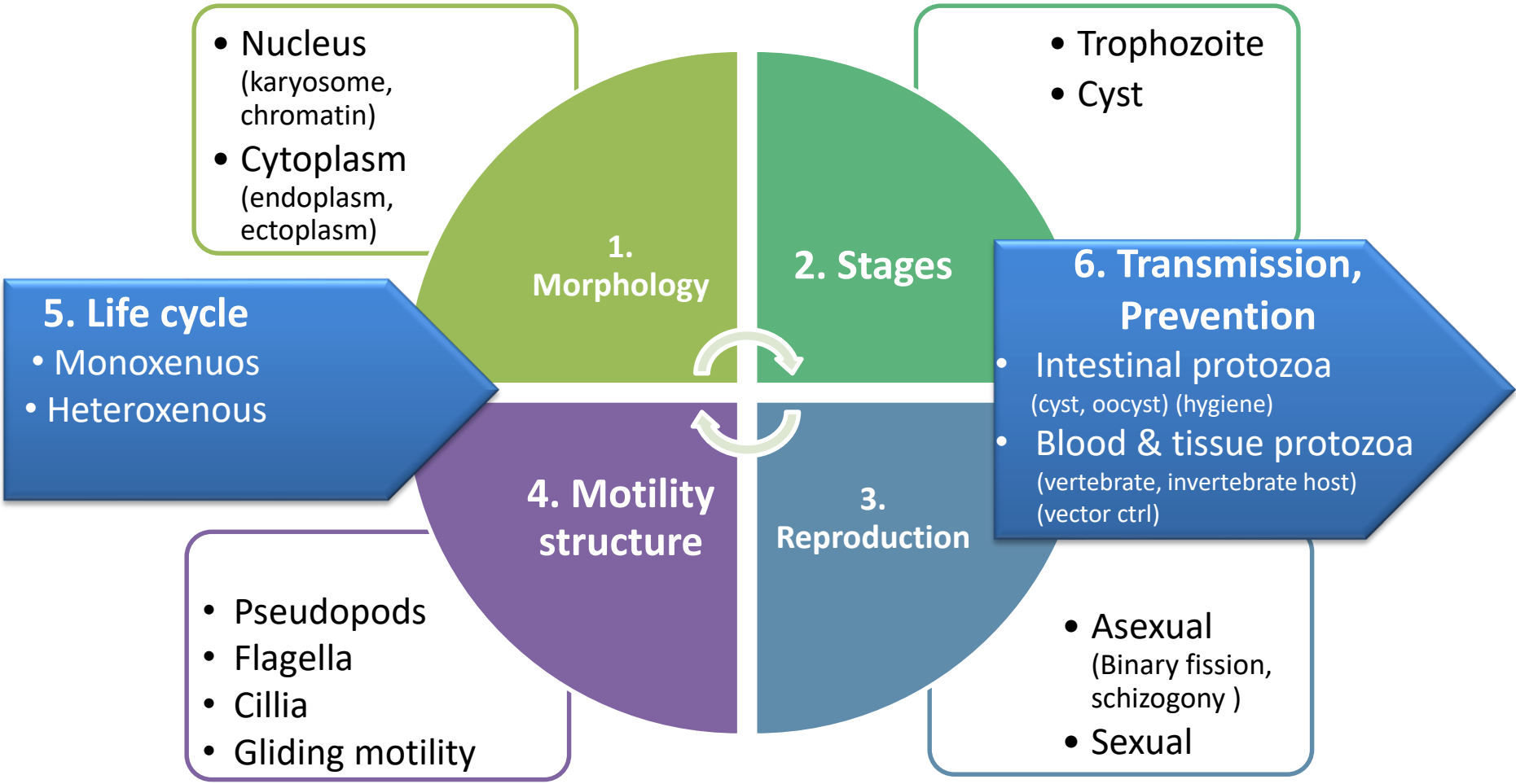
- Description of classification (Taxonomy)

PHYLUM	DESCRIPTION
3. Apicomplexa	• Sporozoa: complex life cycles (alternating sexual & asexual generations) • Pathogens: Coccidia (intestinal mucosa) • Have apicoplast and an apical complex structure involved in penetrating a host's cell (most) • Motile structures (flagella or pseudopods):present in certain gamete stages
4. Microspora	• Tiny intracellular parasites • Immunocompetent (rare) vs immunocompromised

