Microbiology

Prepared by:

Dr. Shereen Ahmed Fahmy

Assis.Prof. of Parasitology

Zoology Department

For

Post graduate Students (Credit hours) Diploma of biological Laboratory Analyses

Courtesy

- **Be Respectful**

- **Be On Time**

(I reserve the right to close and lock the door 10 min after class or lab begins.)

- **Pay Attention**

- **If you can't pay attention, at least keep it to yourself … don't disrupt others.**

- **Cell Phones** *off/silenced*

Chapter (1)

Introduction to Microbiology

Microbiology

Microbiology - The science that studies very small living things , Usually requires a magnification tool – the microscope.

Some organisms are large such as – **Helminths – worms**

Sub groups of Microbes we will study

Bacteria

Archaea

Fungi

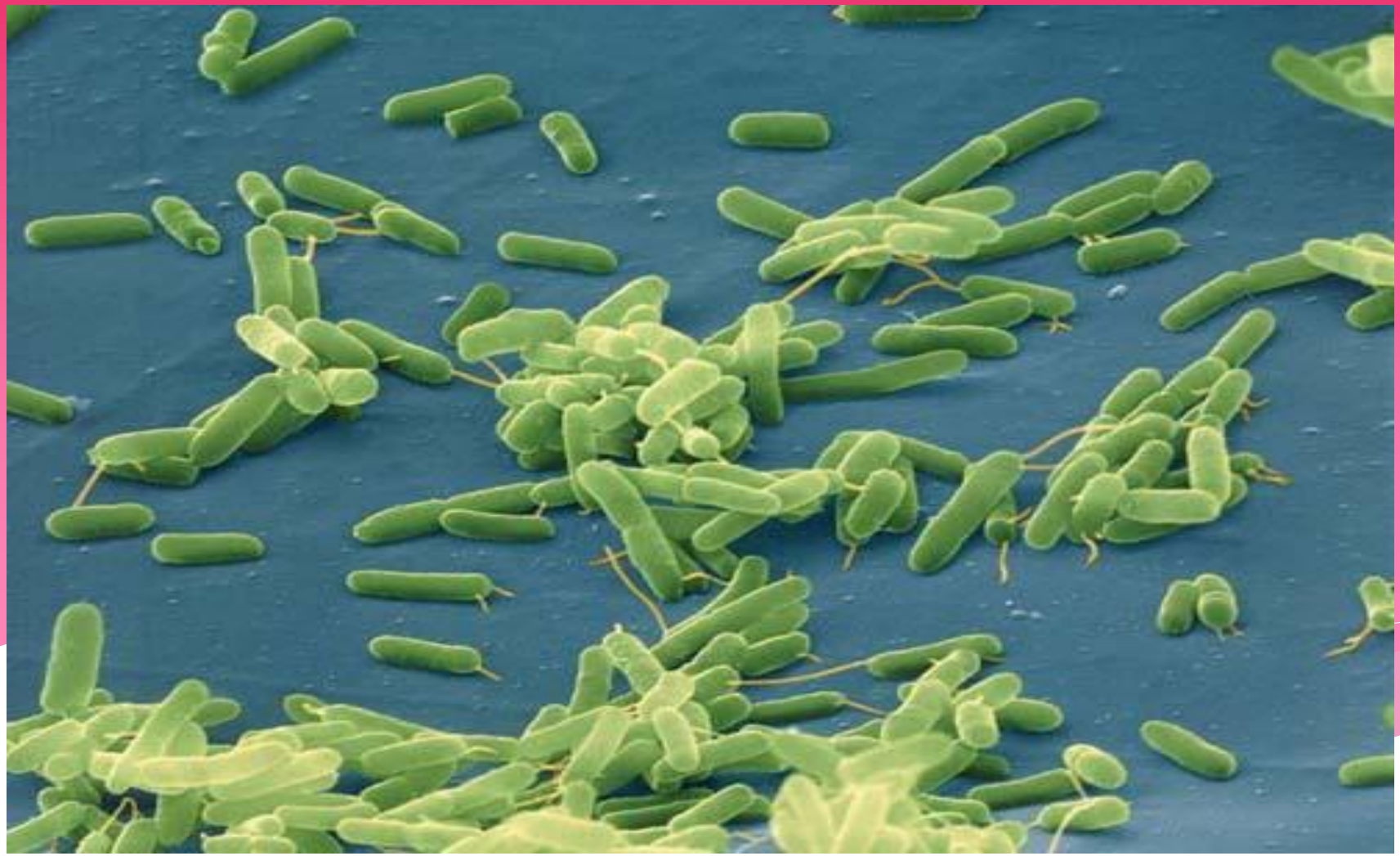
Algae, Viruses

Protozoans

Multicellular animal parasites – Helminths

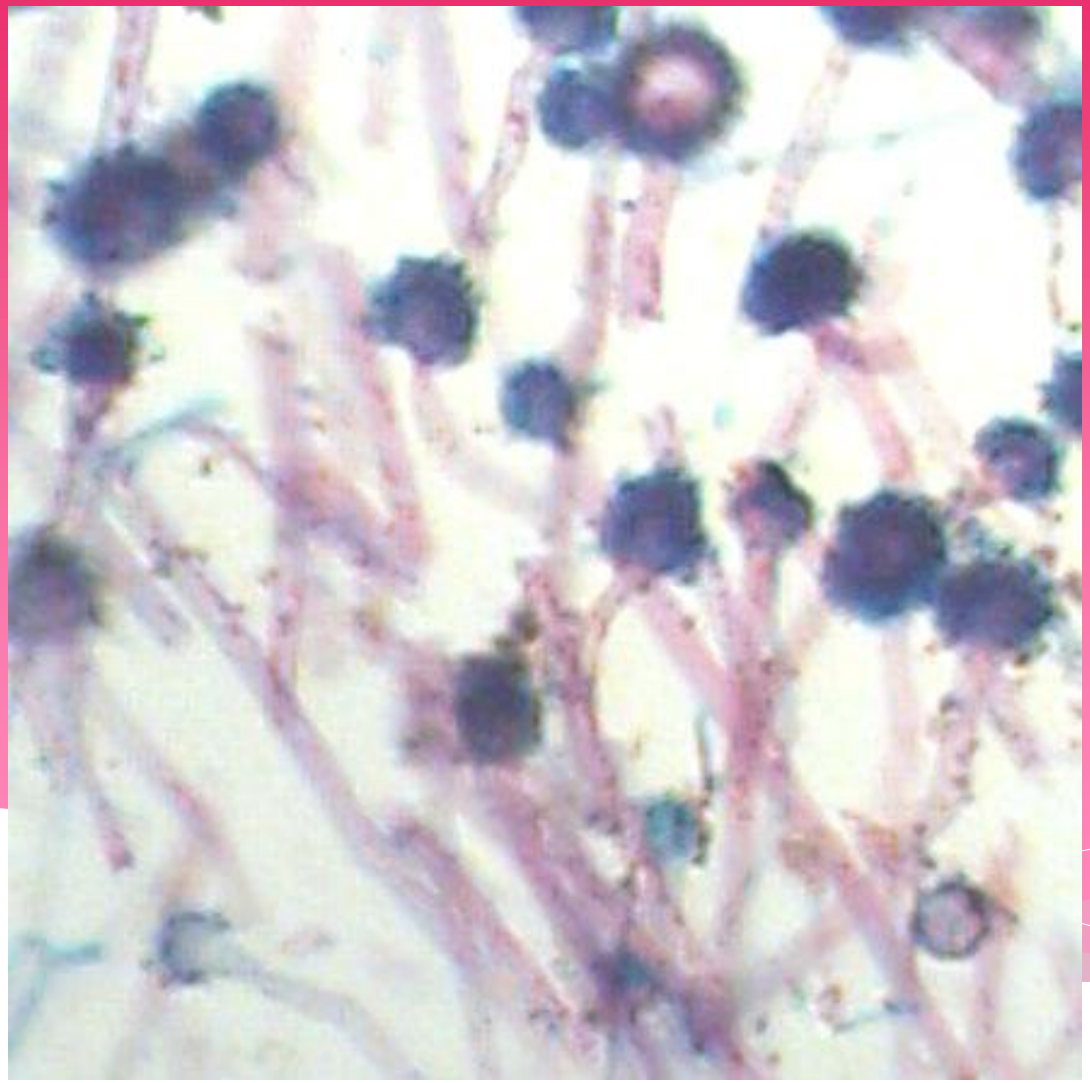
Microbiology

Bacteria



Microbiology

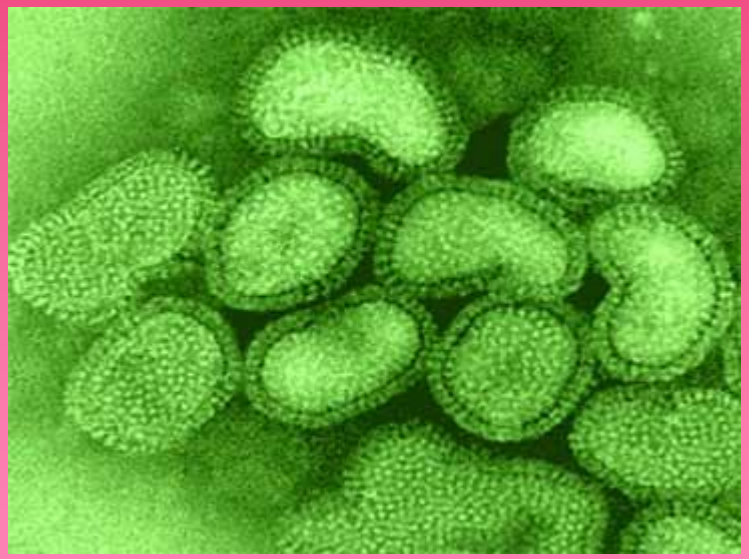
Fungi



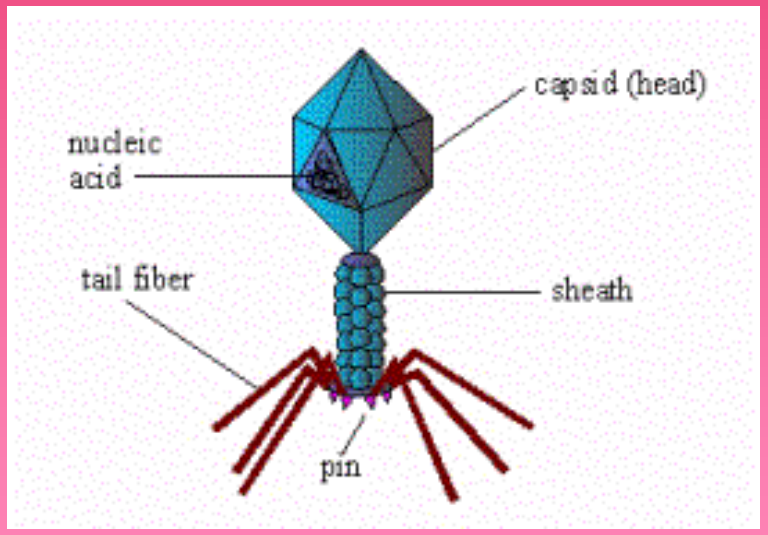
Microbiology

Viruses

Avian Flu



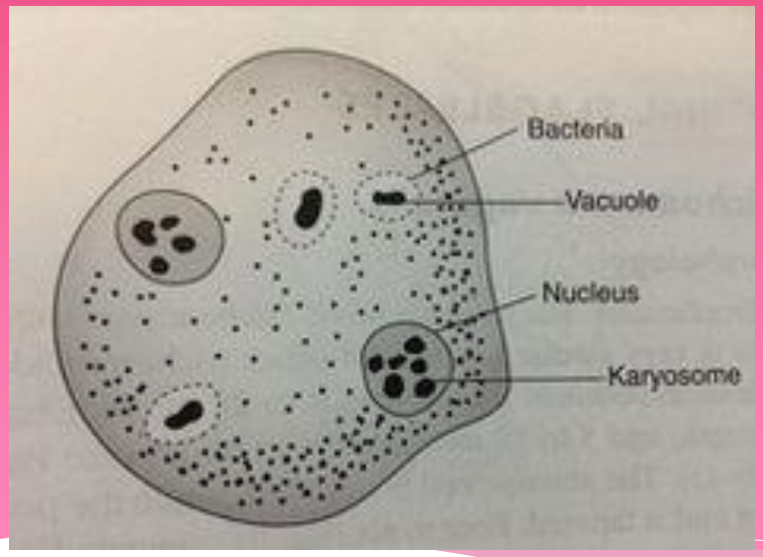
Bacteriophage



Microbiology

Protozoans

Dientamoeba



Giardia

Microbiology

Helminths

Ascaris round worm

Tapeworm

Effect Of Parasites On The Host

The damage which pathogenic parasites produce in the tissues of the host may be

described in the following two ways;

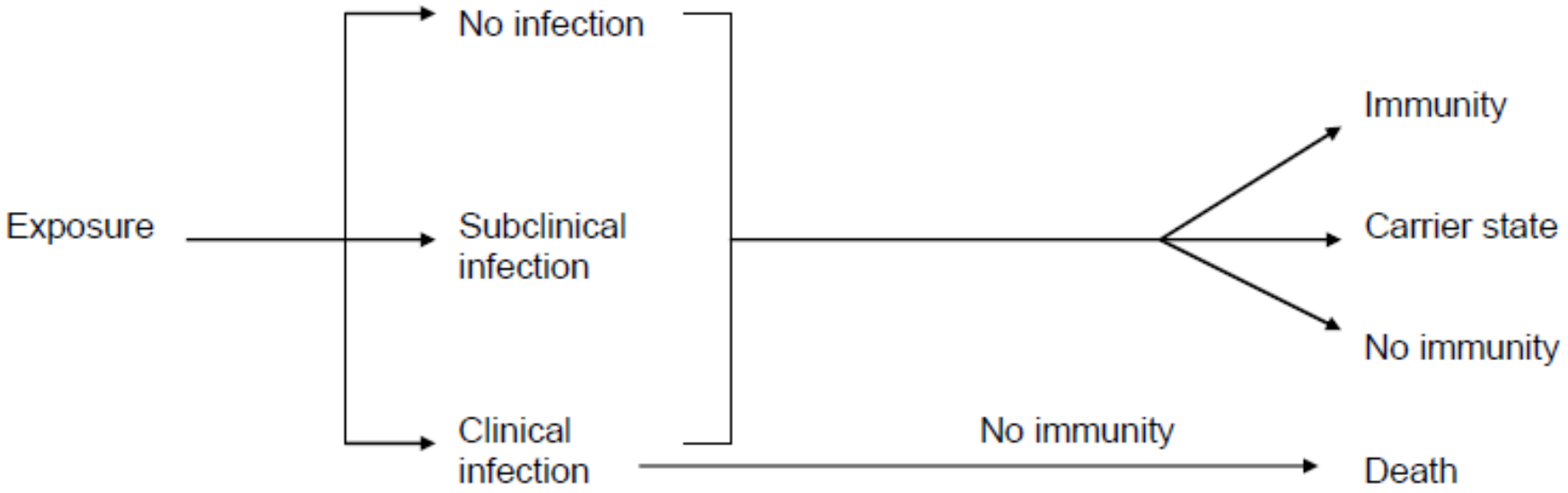
(a) **Direct effects of the parasite on the host**

