

# Index

## Week 1: Protozoans and Phylum Cnidaria

- Invertebrates
- Protozoans
  - General characteristics
    - Nutrition
    - Reproduction
    - Movement
  - Paramecium
    - Osmoregulation
    - Digestion
    - Excretion
    - Reproduction
  - Sub-phylum Kinetoplasta
  - Phylum Apicomplexa
  - Phylum Ciliophora
  - Amoebas
- Phylum Cnidaria
  - Polyps and Medusas
  - Class Hydrozoa
    - Freshwater Hydra
    - Marine *Obelia*
    - *Physalia*: Portuguese Man-O-War
  - Class Scyphozoa
  - Class Anthozoa

## Week 2: Phylum Platyhelminthes, Nematoda and Annelida

- Introduction
- Phylum Platyhelminthes: Flatworms
  - Structure
    - Nervous system
    - Ectodermal layer
    - Endodermal layer
    - Mesodermal layer
  - Class Turbellaria
  - Class Trematoda: Flukes
    - Human liver fluke
    - Blood fluke
    - Sheep liver fluke
  - Class Cestoda: Tapeworms
- Pseudocoelomates
  - Phylum Nematoda: Roundworms
    - Structure
    - *Ascaris lumbricoides*
    - Other parasitic Nematodes
- Phylum Annelida: Segmented Worms
  - Structure
  - Class Polychaeta
  - Class Oligochaeta
  - Class Hirudinida

### **Week 3: Phylum Mollusca**

- Phylum Mollusca
  - Structure
  - Class Monoplacophora: Neopilina
  - Class Polyplacophora: Chitons
  - Class Schaphopoda
  - Class Gastropoda
  - Class Bivalvia: Mussels, oysters, clams
  - Class Cephalopoda: Squid, octopus, nautilus, cuttlefish

### **Week 4-5: Phylum Arthropoda**

- Phylum Arthropoda
  - Introduction
  - Abundancy and wide distribution of Arthropods
  - General characteristics
  - Subphylum Triobita
  - Subphylum Chelicerata
    - Class Merostomata, Subclass Xiphosurida: Horseshoe crabs
    - Class Pycnogonida: Sea spiders
    - Class Arachnida: Spiders
      - Order Scorpiones
  - Subphylum Crustacea
    - Class Malacostraca
      - Structure
      - Order Isopoda
      - Order Amphipoda
      - Order Euphanusiacea: Krill
      - Order Decapoda: Shrimps, Crabs and Lobsters
    - Class Branchiopoda: Sea Monkeys
    - Class Ostracoda: Ostracods
    - Class Maxillopoda
      - Subclass Cirripedia: Barnacles
      - Subclass Branchiura: Fish parasites/lice
  - Subphylum Myriapoda
    - Class Chilopoda: Centipedes
    - Class Diplopoda: Millipedes
  - Subphylum Hexapoda
    - Class Insecta
      - Structure

### **Week 6: Phylum Echinodermata**

- Phylum Echinodermata
  - Structure
  - Class Asteroidea: Sea stars
  - Class Ophiuroidea: Brittle star, basket star
  - Class Echinoidea: Sea urchins, sand dollars
  - Class Holothuroidea: Sea cucumbers
  - Class Crinoidea: Sea lillies, feather stars
  - Class Concentricycloidea: Sea daisies

## Week 7: Phylum Hemichordata

- Phylum Hemichordata
  - o Class Enteropneusta: Acorn worms
  - o Class Pterobranchia

