Pathologic Protozoa

CHARACTERISTICS OF PROTOZOA

- 1. Unicellular
- 2. Chemoheterotrophs (get their energy by breaking down organic matter).
- 3. Most ingest their food; thus, they have special structures for this.

CHARACTERISTICS OF PROTOZOA

- 4. The vegetative form is the TROPHOZOA (tropho = movement; zoite = animal; they move like an animal). Trophozoa have special organelles for movement.
- 5. Capable of reproduction

  A. Asexual: fission, budding, or schizogony

  (produces a large number of trophozoites)

  B. Sexual: conjugation

CHARACTERISTICS OF PROTOZOA

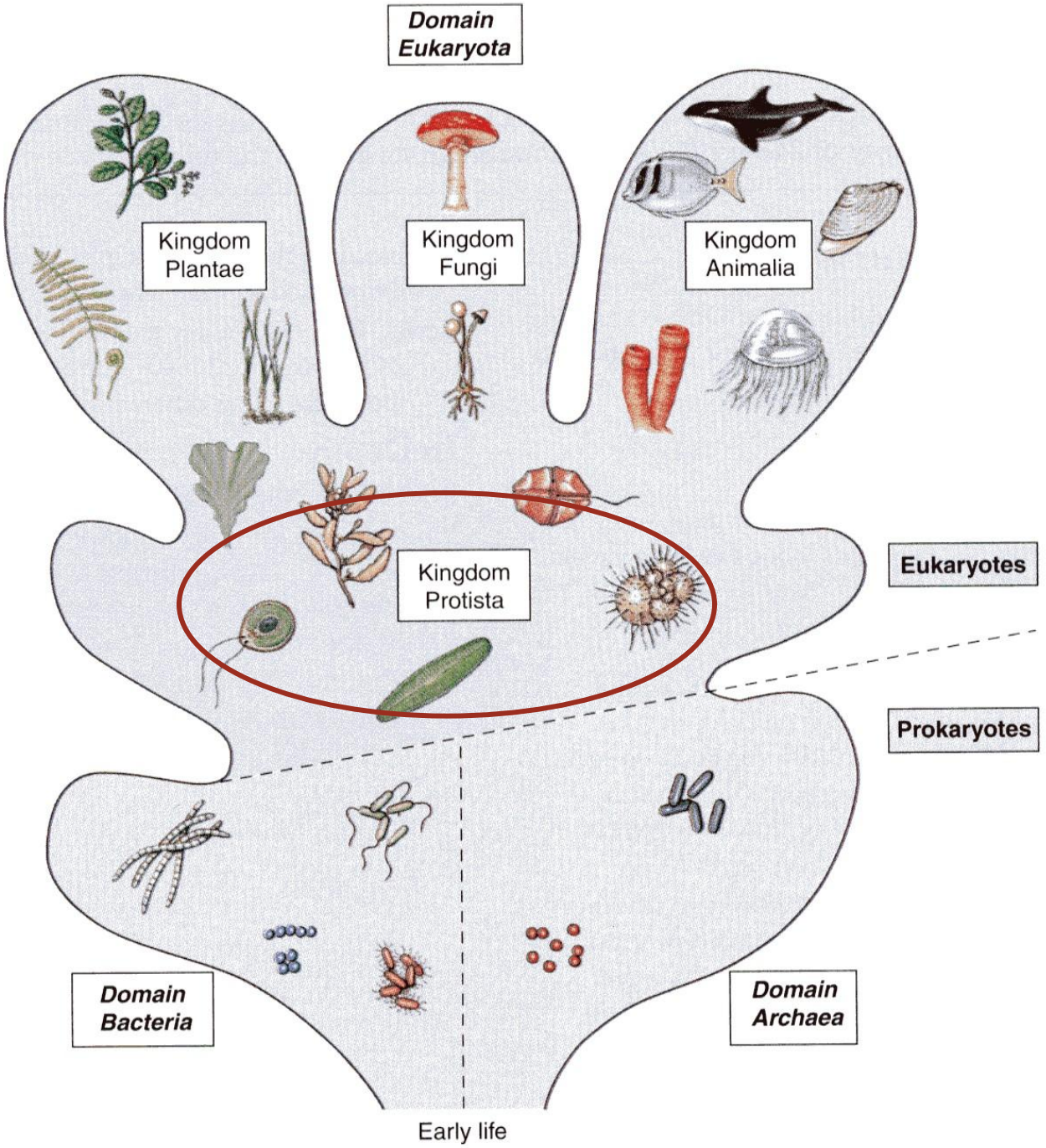
- 6. Some produce cysts.
- These are not tissue cysts like a human gets under their skin; protozoa cysts are cellular.
- They have a thick cell wall that allows for survival in harsh environments better than the trophozoite form.

PROTOZOA CYSTS

- Cysts are not as resistant as a bacterial endospore.
- You can kill cysts by boiling them.
- They can live in the soil or water for months.
- A cyst is no motile, so it is not trophozoic.
- A cyst does not procure its nutrients or ingest food, but it can absorb nutrients.
- It has no organelles to ingest food.

Classification

Domain: Eukaryotes
Kingdom: Protista



Classification

- Traditional classification of protozoa phylae was based on mode of locomotion.
  - **MASTIGOPHORA (flagella)**
  - **CILIOPHORA (cilia)**
  - **SARCODINA (amoebas)**
  - **SPOROZOA (spore-formers)**
    - **Apicomplexa (attachment organ)**

Modern Classification

Modern classification of protozoa is based on how they evolved and how closely related they are (phylogenetic taxonomy), as determined by their ribosomal RNA. The human pathogenic protozoa may be classified as follows:

- METAMONADA (multiple flagella with feeding grooves)
- AMOEBOZOA (amoebas)
- APICOMPLEXA (attachment organ)
- CILIOPHORA (cilia)
- EUGLENOZOA (flagella and disc-shaped cristae in mitochondria)

EUGLENOZOA

EUGLENOZOA (older classification = Mastigophora): has flagella and its mitochondria have disc-shaped cristae

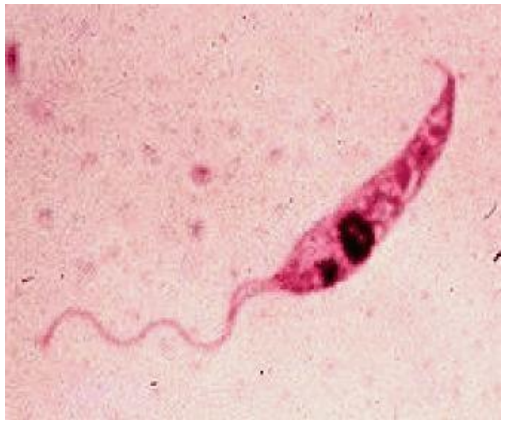
- Organisms
  - *Trypanosoma*
    - Disease: Trypanosomiasis
  - *Leishmania donovani*
    - Disease: Leishmaniasis

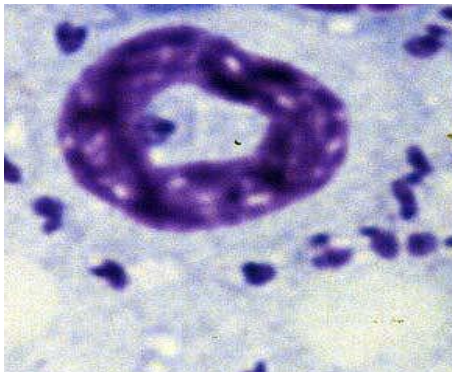
MASTIGOPHORA DISEASES

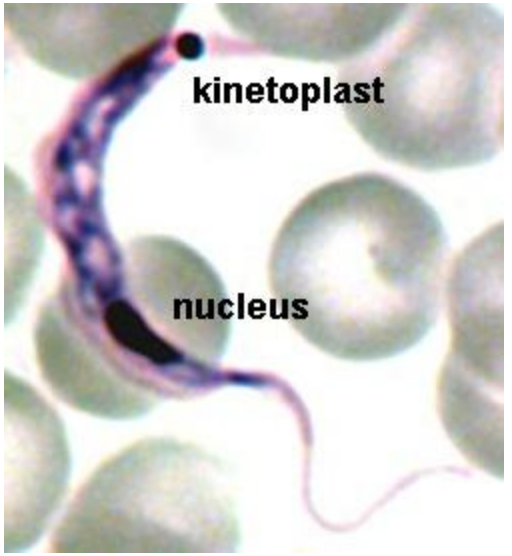
- Trypanosomiasis
- Leishmaniasis

TERMS

- Promastigote: has single flagella
- Amastigote: has no flagella
- Kinetoplast: round mass of circular DNA