(b) **(b) Indirect effects of the parasite on the host:**

Microbiological Classification of Infectious Diseases

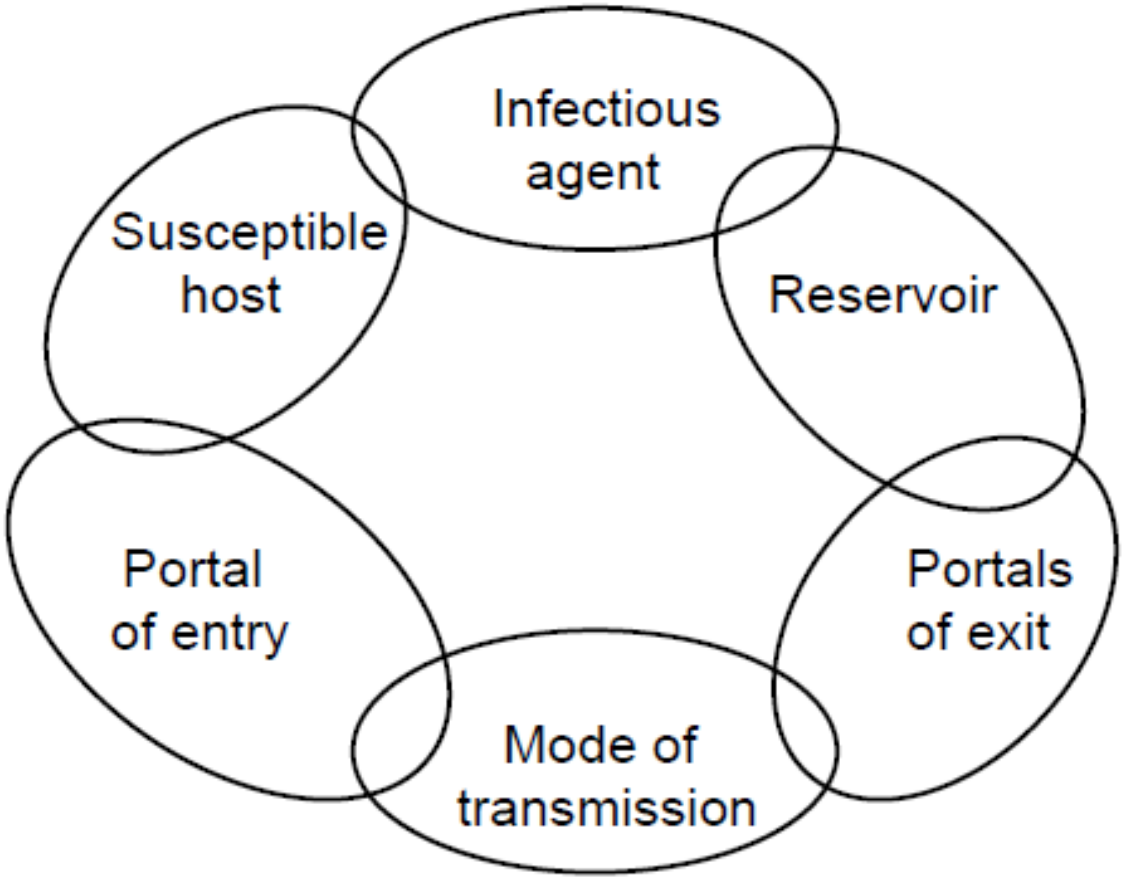
1) Disease is a disturbance in the state of health
2) Microbes cause disease in the course of stealing space, nutrients, and/or living tissue from their symbiotic hosts .
3) Microbes do most of the following:
    1) Gain access to the host (contamination)
    2) Adhere to the host (adherence)
    3) Replicate on the host (colonization)
    4) Invade tissues (invasion)
    5) Produce toxins or other agents that cause host harm (damage)

The different outcomes of an exposure to an infectious agent



Kramer A, et al. Principles of infectious disease epidemiology. In *Modern Infectious Disease Epidemiology*, Kramer A, et al (eds). Springer Science + Business Media, 2010; p 92 (modified from Giesecke 1994)

The chain of infection



Kramer A, et al. Principles of infectious disease epidemiology. In *Modern Infectious Disease Epidemiology*, Kramer A, et al (eds). Springer Science + Business Media, 2010; p 91

BIOLOGIC CHARACTERISTICS OF INFECTIOUS AGENTS

* ***Infectivity*** – the ability to infect a host.
* ***Pathogenicity*** – the ability to cause disease in the host.
* ***Virulence*** – the ability to cause severe disease in the host.
* ***Immmunogenicity*** –the ability to induce an immune response in the host.

Infectious Disease Terms

- Infectious dose – number of organisms needed to successfully infect.
- Parasite – an organism that benefits at the expense of another organism, the host.
- Pathogen – any disease causing microorganism (bacteria, parasite) or virus.
- Pathogenic – Disease – causing.
- Disease – noticeable impairment of body function.
- Latent infection -infection in which the infectious agent is present but not active.
- Incubation period – interval from exposure to clinical symptoms.
- Infectious period – interval during which host can transmit infection

Infectious Disease Terms

- Infectious disease –disease caused by an infecting microorganism or virus.
- Primary infection – infection in a previously healthy person.
- Secondary infection- an additional infection that occurs as a result of a primary infection and that occurs during or immediately following the primary infection.
- Reproductive rate – ability of an agent to spread in populations. Outbreak – limited spread.
- Endemic – usually present; steady prevalence.
- Epidemic – rapid spread.
- Pandemic – occurring across countries and in multiple populations.

MODES OF TRANSMISSION

Direct

Droplet

Aerosol

Skin to skin

Indirect

Fomites (clothes, blankets, door handles etc)

Vectors (e.g. mosquitoes)

Food and water

Intermediate hosts (e.g. snails)

Measures of Disease Occurrence

Measure	Description
Prevalence	Number or proportion of persons with a specific disease at a specific time point in the population
Incidence	Number or proportion of persons developing a specific disease during a time period
Morbidity	Ambiguously used: prevalence or incidence
Mortality	Number or proportion of persons dying during a time period
Fatality rate	Proportion of persons dying from a specific disease among all persons with the disease
Attack rate	Proportion of cases developing the disease among all persons who were exposed to the disease

Mikolajczyk R. Methods and concepts of epidemiology. In *Modern Infectious Disease Epidemiology*, Kramer A, et al (eds). Springer Science + Business Media, 2010; p 193

CLASSIFICATION OF INFECTIOUS AGENTS (1 of 2)

* Bacteria – survive on appropriate media, stain gram-positive or -negative
* Viruses – obbligate intracellular parasites which only replicate intracellularly (DNA, RNA)
* Fungi – non-motile filamentous, branching strands of connected cells
* Metazoa – multicellular animals (e.g.parasites) with complicated life cycles often involving several hosts

CLASSIFICATION OF INFECTIOUS AGENTS (2 of 2)

* **Protozoa – single cell organisms with a well-defined nucleus**
* **Rickettsia – very small bacteria spread by ticks**
* **Prions – unique proteins lacking genetic molecules**
* ***Chlamydia* – bacteria lacking cell walls**