## Week 8-10: Phylum Chordata

- Phylum Chordata
  - o Structure
  - o Subphylum Urochordata
    - Class Ascidiacea: 'Tail chordates'
    - Class Thaliacea: Open ocean unicates
    - Class Larvacea: Oikopleura
  - o Subphylum Cephalochordata
  - o Subphylum Vertebrata (Craniata): Early vertebrates
    - Agnatha (jawless fish)
      - Class Myxini: Hagfishes
      - Class Cephalaspidomorphi: Lampreys
    - Gnathostomes (jawed fish)
      - Class Chondrichthyes: Cartilaginous Fishes
        - o Subclass Elasmobranchii: Sharks
        - o Subclass Holocephali: Rays and chimaeras
      - Class Osteichthyes: Bony Fishes
        - o Subclass Actinopterygii: Ray-finned fish
          - Saltwater and freshwater fish
          - Deep sea fish
          - Seahorses
        - o Subclass Sarcopterygii: Lobe-finned fish
  - o Class Amphibia
    - Order Gymnophiona (Apoda): Caecilians
    - Order Caudata (Urodela): Salamanders
    - Order Anura: Frogs
  - o Class Reptilia: Modern reptiles
    - Subclass Anapsida
      - Order Testudines: Turtles
    - Subclass Diapsida
      - Order Crocodylia: Crocodiles and alligators
      - Order Sphenodontia: Tuataras
      - Order Squamata
        - o Suborder Sauria: Lizards and snakes
        - o Suborder Serpentes: Snakes

# Week 1: Protozoans and Phylum Cnidaria

## INVERTEBRATES

### General

- Form the basis of many food webs – after the plants
- They can decrease or increase their numbers to plague proportions – a cascade effect, which can impact top predators

### Taxonomic Classification of Animals

1. Kingdom
2. Phylum
  - Sub-Phylum
3. Class
  - Sub-Class
4. Order
5. Family
6. Genus
7. Species

**REMEMBER:  
KEEP POND  
CLEAN OR  
FROGGY  
GETS SICK**

### Conventions

- **Family names** end in 'dae'
- **Subfamily names** end in 'nae'
- Each species has a Latin binomial (two words) – a **genus followed by a species name**
- The **genus** begins with a **capital (upper case)** letter and is in ***italics* or underlined** e.g. *Physalia*, *Obelia*, *Paramecium*, *Hydra*
- **Species** names begins with a **lower case letter** and are also in ***italics* or underlined**
  - Species names are rarely used alone – always after the name of the genus e.g. *Homo sapiens* NOT *sapiens*
  - If a scientific name is used many times, the genus name can be abbreviated e.g. *H. sapiens* AFTER it has been spelt out once
  - If a single species hasn't been formally described and named you can use the abbreviation 'sp.' e.g. *Paramecium* sp.
- If you aren't sure if there's just one species use 'spp.' E.g. *Paramecium* spp.
- Sp. And spp. Are NOT Latin words so they are NOT in italics or underlined
- Genus is singular = 1 genus
- Genera is plural = 2 or more genera
- Species is used for one or more species; never use 'specie'

# PROTOZOANS

## General Characteristics

### General

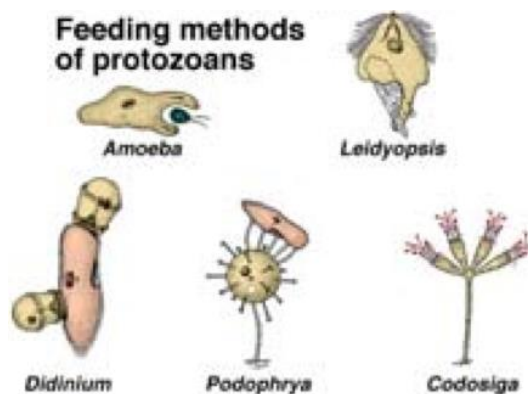
- Main characteristics
  - o Animal-like features
  - o **Uni-cellular**
  - o Most are microscopic
  - o **No cell wall**
  - o Complex organelles
  - o No organs or tissues
  - o Variable shape
  - o Very diverse
- Structures involved in locomotion are...
  - o Cilia
  - o Flagella
  - o Pseudopodia
- They have structures involved in obtaining food and osmoregulation
  - o Particularly Paramecium, which has a contractile vacuole
- There are various modes of reproduction
  - o **Asexual**
    - Fission
    - Budding
    - Cysts
  - o **Sexual**
    - Conjugation
    - Syngamy



## Nutrition

### General

- **Autotrophic:** Able to synthesise their own food
- **Heterotrophic:** Obtain organic molecules synthesised by other organisms e.g. phagotrophs (ingest visible particles)
- **Saprophytic:** Ingests food in a soluble form