Source: 1. Heelan, J.S. & Ingersoll F.W. (2004). Essential of Human Parasitology. Thomson Delmar Learning.
2. http://parasitologyillustrated.com/index.html

2. Describe characteristics of protozoa for its identification

- Morphology, Stage, Reproduction,
- Motility structure, Life cycle, Transmission, Prevention



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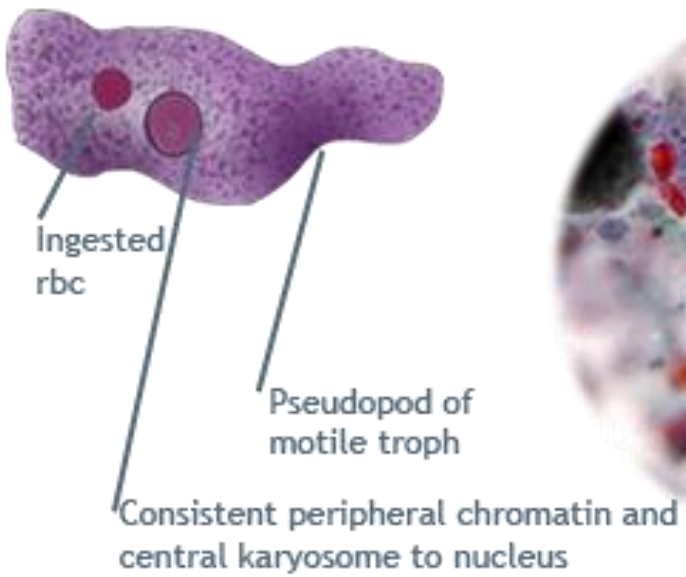
Example: *E. histolytica*

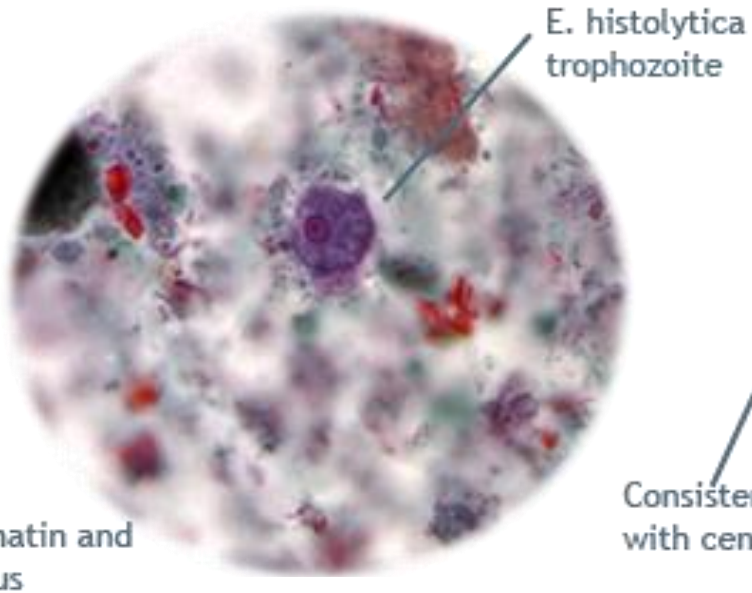
Characteristics	Trophozoites	Cysts
Size (μm)	10 - 60	10 - 20
Nucleus	1	mature cyst of *E. histolytica* (4)
Chromatin	Bead-like arrangement of peripheral clear chromatin	Evenly distributed peripheral clear chromatin
Karyosome	Present	Present
Chromatoid body	Absent	Present (blunt, smooth & rounded ends)
Motile structure	Pseudopods	Absent
Glycogen vacuoles	Absent	Present in immature cyst

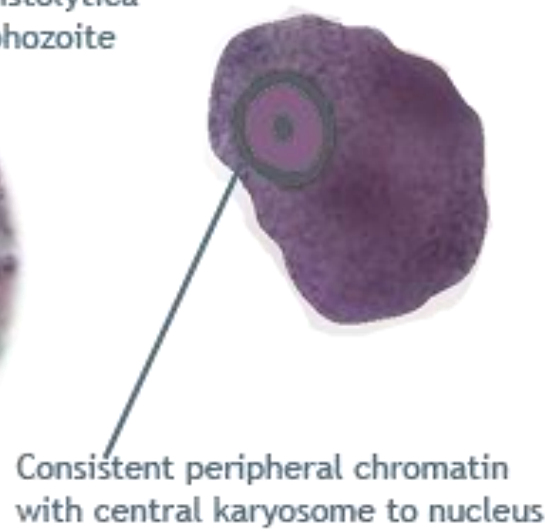
2. Describe characteristics of protozoa for its identification