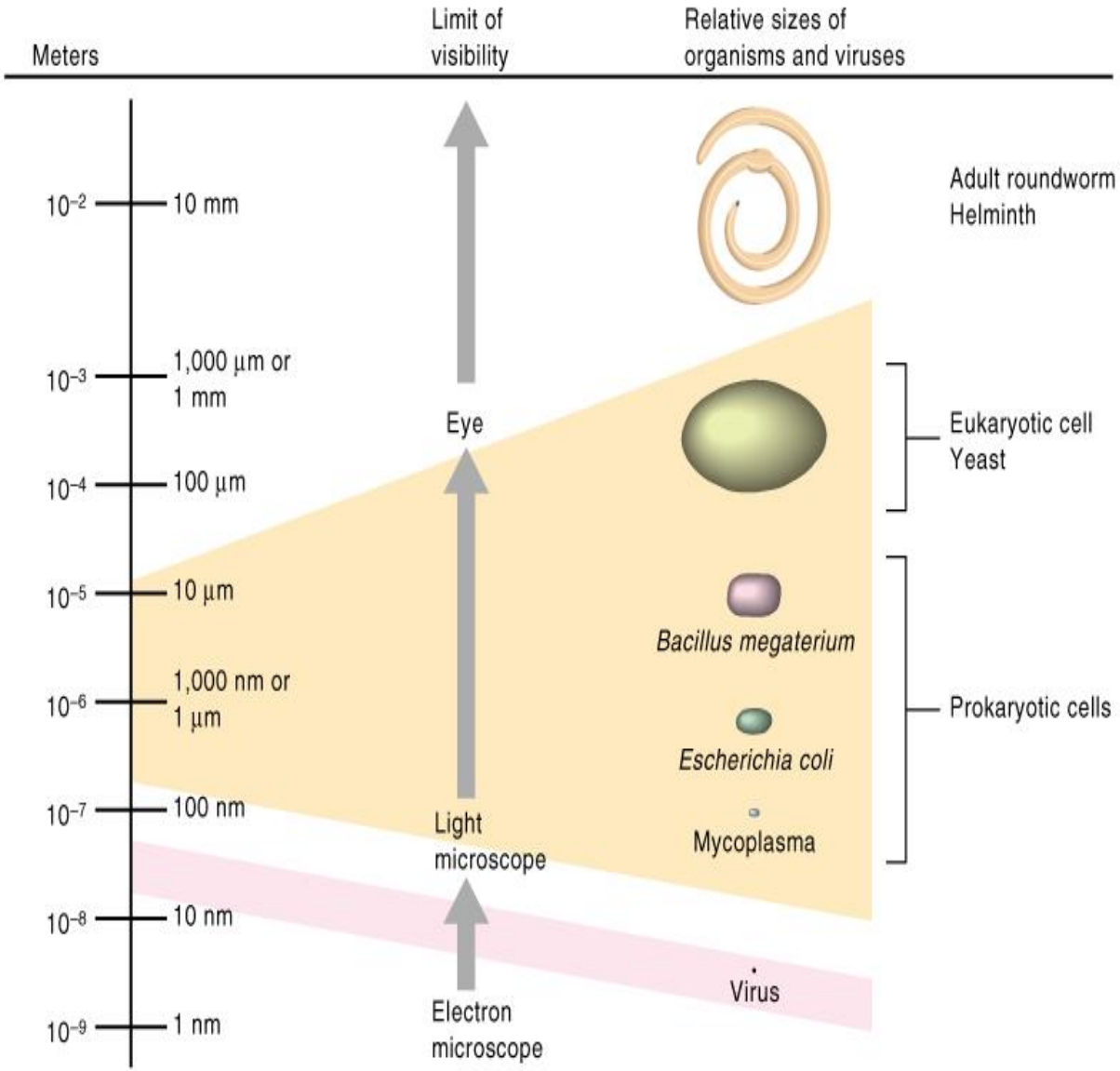
Size Comparison of Microbes

The basic unit of length is the meter (m), and all other units are fractions of a meter.

nanometer (nm) = 10^{-9} meter = .000000001 meter
micrometer (μm) = 10^{-6} meter = .000001 meter
millimeter (mm) = 10^{-3} meter = .001 meter
1 meter = 39.4 inches

These units of measurement correspond to units in an older but still widely used convention.

1 angstrom (Å) = 10^{-10} meter
1 micron (μ) = 10^{-6} meter



Microbiological Classification of Infectious Diseases

* **Types of Parasites:**
  * **Protozoa**: Single-celled, microscopic organisms that can perform all necessary functions of metabolism and reproduction.
  * Some protozoa are free-living, while others parasitize other organisms for their nutrients and life cycle.
    * The morphology of protozoa varies widely and includes oval, spherical and elongated cells that can range in size from 5-10 to 1-2 mm.
    * Structurally, the protozoa resemble other eukaryotic cells and possess a cytoplasmic membrane that encloses cytoplasm containing membrane-bound nuclei, mitochondria, 80s ribosomes and a variety of organelles.

Microbiological Classification of Infectious Diseases

* **Types of Parasites:**
  * **Helminths: A large, multicellular organism (worm) that is generally visible to the naked eye in its adult stages.**
  * **Helminths can be free-living or parasitic.**
    * **Nematodes: Roundworms**
    * **Trematodes: Flukes**
    * **Cestodes: Tapeworms**

Chapter (2)

MEDICAL PROTOZOLOGY

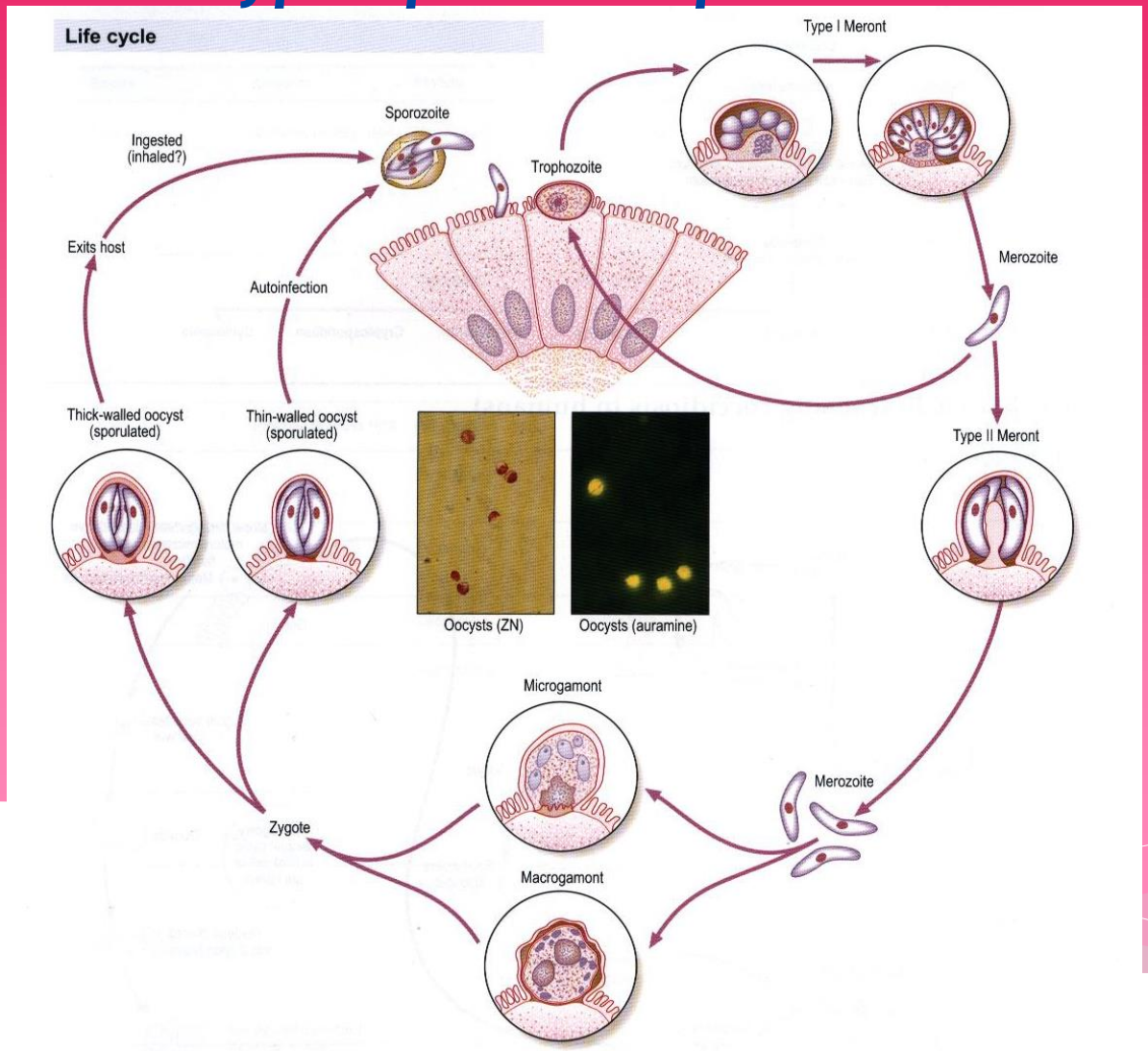
Protozoa serve as an important link in the food chain and ecological balance of many communities in wetland & aquatic environments. They are also important in biological sewage treatment, which involves both anaerobic digestion and/or aeration. In addition, protozoa are important laboratory organisms in research areas, by which their asexual reproduction enables clones to be established with the same genetic make-up.