## Reproduction

### General

- **Asexual**
  - Fission
  - Budding
  - Cysts
- **Sexual**
  - Conjugation
  - Syngamy

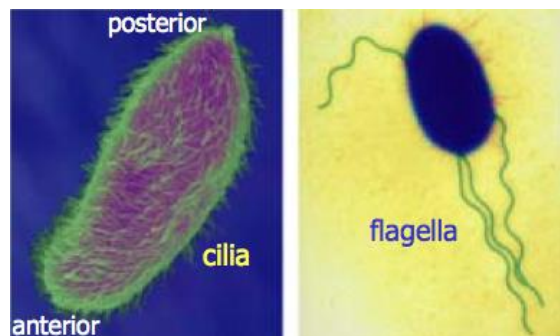
### Sexual Reproduction

- Conjugation – the exchange of genetic material
- Two Paramecium come into contact on the oral surface
- Increases genetic variation

## Movement

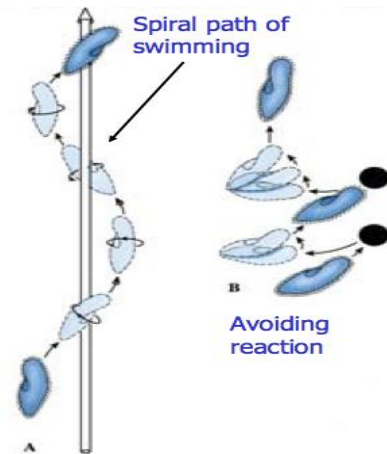
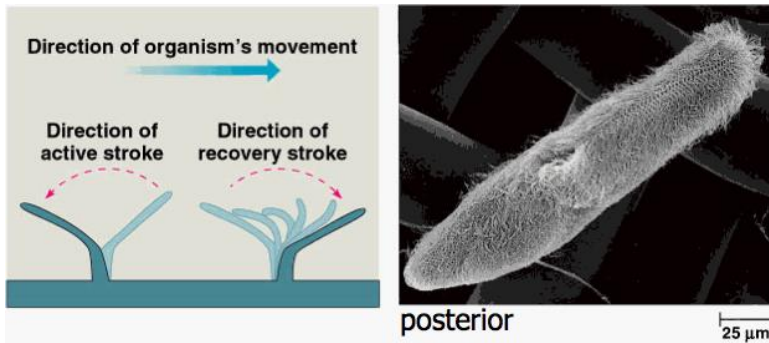
### General

- Protozoans move **chiefly by cilia/flagella/pseudopodia**
- Cilia create water currents for feeding/respiration, and are also responsible for food handling/reproduction/excretion/osmoregulation
- There are **no morphological differences between cilia and flagella**
  - Cilia are **hair-like**
  - Flagella are **whip-like**



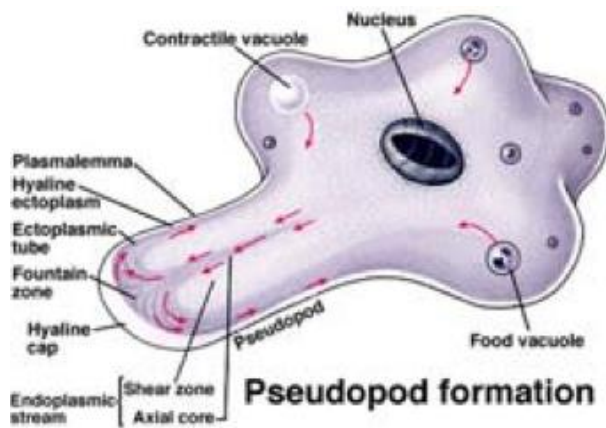
## Movement of Cilia

- Consists of a **power stroke** and **return stroke**
- A Paramecium will know when to change direction when the **electrical potential changes across its membrane**
  - o Attraction – increases the rate of the forward ciliary beat
  - o Avoiding reaction – results in ciliary reversal and backward swimming