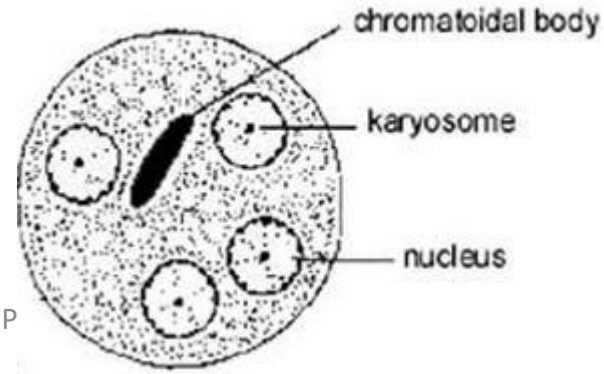
- Morphology, Stage, Reproduction,
- Motility structure, Life cycle, Transmission & Prevention

Example: *E. histolytica*



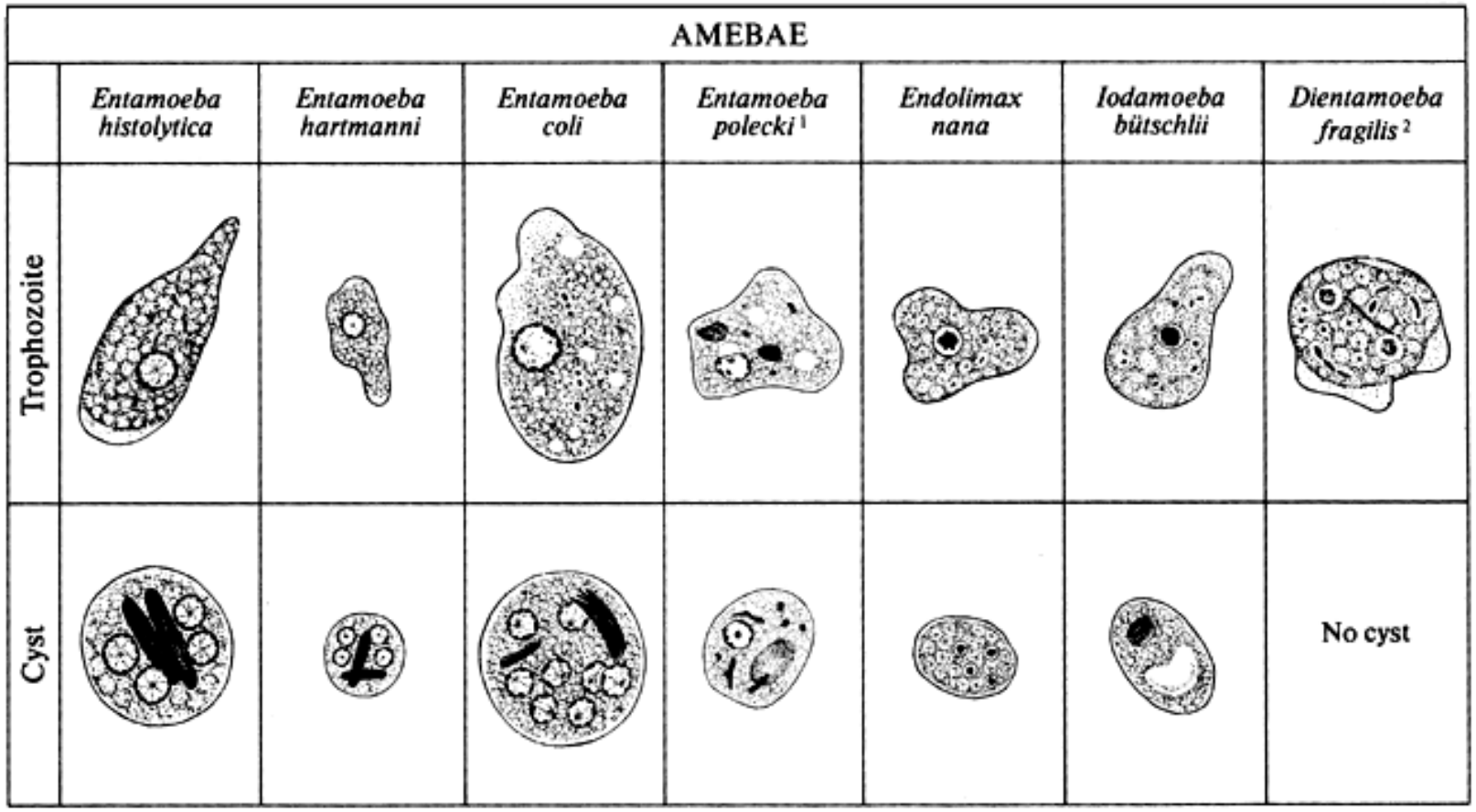