Protozoan organisms are virtually always acquired from an exogenous source, and as such, they have evolved numerous ways to enter the body of the human host. Factors that are important for pathogenecity include:

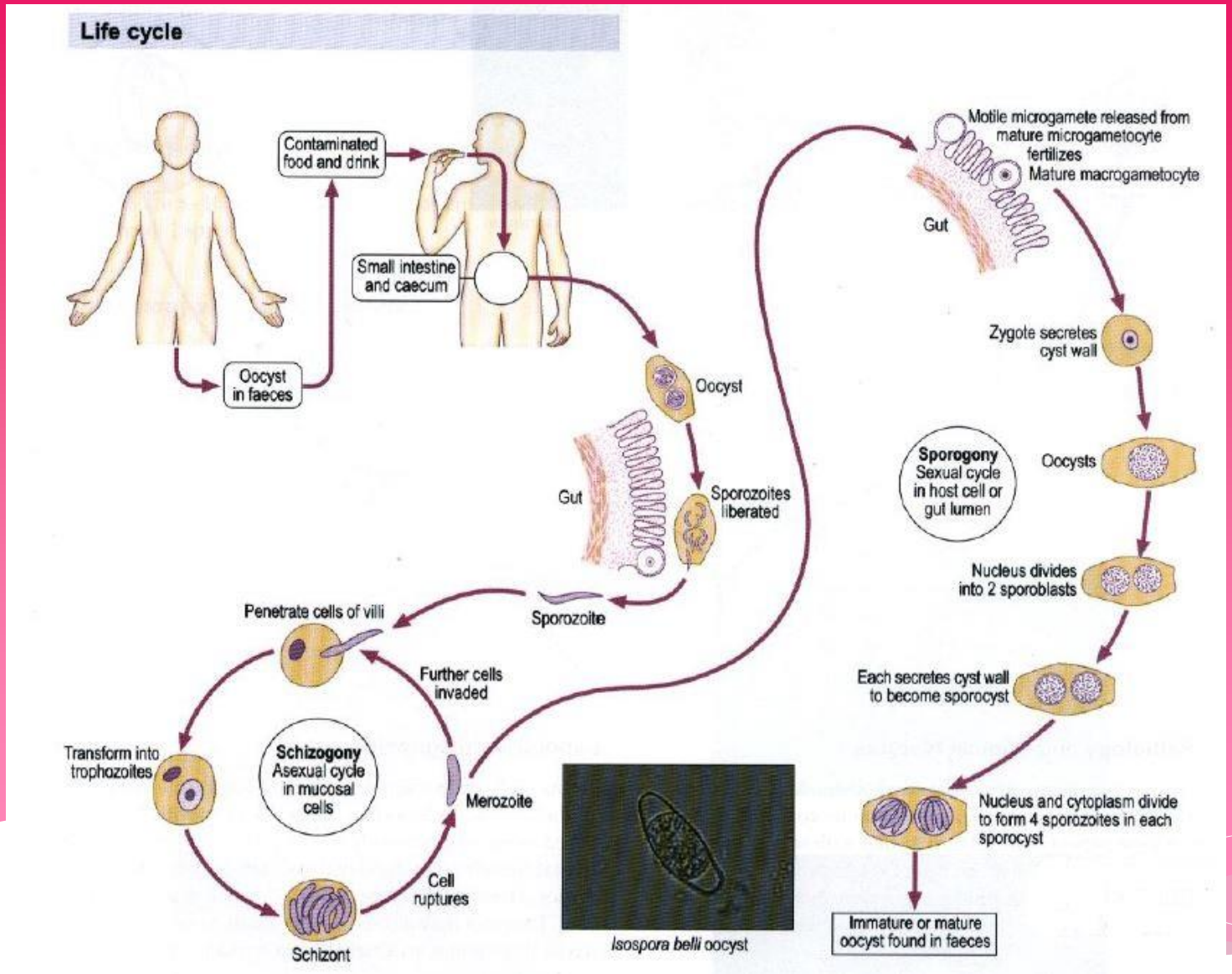
- **Attachment to the host tissue followed by replication to establish colonization.**
- **Toxic products released by parasitic protozoa.**
- **Shifting of antigenic expression to evade the immune response and inactivate host defences.**

Important pathogenic protozoa and commonly caused diseases.

1- Cryptosporidium parvum

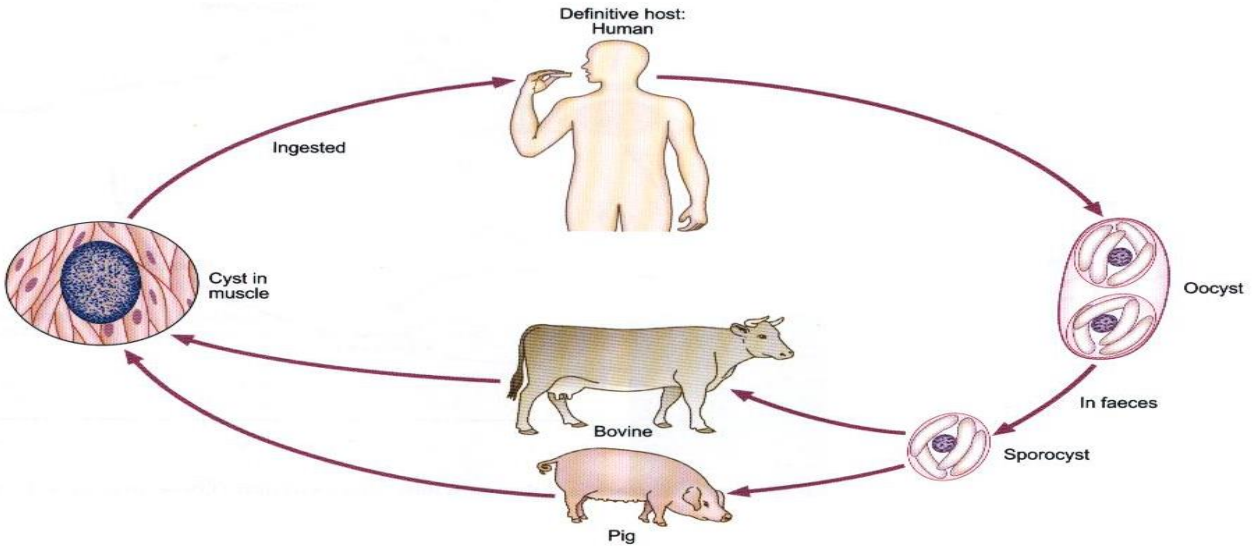


2- Isospora belli



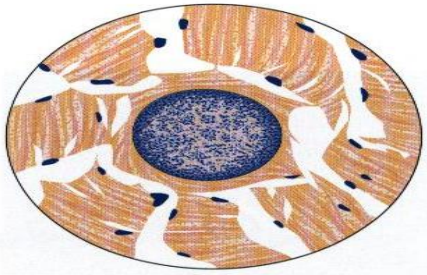
3- Sarcocystis hominis

Probable life cycle

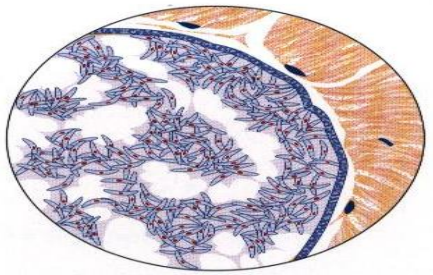


Occasionally humans can act as intermediate hosts for *Sarcocystis* of other animals.