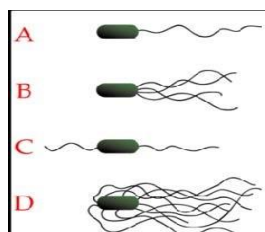


## Movement of Pseudopodia

- "Pseudo" = False
- "Podia" = Foot
- How do pseudopodia work?
  - o (1) **Blunt extension** of cell body forms (lobopodia = broad thick pseudopodia)
  - o (2) **Hyaline cap forms** (extension of the ectoplasm)
  - o (3) **Endoplasm then flows into the hyaline cap**
  - o (4) **Hydrostatic pressure forces endoplasm towards the hyaline cap**



## Movement of Flagella



- Simple undulations

## Paramecium

### General

- Representative ciliate
- **Slipper shaped**
- **Anterior – blunt**
- **Posterior – pointed**
- Oral groove – depression on ventral side with cytostome (mouth)
- Trichocysts – thread like strands that can be discharged
  - o What is the function of a trichocyst?
  - o May be a **defence mechanism** or used for **anchorage while feeding**



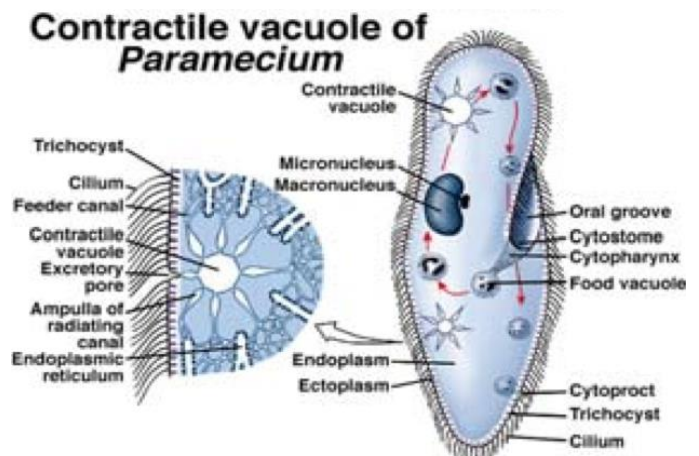
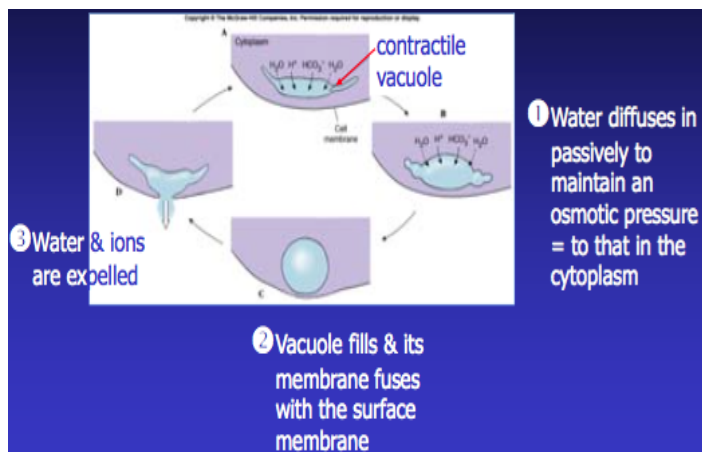
## Osmoregulation

### General

- Vacuoles observed in cytoplasm
- **Contractile vacuoles function in osmoregulation** (water balance) – **mainly in freshwater protozoans**
- **Remove excess water** that's entered the cytoplasm by osmosis
- Vacuoles are made of a system of cisternae and tubules
- Proton pumps in their membranes transport hydrogen and co-transport bicarbonate into the vacuoles

Contractile vacuole work to remove excess water in a three-stage process

- (1) **Water diffuses in passively to maintain an osmotic pressure** = to that in the cytoplasm
- (2) Vacuole fills & its membrane fuses with the surface membrane
- (3) Water & ions are expelled