2. Describe characteristics of protozoa for its identification

- Intestinal Protozoa



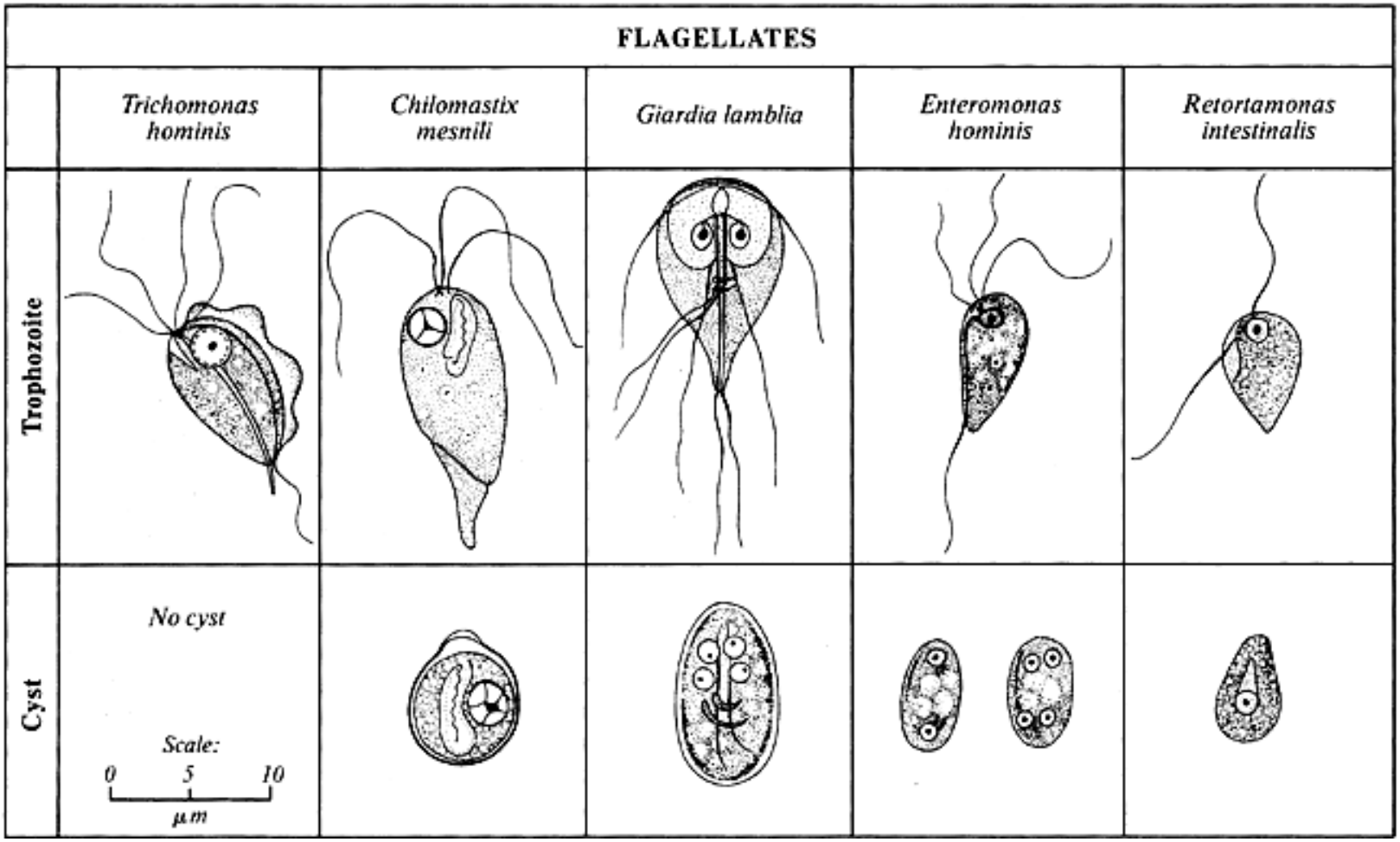
[1]Rare, probably of animal origin
[2]Flagellate