Morphology

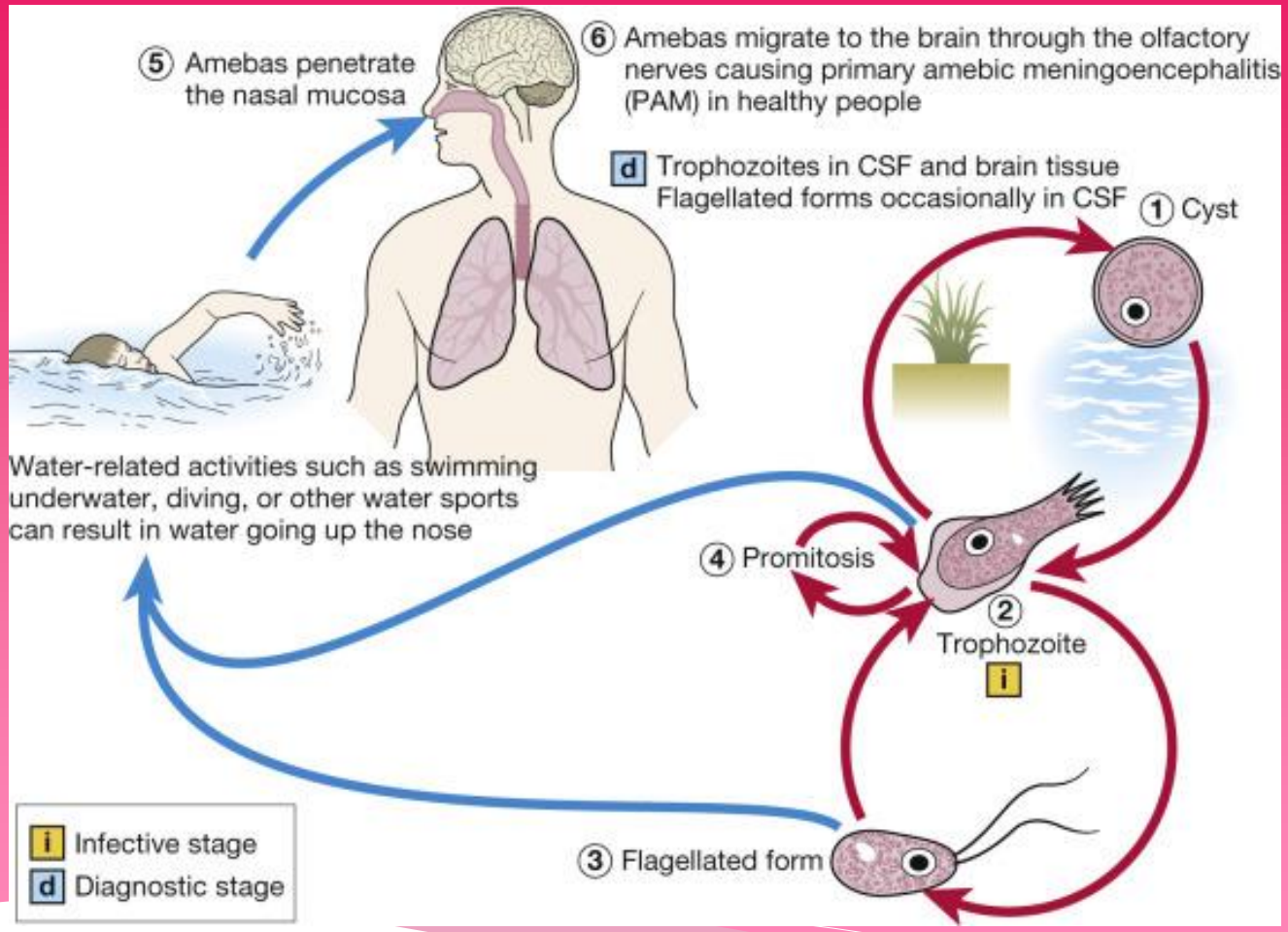


Cyst in human muscle
Miescher's tube x 100

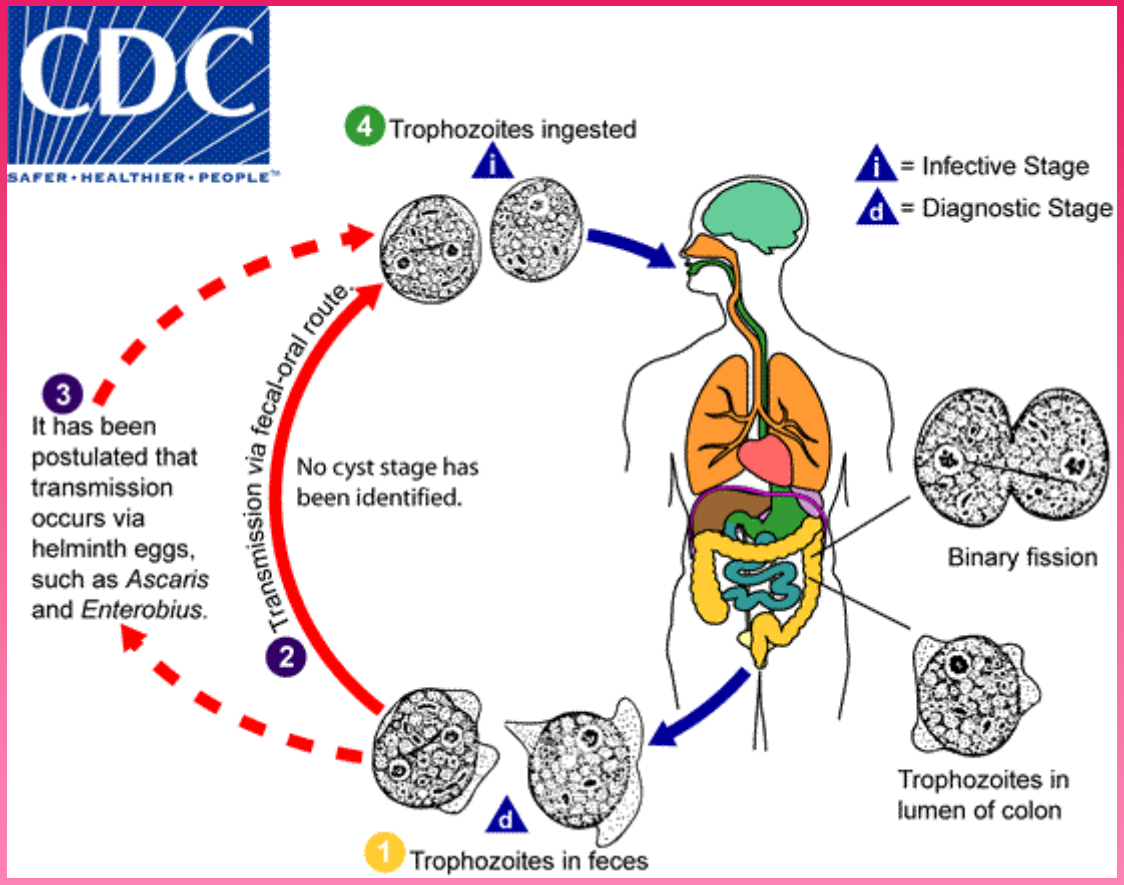


Enlarged portion of
Miescher's tube showing
Rainey's corpuscles (each
12–16 x 4–9 μm): from
a human case

4- Naegleria fowleri



5- Dientamoeba fragilis



Chapter (3)