Leishmania donovani

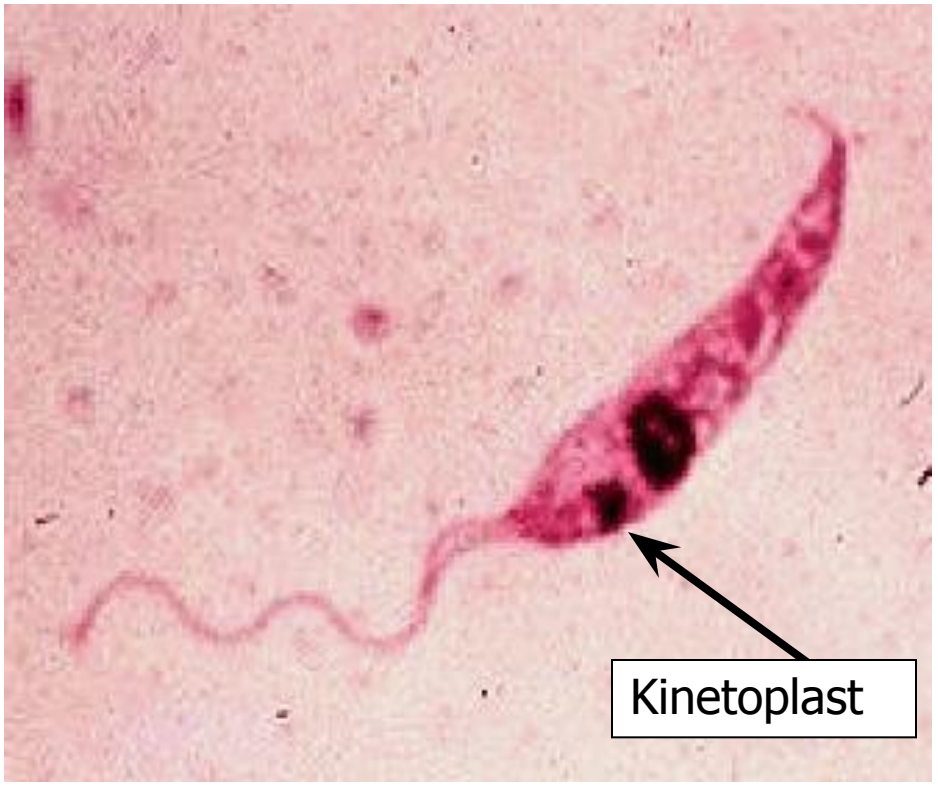
- Domain: Eukaryota
- Kingdom: Protista
- Phylum: Mastigophora
- Class: Kinetoplastida
- Order: Trypanosomatida
- Genus: *Leishmania*
- Species: *donovani*

Leishmania donovani

- **Disease:** Leishmaniasis
- Vector-borne disease transmitted by sandflies.

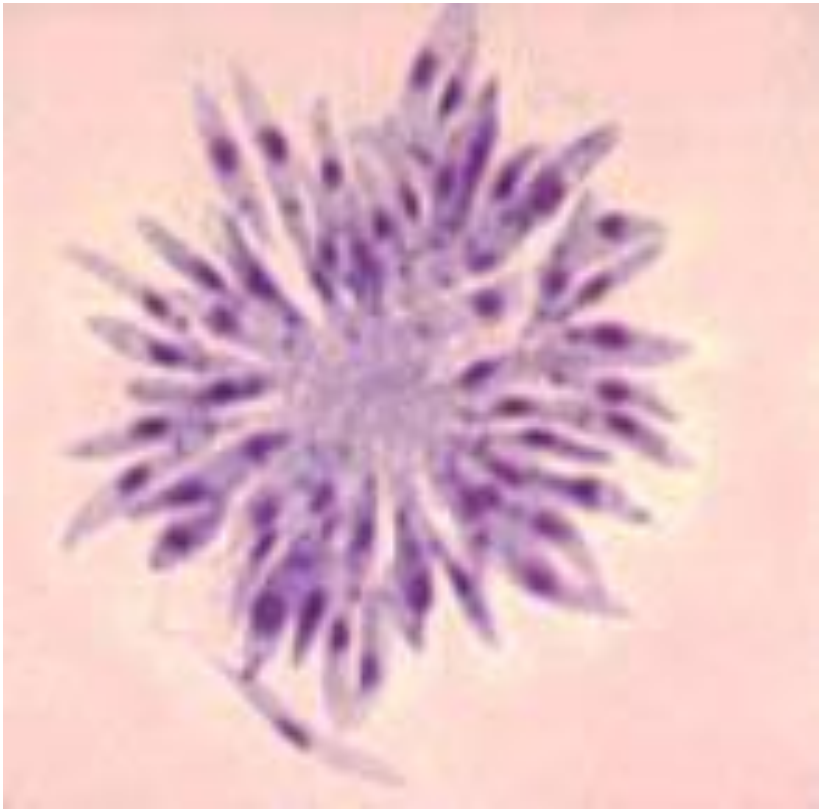
Leishmania Life Cycle

- It starts out as a spindle-shaped, single flagellated cell called a promastigote (mastigote means flagella).
- You can also see the nucleus and a kinetoplast (mass of circular DNA).

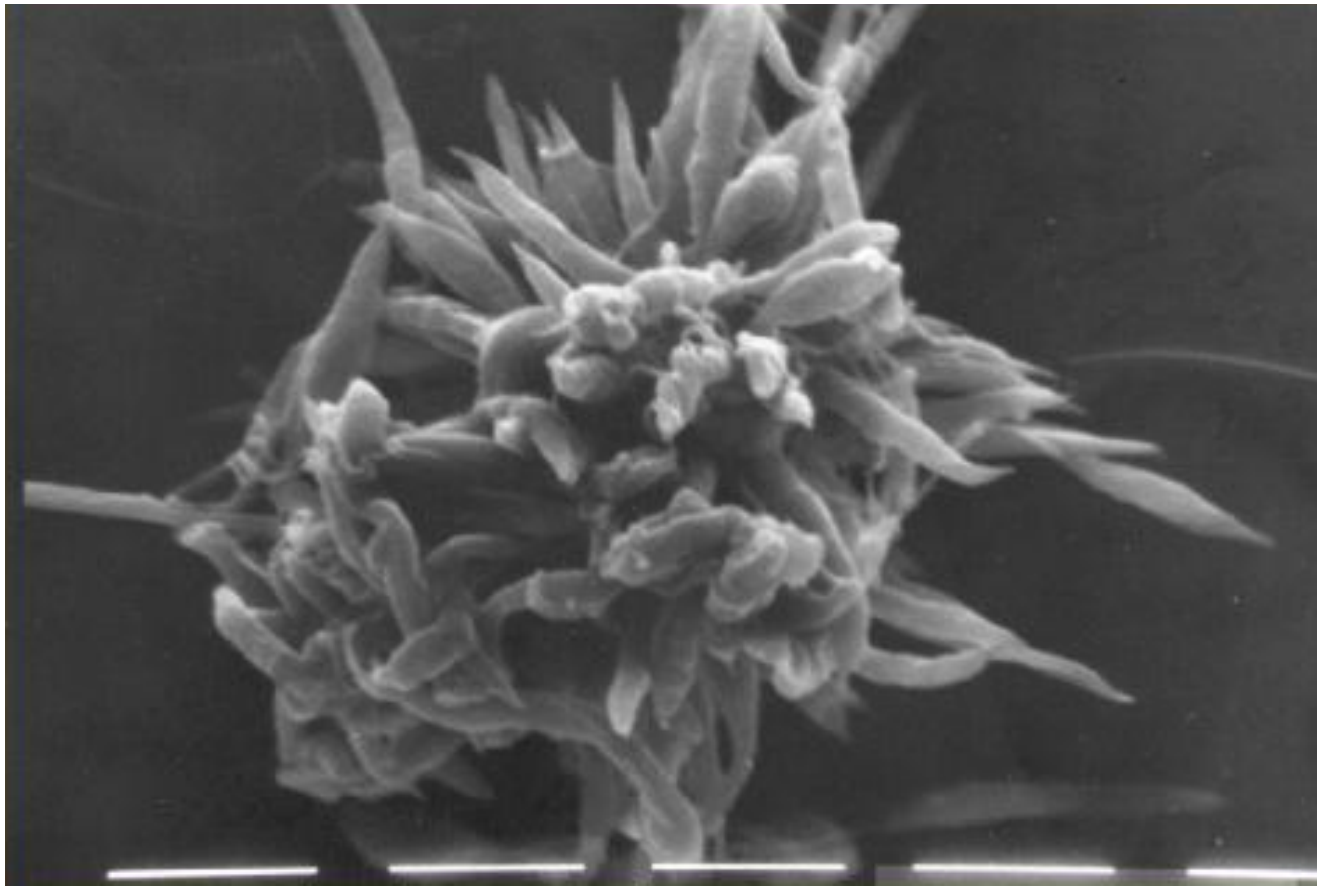


Leishmania rosette

- In prepared slides you can see promastigotes align their nose in a circle, called a rosette.