## Digestion

### General

- Engulfed in a **food vacuole** – intracellular membrane bound vesicle
- **Lysosomes** – small vesicles containing digestive enzymes, fuse with food vacuole
- Undigested material released to outside – exocytosis Most ciliates / flagellates – a definite mouth structure (cytostome)
- Amoeba – release can occur across almost any point along membrane

## Excretion

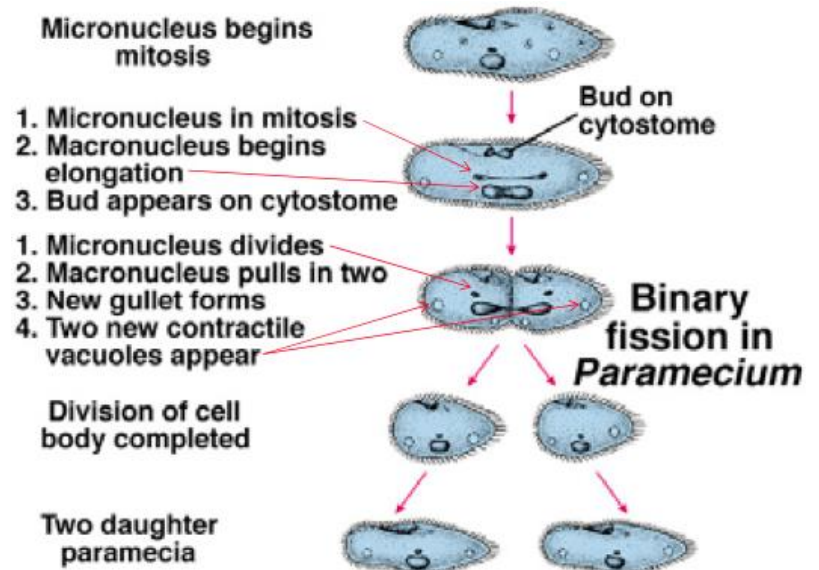
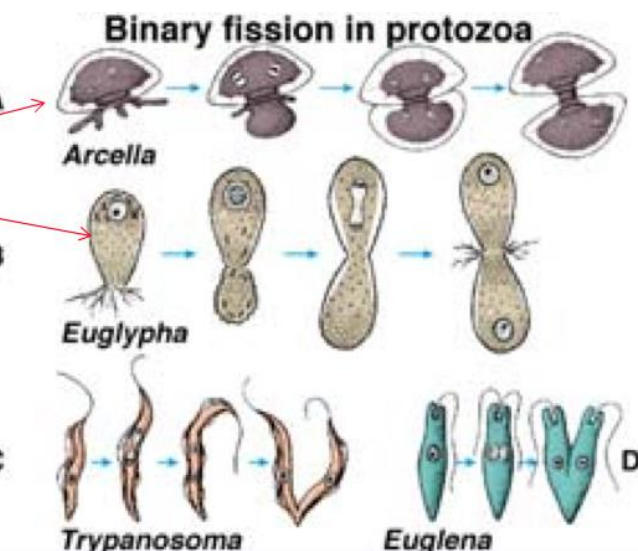
### General

- Metabolic wastes – entirely by diffusion
- Main end product of nitrogen metabolism is ammonia – readily diffuses across cell membranes

## Reproduction

### Fission

- Multiplication of cells that produces more individuals
- Most common is binary fission – produces 2 identical individuals
- Nuclei divide



### Sexual Reproduction

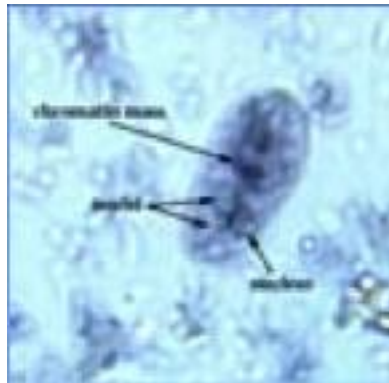
- No embryo development
- **Sexual reproduction is common**
- Essential features of sexual reproduction include...
  - o Reduction in chromosome number to half
  - o Development of sex cells (gametes)
  - o Fusion of gamete nuclei

### Encystment & Excystment

- Some protozoans form cysts to survive in harsh conditions



- Parasitic forms – survival between hosts – produce a protective outer coating e.g. *Giardia lamblia*
- Common in soil and freshwater inhabiting species, rare to absent in marine environments



*Giardia lamblia*  
Late cyst in freshwater,  
waiting for a host



*Giardia lamblia*  
Trophozoite, feeding stage,  
in mammalian gut

## Sub-Phylum Kinetoplasta

### General

- Parasitic – most important protozoan parasites are **kinetoplastans**
- Some nonpathogenic others produce severe disease in humans and animals e.g.