Scale: 0 5 10 μm

Adapted from Brooke and Melvin, 1964

2. Describe characteristics of protozoa for its identification

- Intestinal Prorozoa



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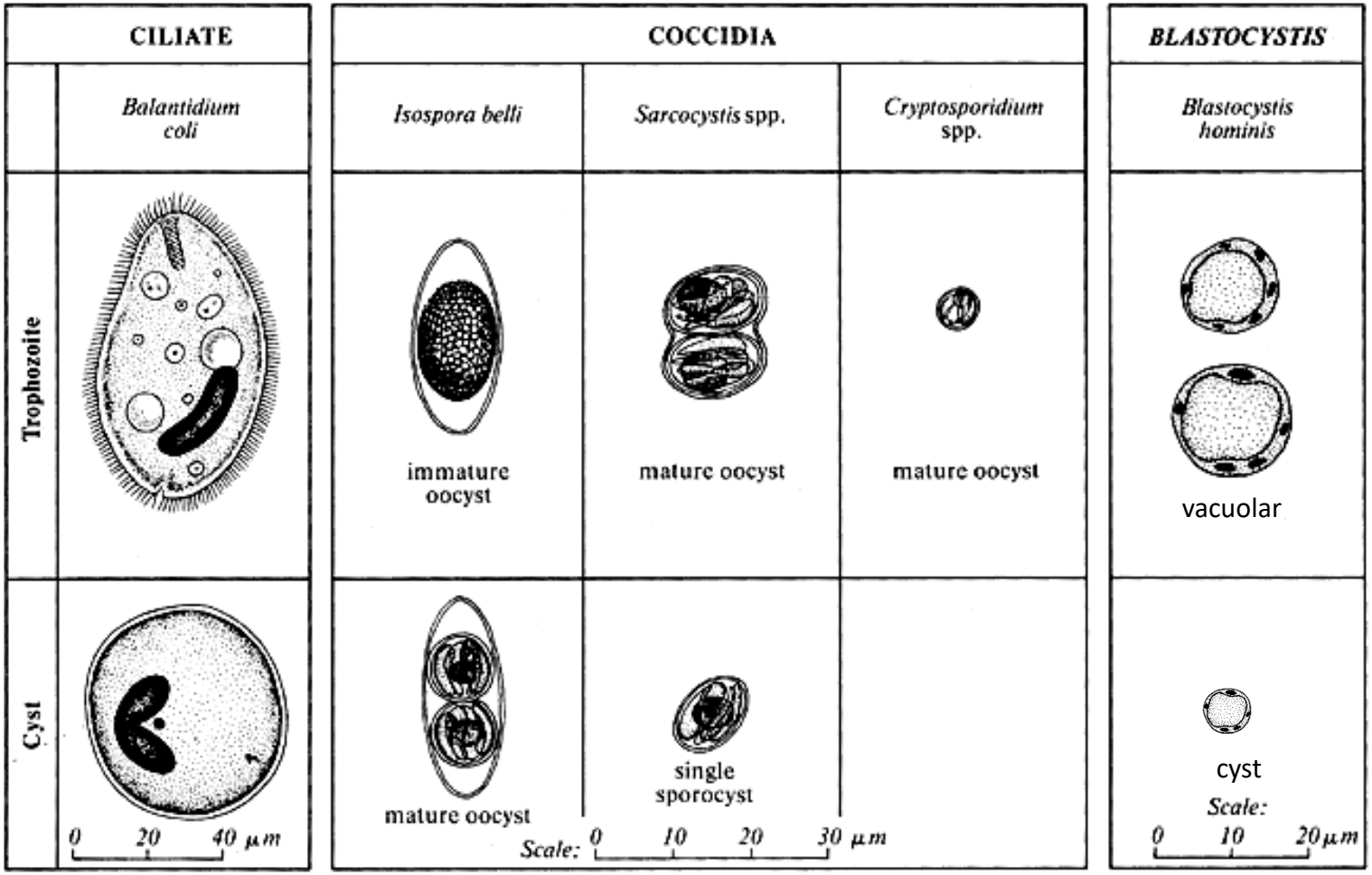
- Intestinal Protozoa