Leishmaniasis rosette



Leishmania Life Cycle

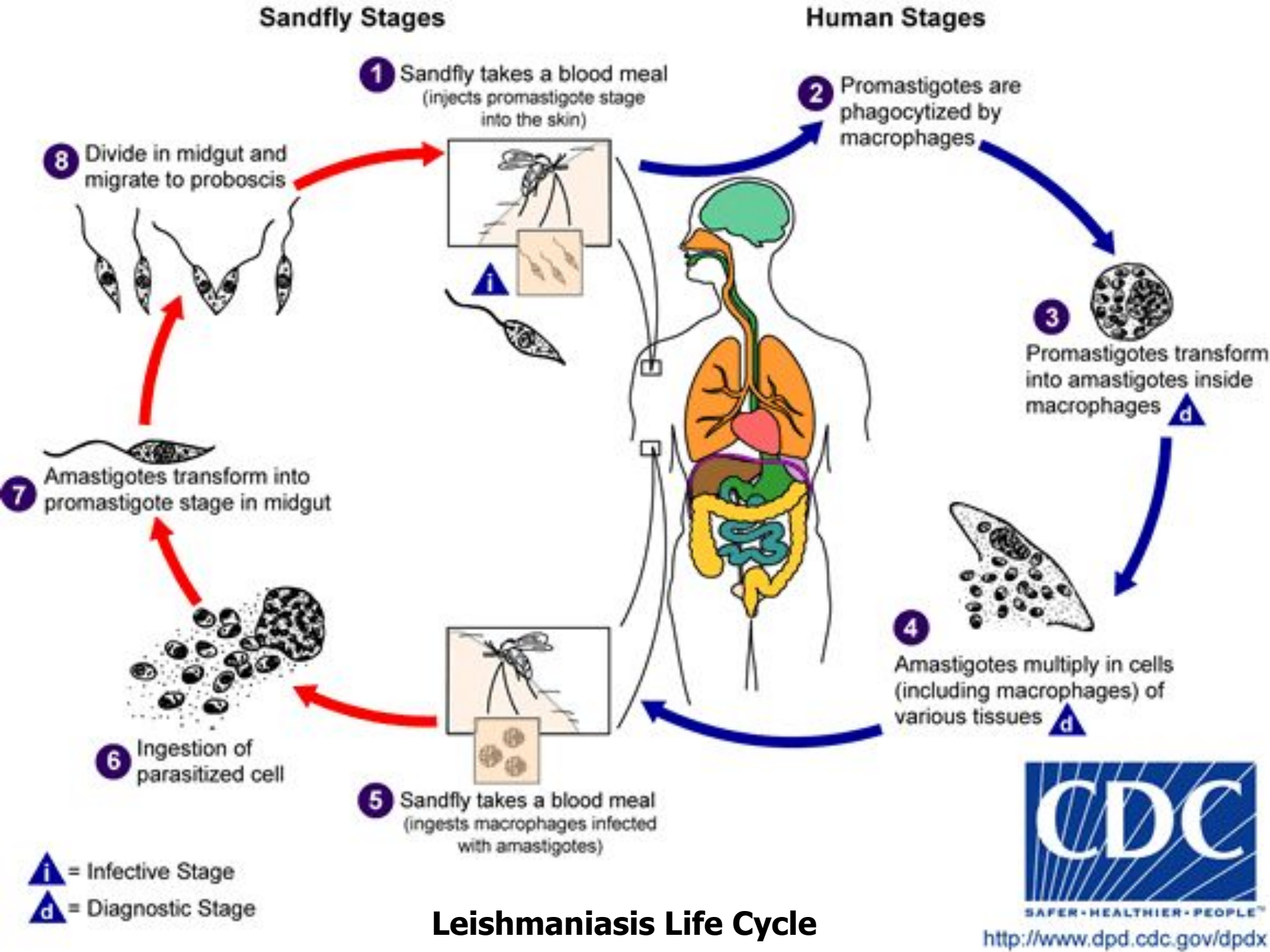
- It reproduces in the gut of a female sandfly, and migrates to her proboscis (mouth part).
- It is introduced into the human by her bite.
- It then enters a macrophage and becomes intracellular.
- Here, it loses its flagella and is now known as an amastigote.

Leishmaniasis

- These amastigotes multiply in various organs including the spleen, liver, and lymph nodes.
- Symptoms include lymph adenopathy, fever, weight loss, and a decrease in all blood cells.
- The treatment is almost as bad as the disease because of the side effects. It is best to catch it early.

Leishmania Life Cycle

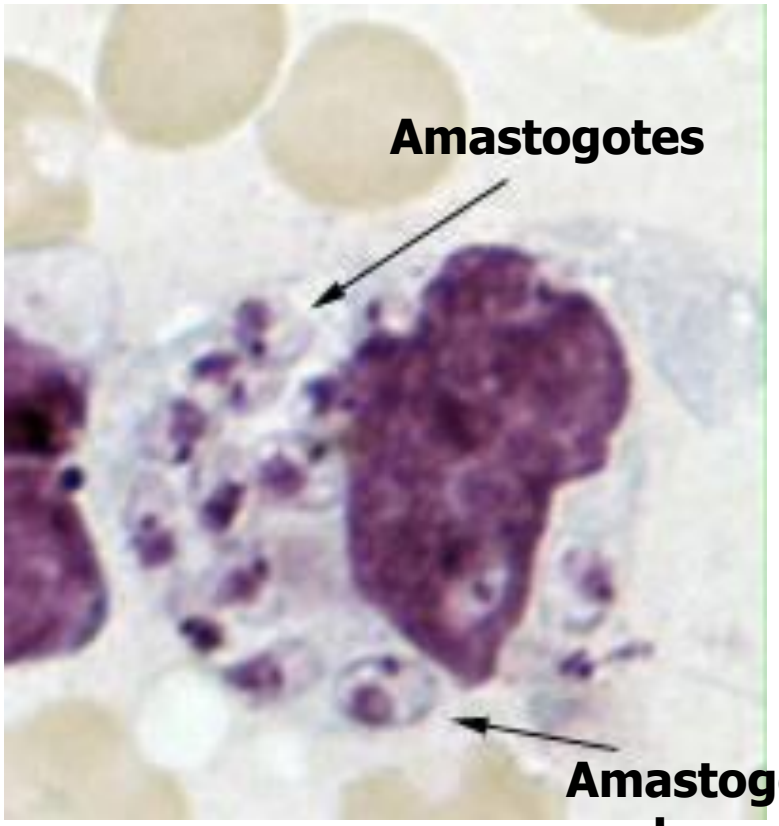
- The female sandflies inject the infective stage, promastigotes, during blood meals.
- Macrophages phagocytize them and they transform into amastigotes.
- Other sandflies become infected during blood meals when they ingest infected macrophages.
- In the sandfly's midgut, the parasites differentiate into promastigotes, which multiply and migrate to the proboscis.