#### Trypanosoma

- *T. brucei rhodesiense* – **causes African sleeping sickness**
  - Transmitted by Tsetse fly
  - Doesn't affect the antelope and other wild mammals that carry the parasites
- *Trypanosoma cruzi* – Chagas disease in humans – 'An adult "kissing bug", the most common species (*Triatoma rubida*) – vector of Chagas disease



### African Sleeping Sickness

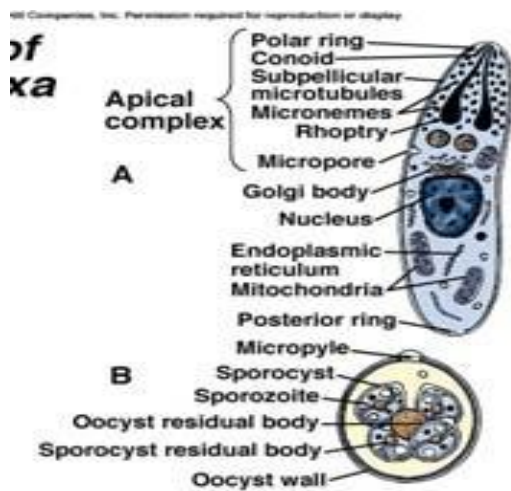
- Wild game in Africa – trypanosomes
- Fly bites wild mammals then bites human – probably not the actual cause of infection
- Multiply in number in blood
- Invade tissue – fluid around spinal fluid and brain
- Person loses consciousness



# Phylum Apicomplexa

## General

- Endoparasites
- Group of organelles, the apical complex
- Locomotor organs less obvious
- At some point in life cycle – spore develops
- Often life cycle with sexual and asexual stages
- Invertebrate intermediate host included in cycle
  - o Example: Plasmodium sporozoan parasite which causes malaria, vector is the mosquito

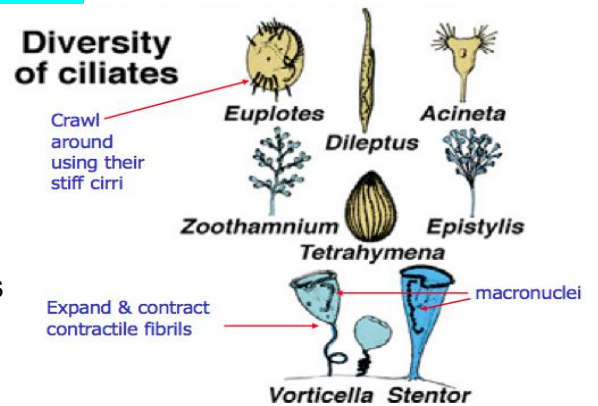


Female Anopheles injecting sporozoites of Plasmodium spp. that migrate to the liver

# Phylum Ciliophora

## General

- Have cilia
- Structurally complex and diverse
- Free-living, commensal, or parasitic
- Have a pellicle
- Multinucleate
- Macronucleus for metabolic, developmental functions
- Micronucleus for sexual reproduction



## Reproduction

- Binary fission
- Conjugation
- Self-fertilization (autogamy) – similar to conjugation but no exchange of nuclei

# Amoebas

## General

- Locomotion and feeding **by pseudopodia**
- Inhabit diverse moist environments
- **Most are omnivores**
- Nucleus, contractile vacuole, food vacuoles easy to see
- Few endoparasitic e.g. Entamoeba histolytica causes amoebic dysentery
- Not all are naked – some have protective tests (shell)