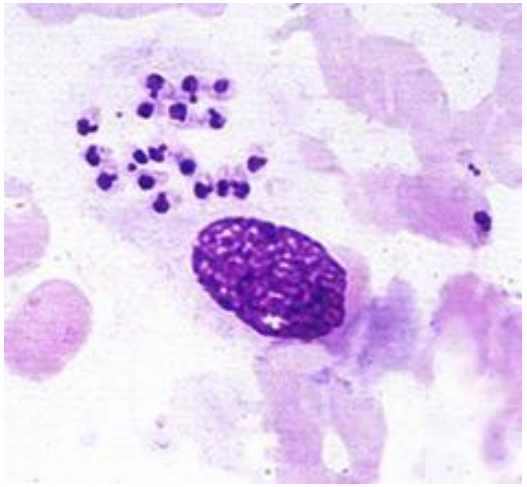


Source: http://www2.bc.cc.ca.us/bio16/pal/Parasitology.htm

2. Describe characteristics of protozoa for its identification

- Blood and Tissue/ Atrial Flagellates

Trypanasoma spp.

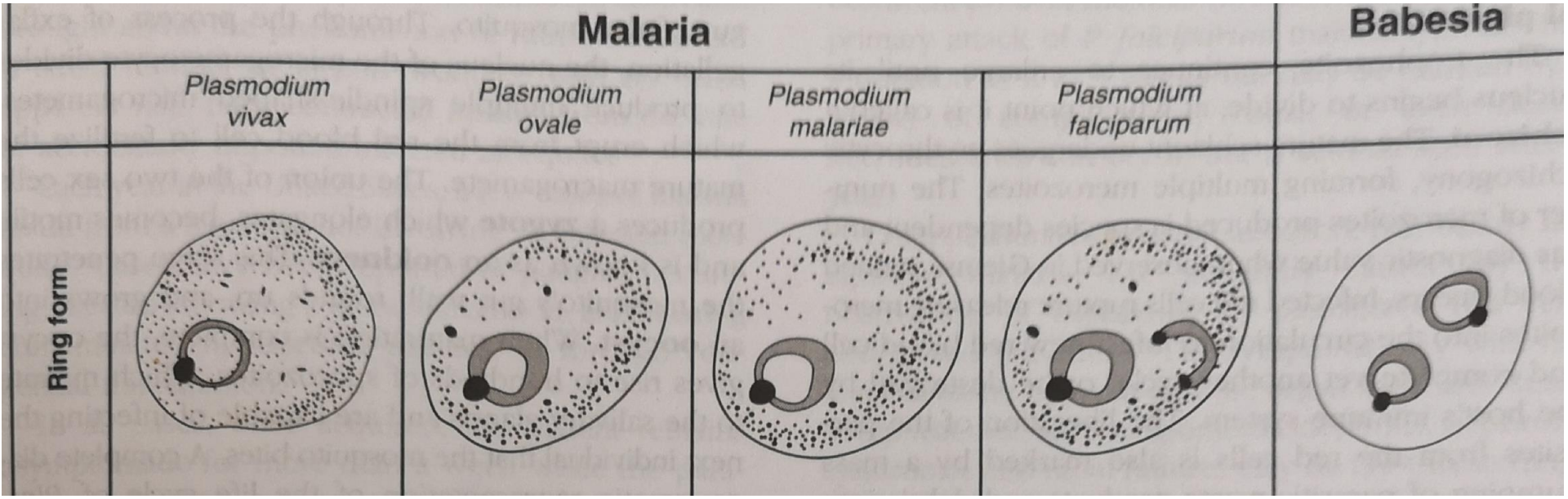


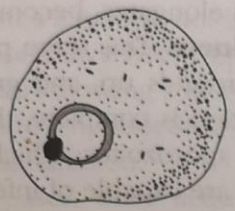
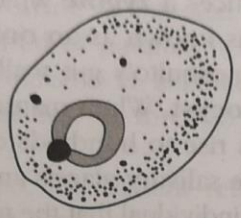
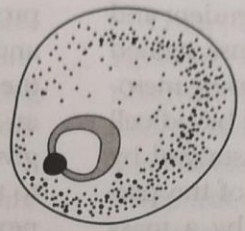
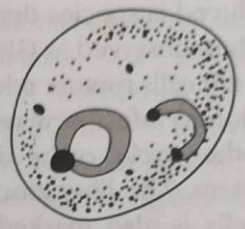
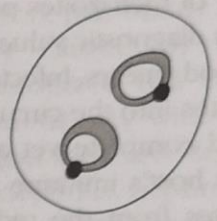
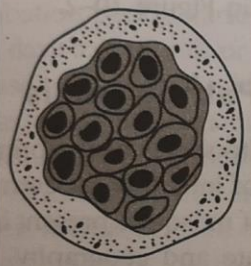
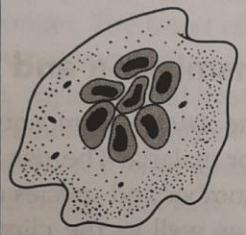
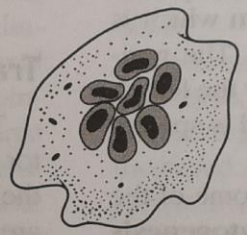
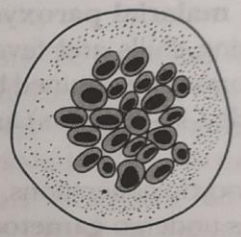
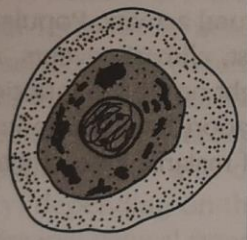
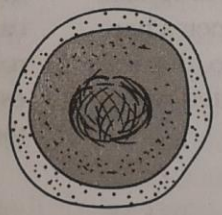
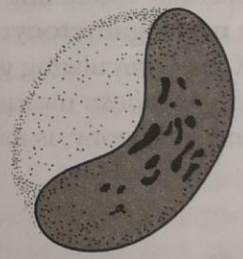
Leishmania spp.

Trichomonas vaginalis

2. Describe characteristics of protozoa for its identification

- Blood and Tissue Sporozoa



	Malaria				Babesia
	Plasmodium vivax	*Plasmodium ovale*	*Plasmodium malariae*	*Plasmodium falciparum*	
Ring form					
Schizont					
Microgametocyte					
Macrogametocyte					

3. Differentiate protozoa from artifacts

- Artifacts (Human & non-human elements)
- Characteristics of artifacts

Structures That Mimic Protozoan Parasites