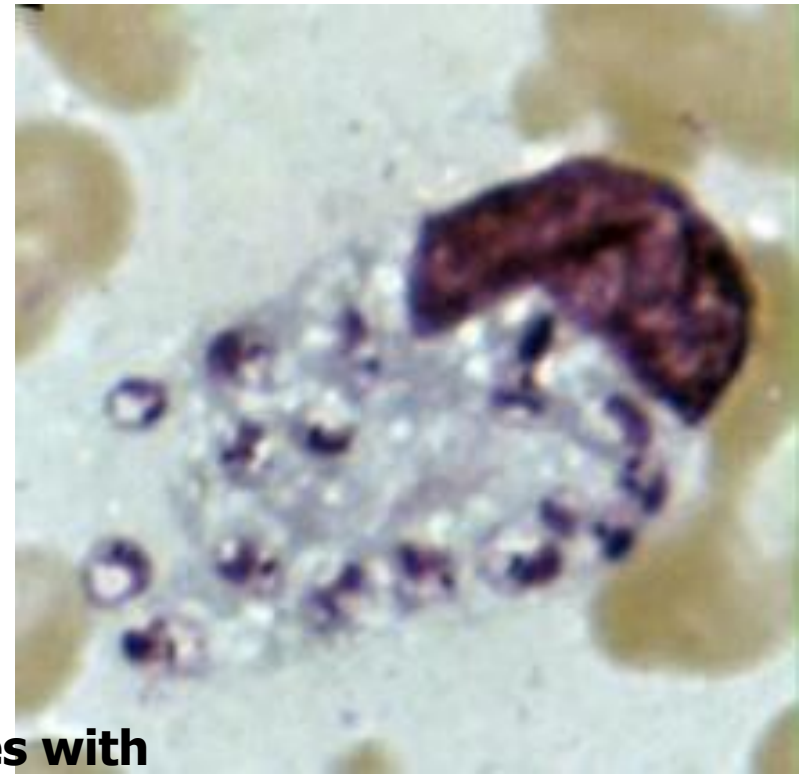
Leishmaniasis Life Cycle

Leishmania donovani
(Promastigote)
Single flagellum found in sand flies

Leishmaniasis

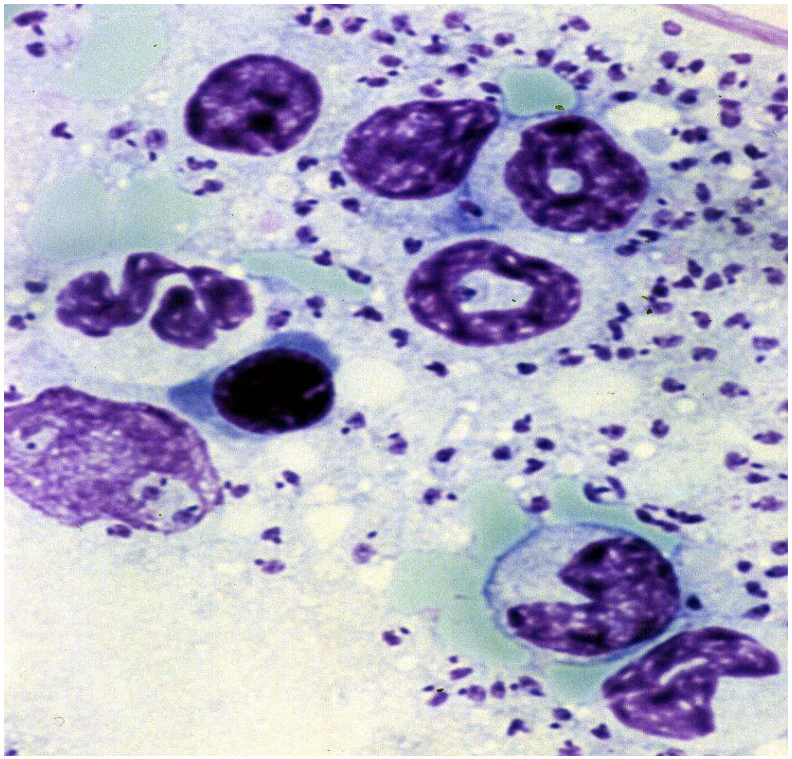


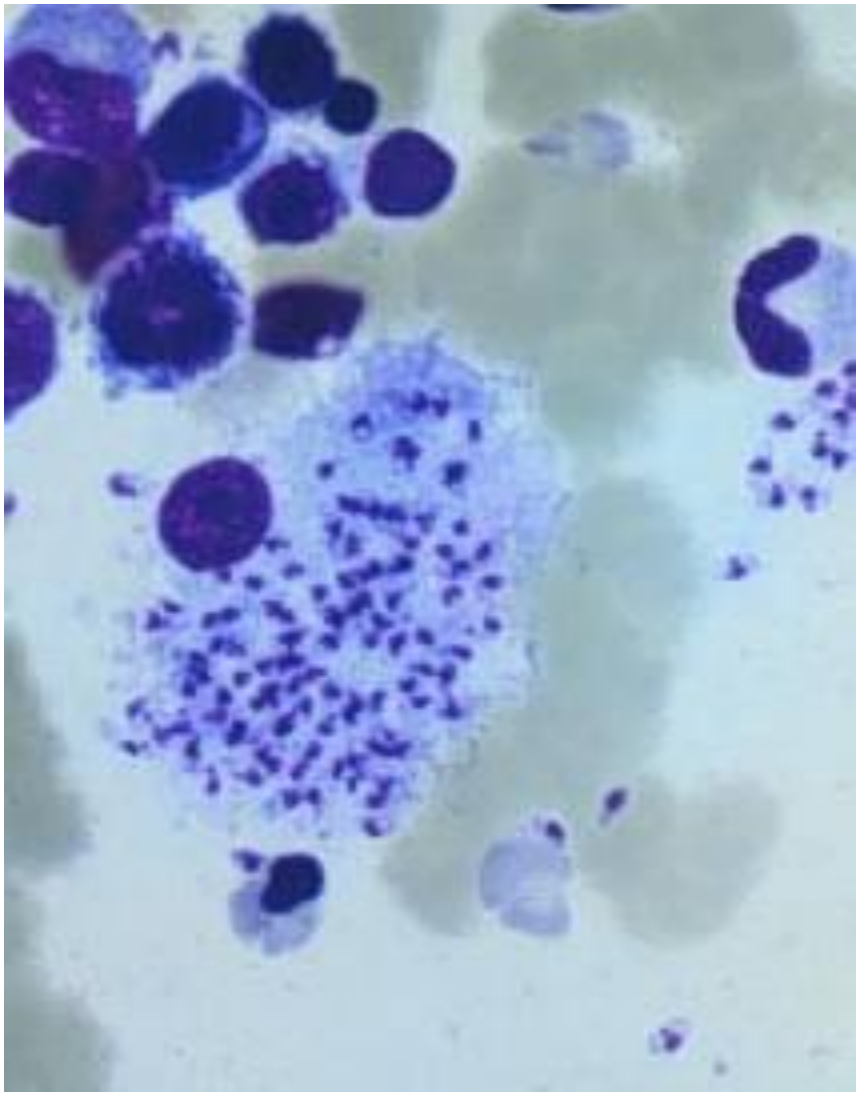
Macrophage rupturing



Leishmania

- Amastigotes





Sandfly

- This looks like a mosquito, except its body is hairy and the wings are feathery.

Leishmaniasis

- **Geographic Distribution:**
  More than 90 percent of the world's cases of visceral leishmaniasis are in India, Bangladesh, Nepal, Sudan, and Brazil.
- Leishmaniasis is also found in Mexico, Central America, and South America, southern Europe, Asia, the Middle East, and Africa.

Leishmaniasis

- There are three forms of Leishmaniasis:
  - Cutaneous
  - Mucocutaneus
  - Visceral

Cutaneous Leishmaniasis

- The disease is only at the site of the bite.
- This form is seen in Texas, Mexico, Asia, and the Middle East (our Iraq troops are coming down with this form).
- It manifests as a large, wet sore with raised edges. It looks like a volcano with weepy serum coming out of the center.
- The wound is not contagious, just the sandfly bite.
- Dogs can get this disease, too.

Leishmaniasis (cutaneous)

Leishmaniasis (cutaneous)

Leishmaniasis (cutaneous)

Leishmaniasis (mucocunateous)

- This is when the disease located in the mucous membranes of the nose and mouth.
- The most gruesome photos are of this form.

Leishmaniasis (mucocunateous)

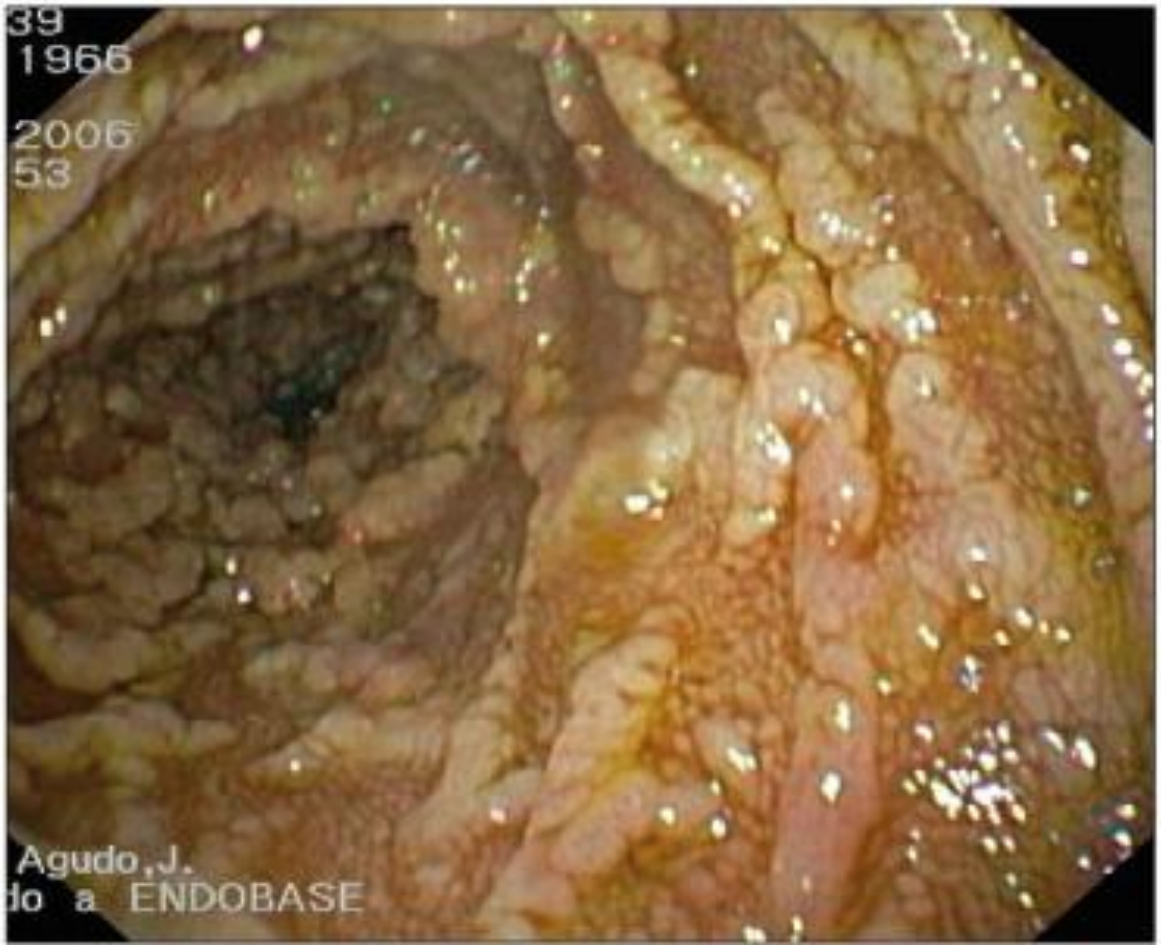
Leishmaniasis (visceral)

- This is the most serious form. It occurs especially in immunocompromised people, especially HIV patients.
  - The amastagotes reproduce inside macrophages.
  - Only T-cells can kill infected macrophages, but HIV is a disease that infects T-cells.
  - This form is known as Kala Azar.