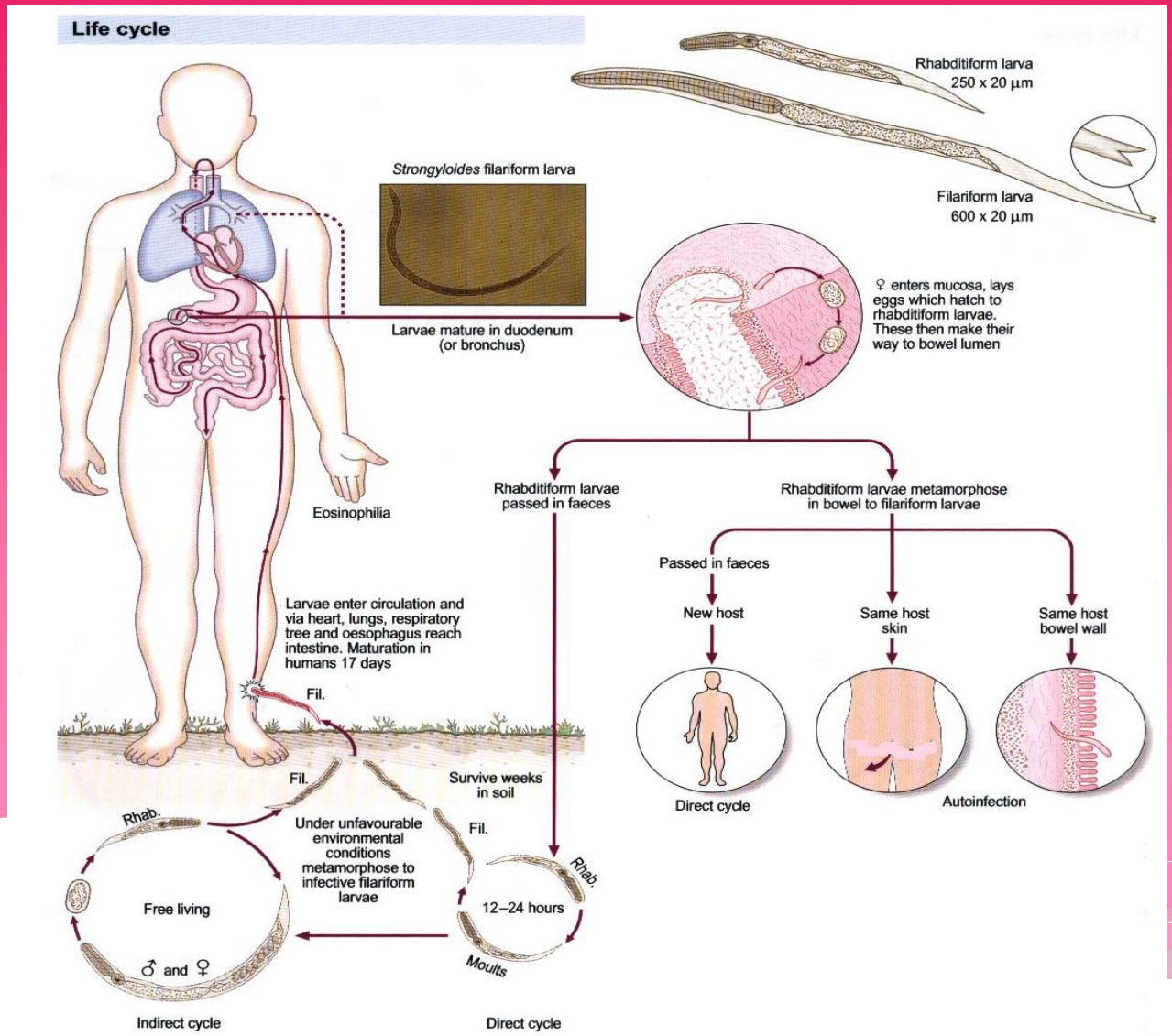
MEDICAL HELMINTHOLOGY

Medical helminthology is concerned with the study of helminthes or parasitic worms. Helminthes are trophoblastic metazoa (multi-cellular organisms). Helminthes are among the common parasitic causes of human suffering. They are the cause of high morbidity and mortality of people worldwide.

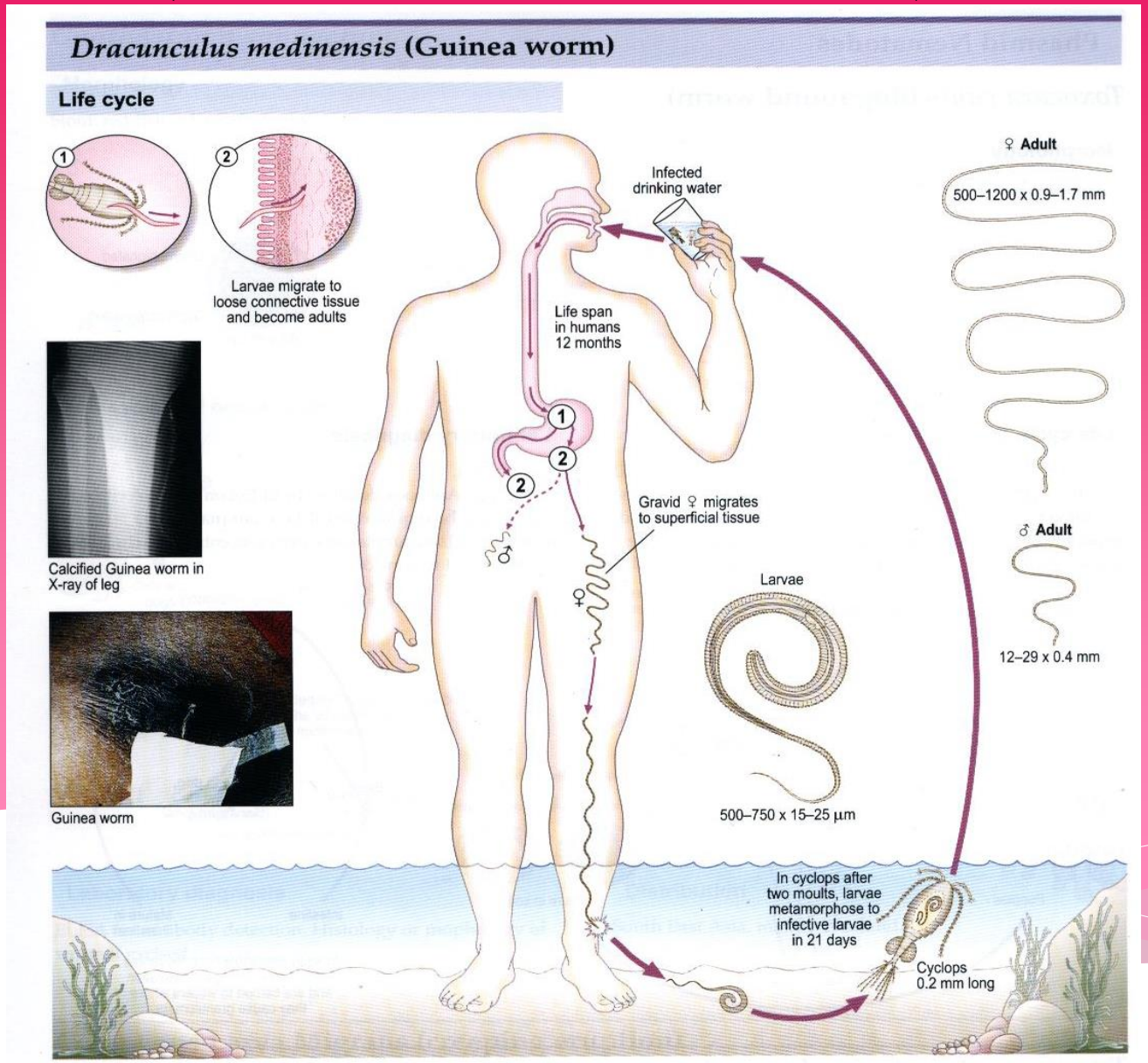
The sources of the parasites are different. Exposure of humans to the parasites may occur in one of the following ways:

1. Contaminated soil (Geo-helminthes), water (cercariae of blood flukes) and
food (Taenia in raw meat).
2. Blood sucking insects or arthropods (as in filarial worms).
3. Domestic or wild animals harboring the parasite (as in echinococcus in dogs).
4. Person to person (as in Enterobius vermicularis, Hymenolopis nana).
5. Oneself (auto-infection) as in Enterobius vermicularis.