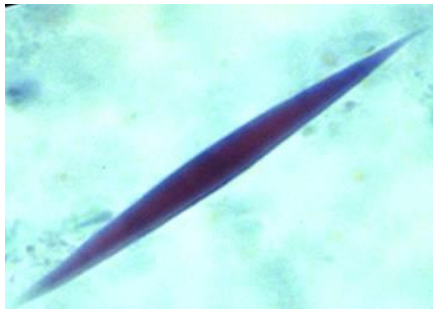
Artifact	Parasite	Distinguishing Characteristics of Artifact
Polymorphonuclear leukocyte (PMN)	*Entamoeba histolytica* cyst	Granular or frothy cytoplasm; nuclear/cytoplasmic ratio 1:1; presence of chromatin bands
Macrophage	*E histolytica* or *Entamoeba coli* trophozoites	Ingested PMNs, round red bodies; nuclear/cytoplasmic ratio 1:4 to 1:6; debris-filled cytoplasm
Squamous and columnar epithelial cells	Amebic trophozoites other than *E histolytica*	Large single nucleus; distinct cell border; smooth cytoplasm that stains poorly
Yeasts	Protozoan cysts including *Cyclospora*, *Cryptosporidium*, and *Microsporidium* species	Size (for some); thick refractile cell wall; cytoplasm uniform with little internal structure; no nucleus; presence of budding forms
Starch granules	Protozoan cysts if 6-19 µm in size	Round to angular form; refractility; no internal structure or nucleus; staining characteristics with iodine

Source: *Colmer-Hamod JA. Fecal Microscopy Artifacts Mimicking Ova and Parasites. Laboratory Medicine. 2001;32(2):80-84*

3. Differentiate protozoa from artifacts

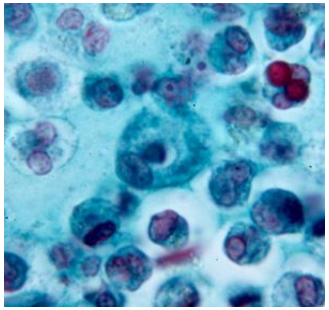
- Artifacts (Human & non-human elements)
- Characteristics of artifacts