Kala Azar

Hepatosplenomegaly

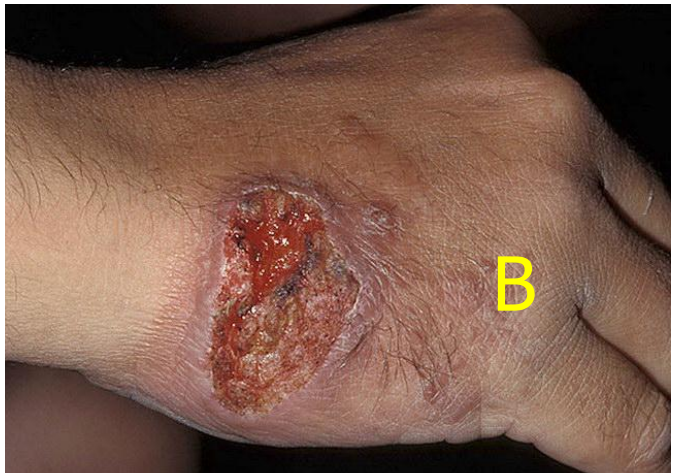
Kala Azar (duodenum)



Определите тип лейшманиоза

Visceral leishmaniosis

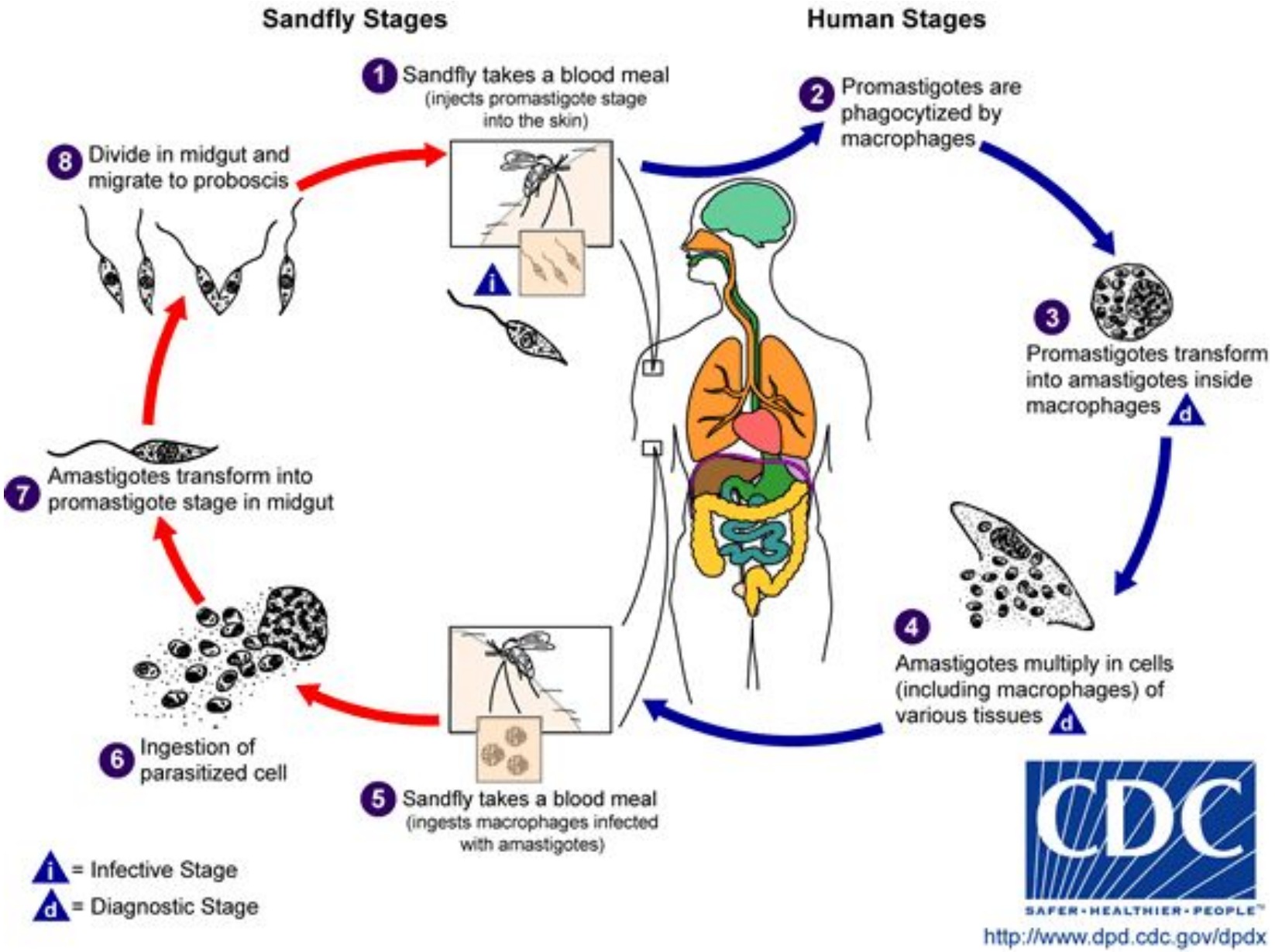
New World skin and mucous leishmaniosis



Old World skin leishmaniosis

New World skin leishmaniosis
(also damages cartilage)

Leishmania life cycle



TERMS

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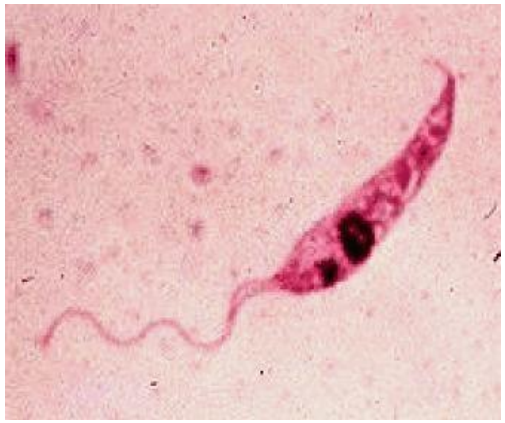
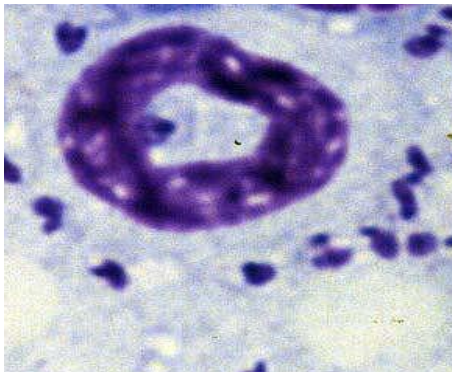
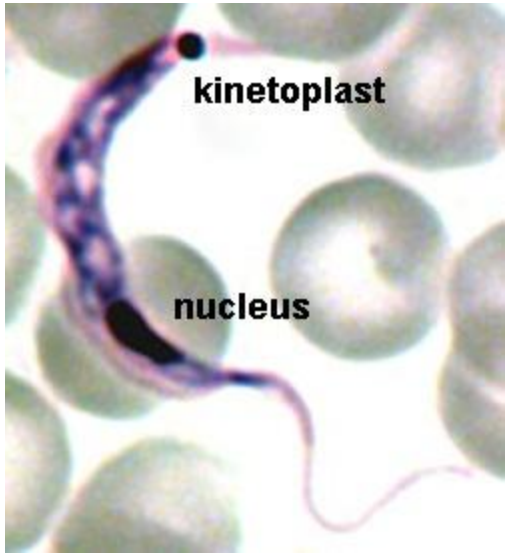






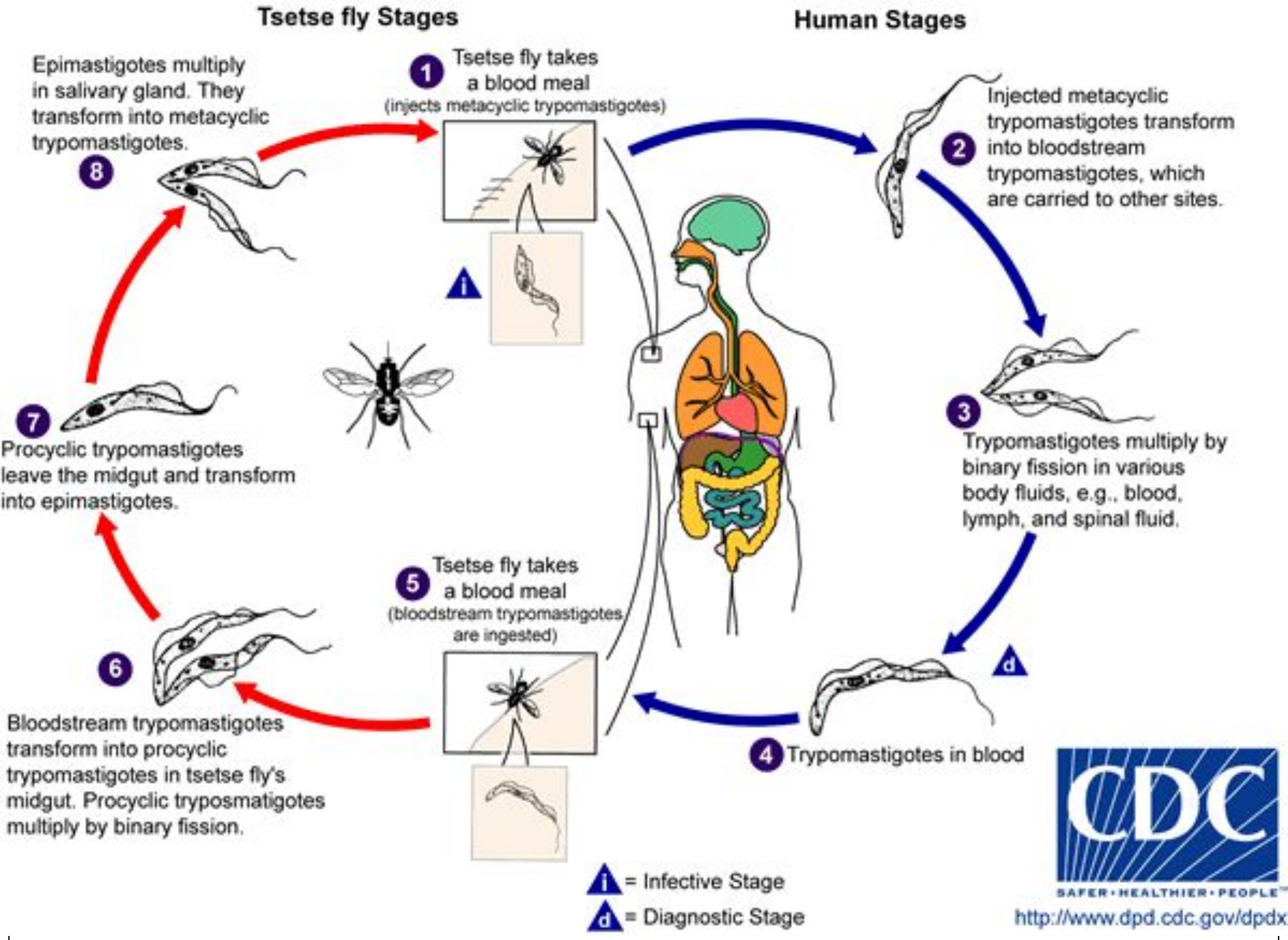
Trypanosomiasis

- African Trypanosomiasis
  - (African Sleeping Sickness)
- American Trypanosomiasis
  - (Chaga's Disease)