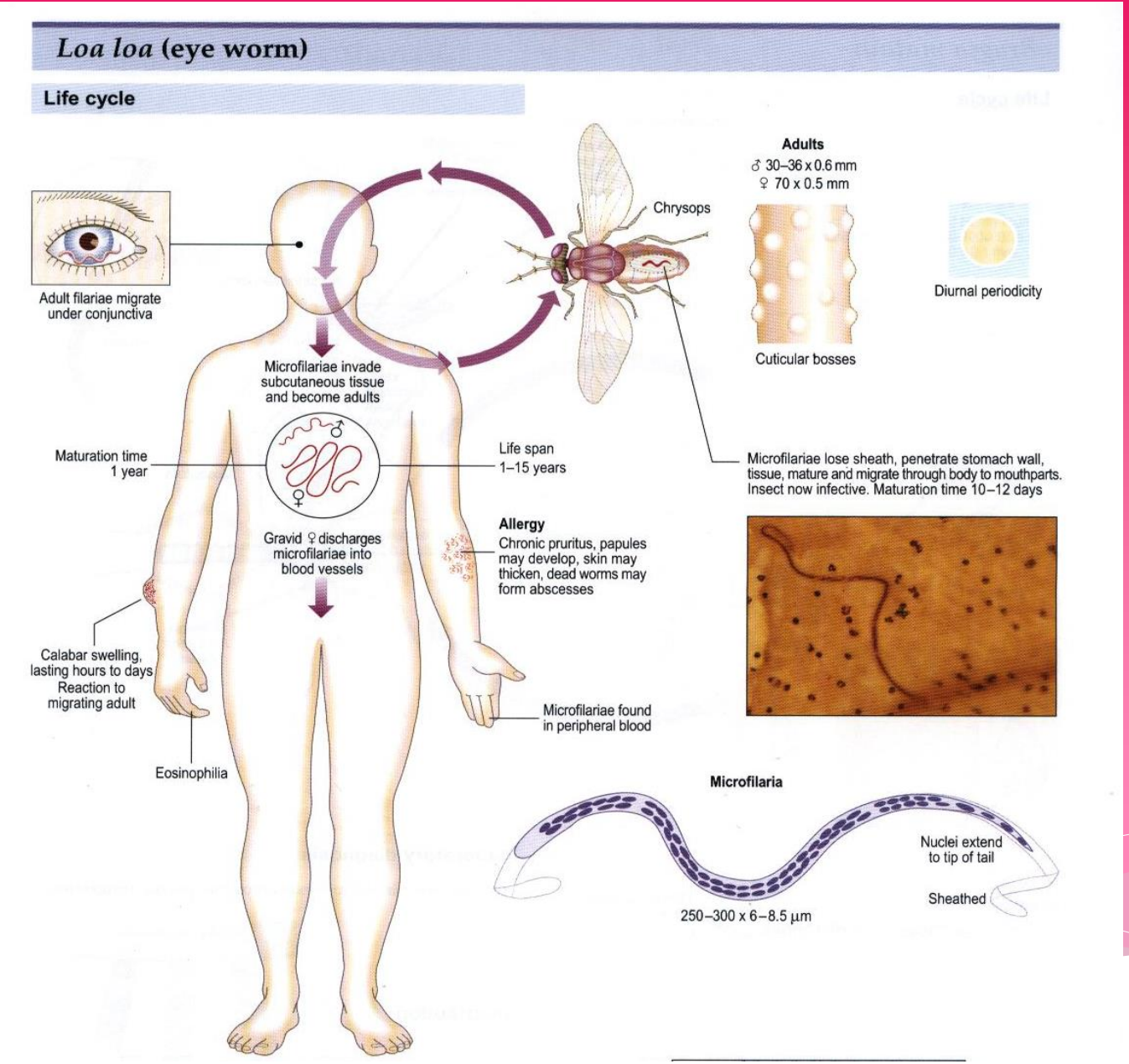
Important pathogenic helminthes
1- Strongyloides stercoralis



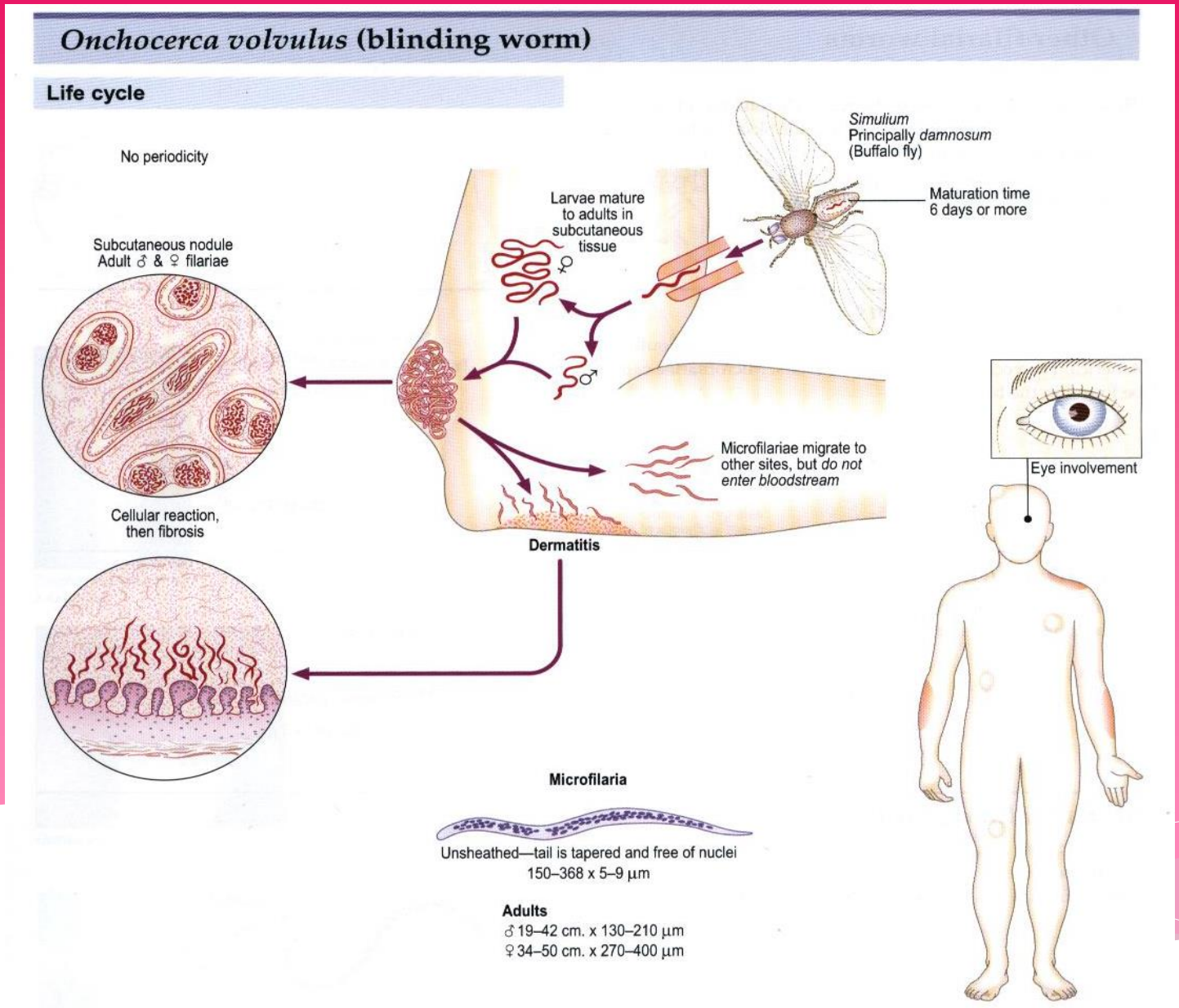
2- *Dracunculus medinensis*
(Guinea worm or Medina worm)



3- Loa loa


Loa loa (eye worm)
Life cycle
Adult filariae migrate under conjunctiva
Microfilariae invade subcutaneous tissue and become adults
Maturation time 1 year
Life span 1–15 years
Gravid ♀ discharges microfilariae into blood vessels
Calabar swelling, lasting hours to days Reaction to migrating adult
Eosinophilia
Allergy
Chronic pruritus, papules may develop, skin may thicken, dead worms may form abscesses
Microfilariae found in peripheral blood
Chrysops
Adults
♂ 30–36 x 0.6 mm
♀ 70 x 0.5 mm
Cuticular bosses
Diurnal periodicity
Microfilariae lose sheath, penetrate stomach wall, tissue, mature and migrate through body to mouthparts. Insect now infective. Maturation time 10–12 days
Microfilaria
Nuclei extend to tip of tail
Sheathed
250–300 x 6–8.5 µm

4- *Onchocerca volvulus* (Blinding worm)




Thank
you!