Artifacts: Human elements



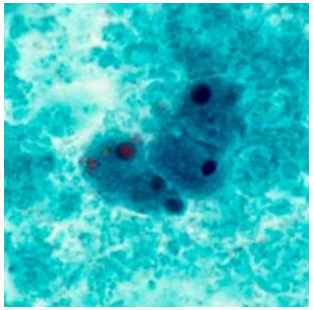
1. Charcot-Leyden Crystals

- Product of eosinophil breakdown
- Occasionally found in faeces of patients suffering from parasitic disease



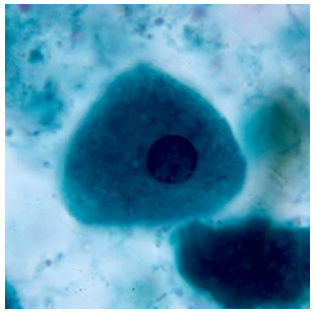
2. White blood cells

- confused with trophozoites of amoebae



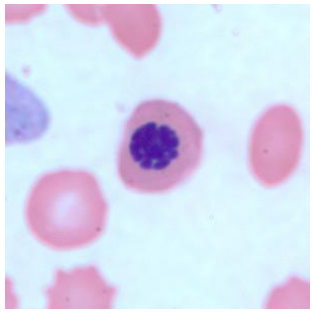
3. Macrophages

- confused with trophozoites of amoebae



4. Epithelial cells

- confused with trophozoites of *Entamoeba*



5. Red blood cells

- Nucleated red blood cell
- confused with schizonts of *Plasmodium* spp.

Source: *1. http://www.cdc.gov/dpdx/artifacts/#*
2. http://www.provlab.ab.ca/webbug/parasite/artifact/artifacts.htm

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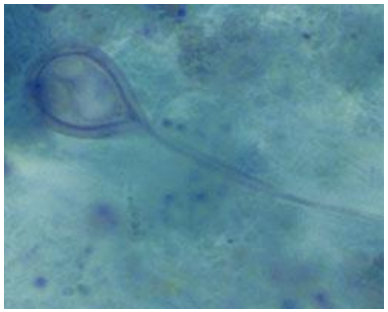
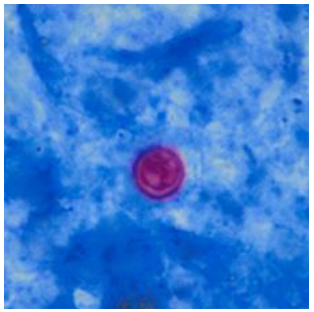
Artifacts: Non-human elements



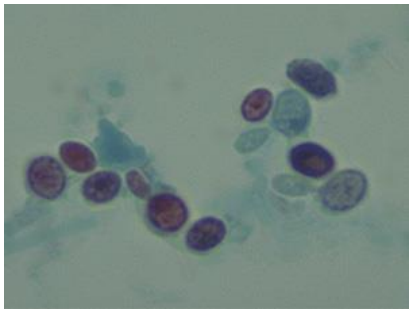
1. Spore

- confused with trophozoite of *Giardia* sp.
- lack of 2 anterior nuclei, dark stained median body and axonemes



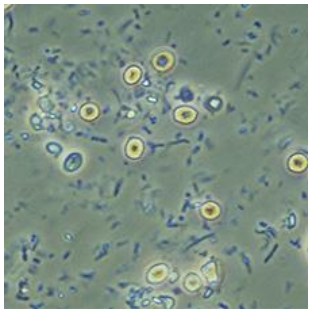
2. Seed

- confused with oocyst of *Cryptosporidium* spp.
- thick outer-membrane, lack of internal structure



3. Yeasts (stained)

- confused with cysts of protozoa
- but, lack nucleus
- budding forms may be seen



4. Yeasts (wet prep.)

- confused with cysts of protozoa
- confirmed with acid-fast stain. (coccidian: pink-red; yeast: green)

5. Air bubbles

- confused with cysts of protozoa (*Blastocystis* spp.)

Source: *1. http://www.cdc.gov/dpdx/artifacts/#*
2. http://www.provlab.ab.ca/webbug/parasite/artifact/artifacts.htm

Recall TLOs

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Thank you