“African Sleeping Sickness”

- **Disease:** African Tryptanosomiasis

- **Causal Agents:**
  - *Trypanosoma brucei gambiense*
  - *Trypanosoma brucei rhodesiense*


Tsetse fly Stages
Human Stages
Epimastigotes multiply in salivary gland. They transform into metacyclic trypomastigotes.
8
1 Tsetse fly takes a blood meal
(injects metacyclic trypomastigotes)
i
2 Injected metacyclic trypomastigotes transform into bloodstream trypomastigotes, which are carried to other sites.
3 Trypomastigotes multiply by binary fission in various body fluids, e.g., blood, lymph, and spinal fluid.
d
4 Trypomastigotes in blood
5 Tsetse fly takes a blood meal
(bloodstream trypomastigotes are ingested)
6 Bloodstream trypomastigotes transform into procyclic trypomastigotes in tsetse fly's midgut. Procyclic tryposmatigotes multiply by binary fission.
7 Procyclic trypomastigotes leave the midgut and transform into epimastigotes.
i = Infective Stage
d = Diagnostic Stage
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http://www.dpd.cdc.gov/dpdx

Geographic Distribution

- *T. b. gambiense* is found in foci in large areas of West and Central Africa.
  - Humans are the main reservoir for *Trypanosoma brucei gambiense*, but this species can also be found in animals.
- *T. b. rhodesiense* is found in East and Southeast Africa.
  - Wild game animals are the main reservoir of *T. b. rhodesiense*.

Trypanosomiasis

- Trypanosomiasis has a biological vector, the tsetse (pronounced “set-see”) fly.
- Wild animals may also be a reservoir (Zooinotic is when a disease is transmitted to animals as well as humans.)

Trypanosomiasis

- The tsetse fly bites a human and injects the trypanomastigotes into the skin.
- This causes a chanchre (pronounced “shanker”), which is an ulcer on the skin.
- Then it enters the lymphatic system.

Trypanosomiasis

- It is characterized by Winterbottom's Sign: swelling of the cervical lymph nodes in the head and neck area.
- CNS symptoms include a shuffling gait (like a stroke victim), slurred speech, and malaise (needing to sleep longer and longer each day).
- They are also restless at night.

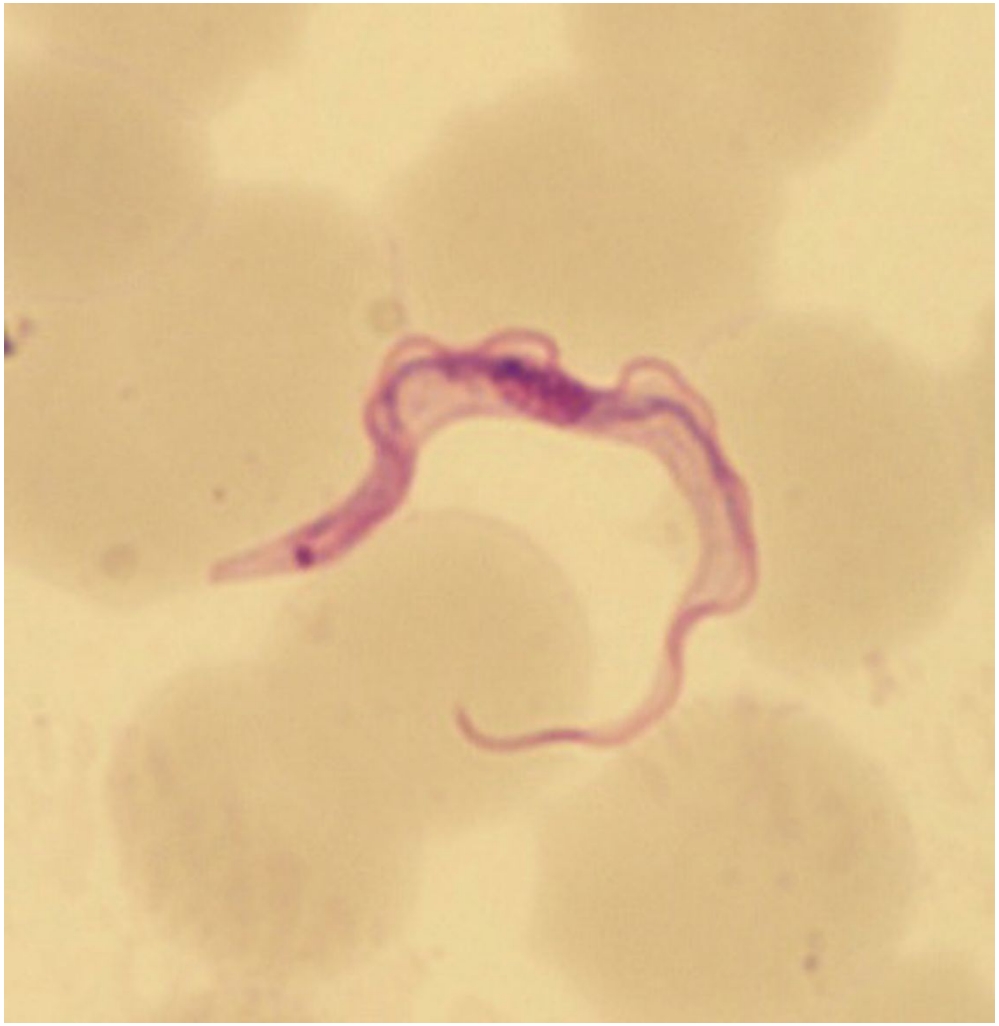
Trypanosomiasis

- CNS symptoms
  - Shuffling gait
  - Slurred speech
  - Malaise (sleeping all day)
- Treatment
  - Melarsoprol: which has dangerous side-effects like chemostherapy. This drug requires administration with a substance called ethylene glycol, which will break down regular plastic tubing, so the drug must be administered with **special plastic iv tubing.**

Trypanosoma brucei

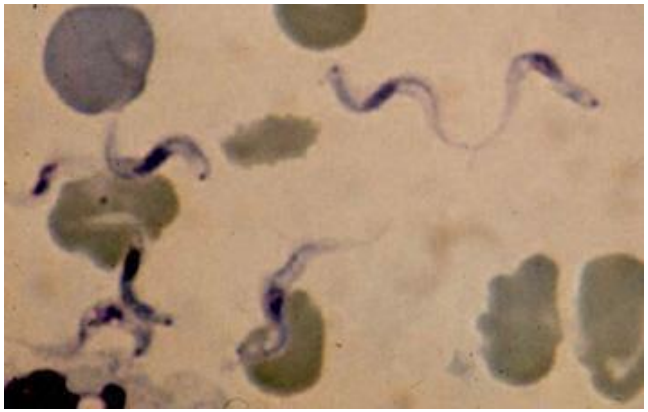
- **Trypomastigote stages are the only form found in patients.**
  - Posterior kinetoplast
  - Centrally located nucleus
  - Undulating membrane
  - Anterior flagellum

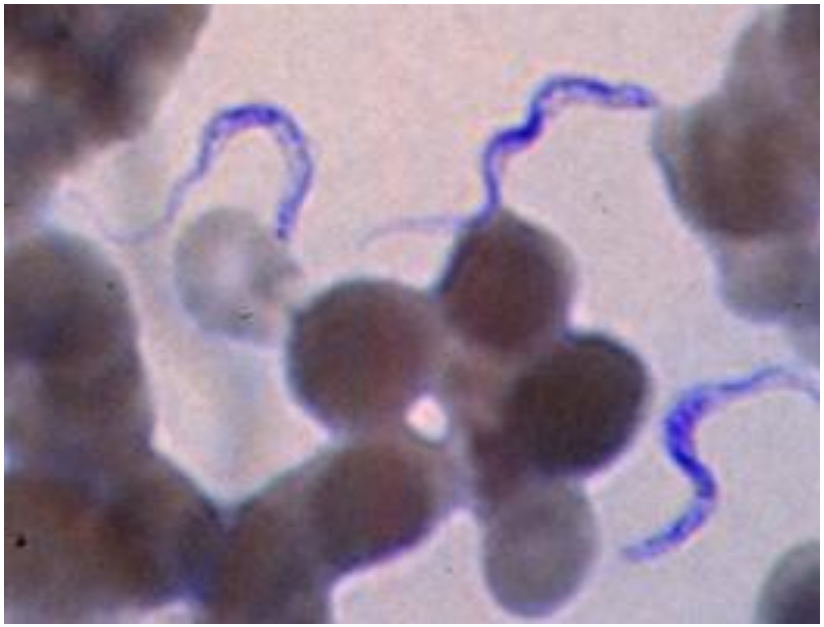
Trypanosoma brucei

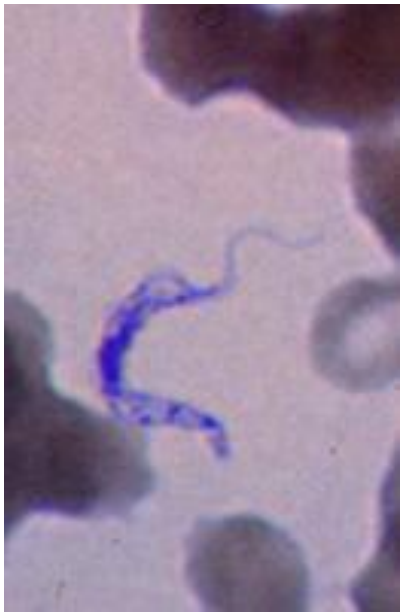


Trypanosoma brucei gambiense

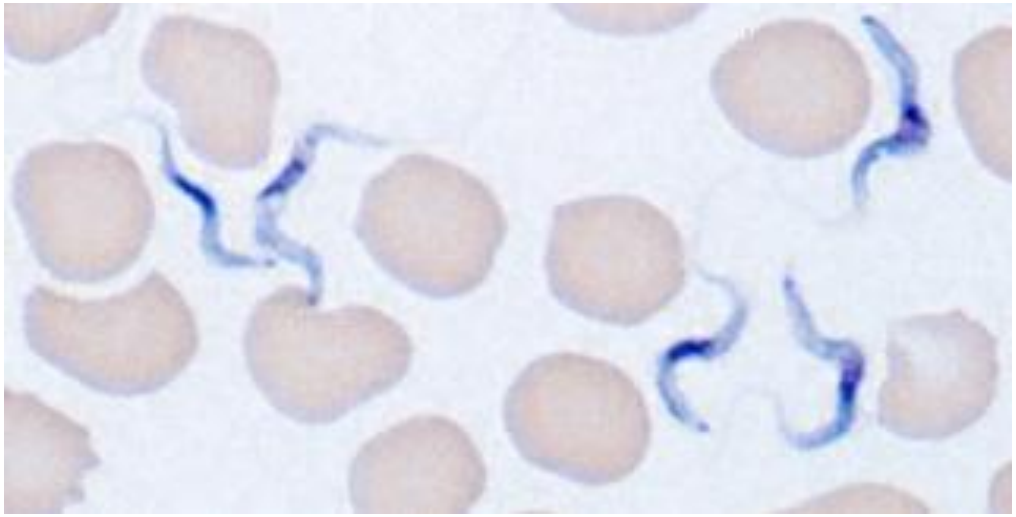
- trypomastigote

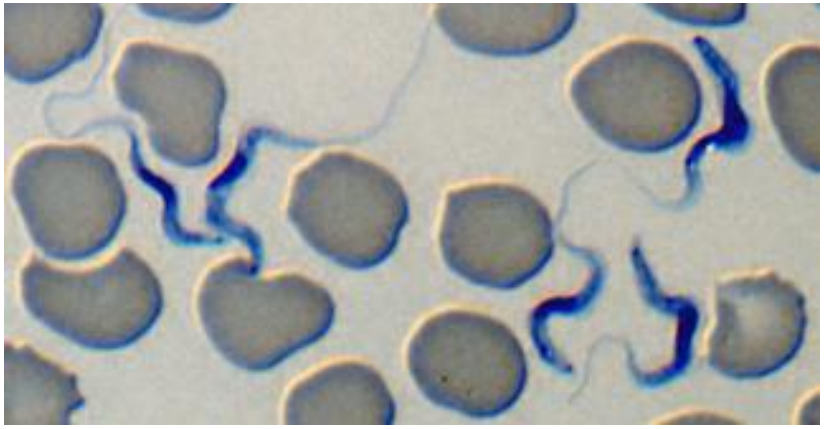




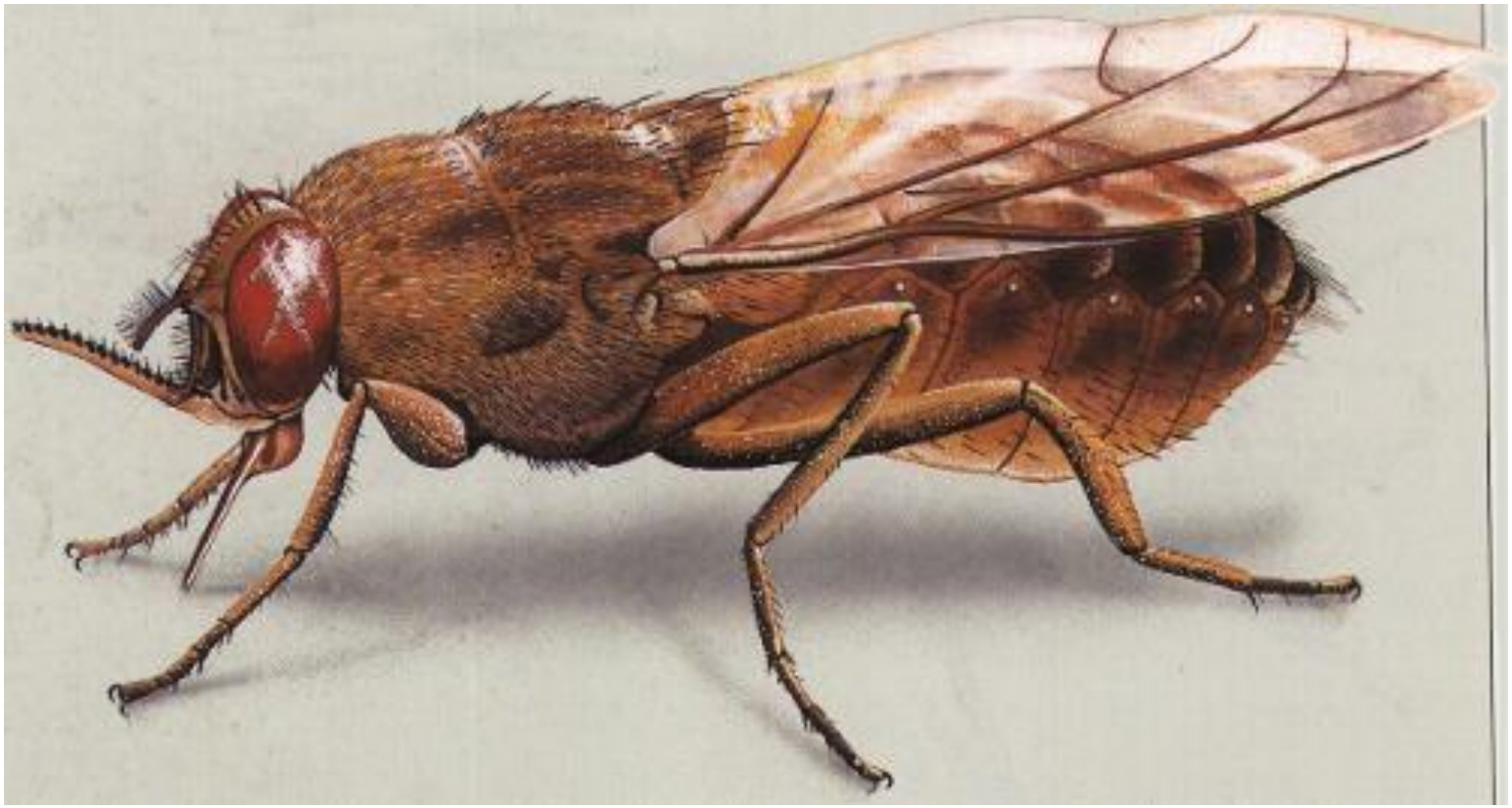


Trypanosoma brucei rhodesiense





Tsetse Fly



“Chaga’s Disease”

- **Disease:** American Tryptanosomiasis

  A zoonotic disease (can infect animals) that can be transmitted to humans by blood-sucking bugs.

- **Causal Agent:** *Trypanosoma cruzi*
  - This organism is a little smaller than *T. bruceii* and has a pronounced gametoplast.

“Chaga’s Disease”

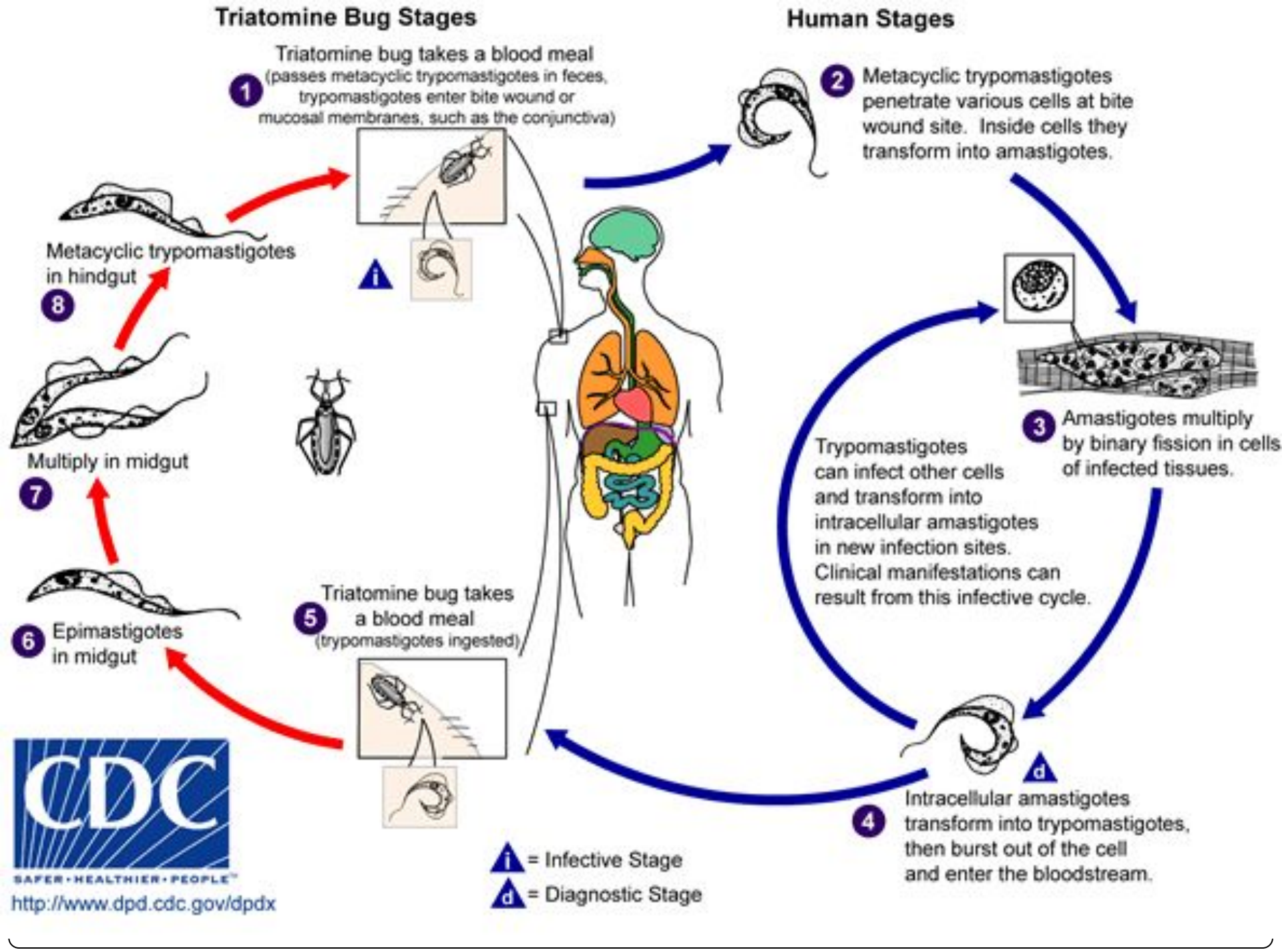
- This disease is NOT found in Africa.
- This disease is also zoonotic; it can infect animals as well as humans.
- The vector is a large bug called the “Kissing Bug”.
- It is found in warm regions and crowded areas, especially in the cracks of adobe huts.
- It comes out at night and crawls on a human while they sleep.

“Chaga’s Disease”

- It prefers the lips because the blood supply is close to the surface.
- It sucks the blood there, but they don’t transmit the organism this way.
- When they suck the blood, they also defecate, and the organism is in the feces.
- When the human wakes up to scratch the itch, feces get into the tiny wound.
- This is a fecal blood route.

“Chaga’s Disease”

- Symptoms include fever, anorexia, swollen lymph nodes, hepatosplenomegally (enlarged liver and spleen), and myocarditis (inflammation of the heart), which usually causes death.
- They also have megacolon (large colon) and megaesophagus (large esophagus).


Triatomine Bug Stages
Human Stages
Triatomine bug takes a blood meal
(passes metacyclic trypomastigotes in feces, trypomastigotes enter bite wound or mucosal membranes, such as the conjunctiva)
1
i
Metacyclic trypomastigotes in hindgut
8
Multiply in midgut
7
Epimastigotes in midgut
6
Triatomine bug takes a blood meal
(trypomastigotes ingested)
5
2
Metacyclic trypomastigotes penetrate various cells at bite wound site. Inside cells they transform into amastigotes.
3
Amastigotes multiply by binary fission in cells of infected tissues.
Trypomastigotes can infect other cells and transform into intracellular amastigotes in new infection sites. Clinical manifestations can result from this infective cycle.
d
4
Intracellular amastigotes transform into trypomastigotes, then burst out of the cell and enter the bloodstream.
i = Infective Stage
d = Diagnostic Stage
CDC
SAFER·HEALTHIER·PEOPLE™
http://www.dpd.cdc.gov/dpdx

Trypanosoma cruzi

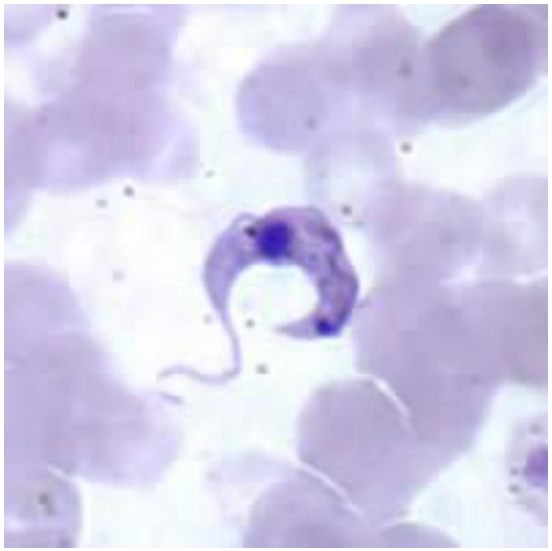
- Insect vector is the “kissing” bug. It takes a blood meal and releases trypomastigotes in its feces near the site of the bite wound.
- Trypomastigotes enter the host through the wound or through intact mucosal membranes, such as the conjunctiva.
- *Trypanosoma cruzi* can also be transmitted through blood transfusions, organ transplantation, transplacentally, and in laboratory accidents.

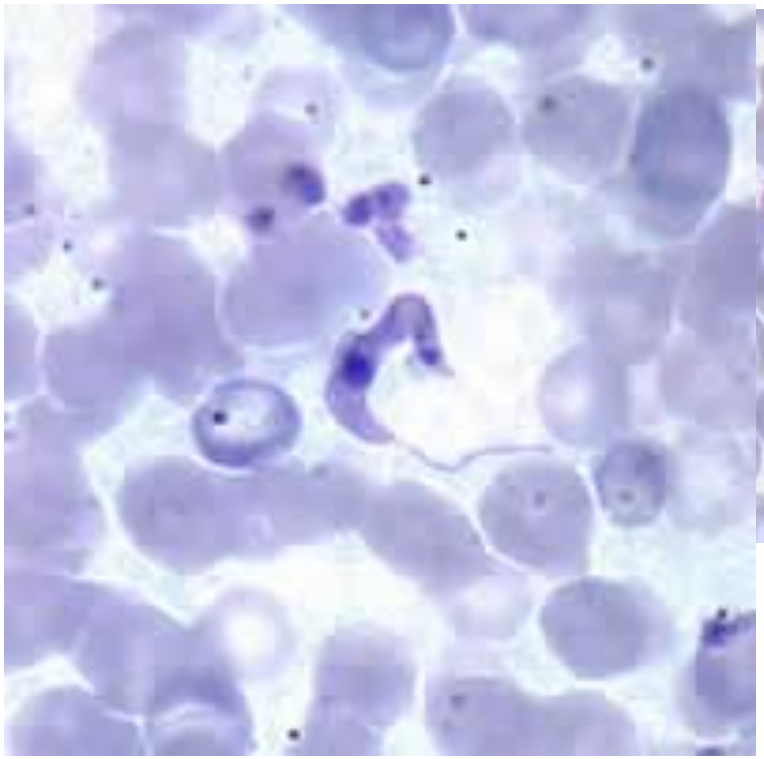
Trypanosoma cruzi

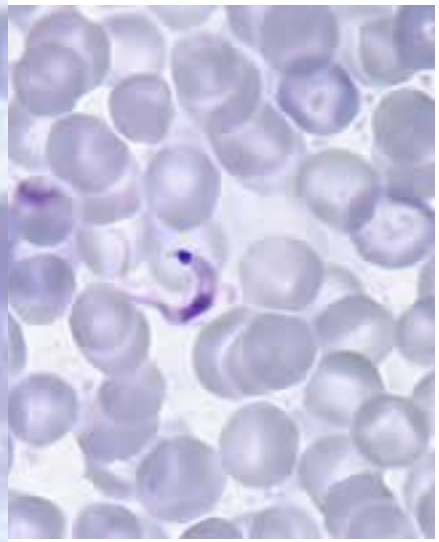
- **Geographic Distribution:**
  The Americas from the southern United States to southern Argentina. Mostly in poor, rural areas of Central and South America. Chronic Chagas disease is a major health problem in many Latin American countries. With increased population movements, the possibility of transmission by blood transfusion has become more substantial in the United States.

Trypanosoma cruzi

Trypanosoma cruzi








Trypanosoma cruzi
large kinetoplast

Trypanosoma cruzi

- Triatomine bug, *Trypanosoma cruzi* vector, defecating on the wound after taking a blood meal.



Kissing Bug

Romana's sign

- Swollen eye, seen in Chagra's disease.

Trypanosoma life cycle