

# Algae, Fungi, Protozoa and Helminthes

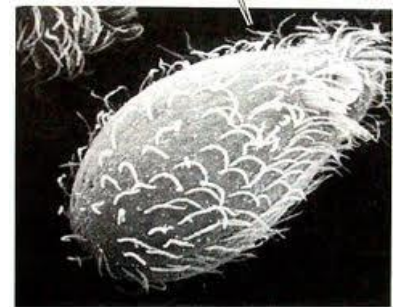
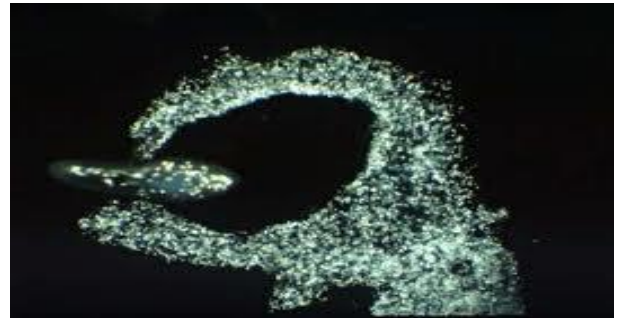
Lecture 11 – Dr. Gary Mumaugh

## The Algae, Fungi, Protozoa and Helminthes

- The world of microorganisms is made of bacteria, fungi, algae, protozoa, and viruses. They are grouped together not by their function but by their small size.
- Some microorganisms, i.e., viruses, bacteria, and protozoa are notoriously small (under one mm) while others, i.e., algae and fungi are related to large size organisms (such as the brown algae that is among the largest of all living organisms).

## Microorganisms: Shared Characteristics

- Pseudopodia (a false foot)
  - Extends the cell membrane and pushes forward or surrounds a food particle
  - Note: Single tail-like structures possessed by protists are called flagellates
  - Flagellums beat back and forth and propel the organism through the water, i.e., trypanosome and trichosomes
- Cilia (tiny hair-like structures) moves back and forth quickly propelling the organisms through the water
  - An example of a ciliate is a paramecium
- Axopodia
  - Pencil-like structures help protozoa to be planktonic or floaters in the water
  - Radiolaria are marine examples of protozoa containing this feature
  - Tend to be helpful in that they are important in lower levels of the food chain
    - They provide food for such living things as: snails, clams, and sponges
    - Some protozoa tend to also be harmful in that they are capable of causing disease in humans, as well as, other animals. Examples of such diseases that can occur in humans are: malaria, black fever, sleeping sickness, and varying types of diarrhea.



## Microorganisms: Categories

- Algae
- Fungi
- Protozoa
- Helminthes

## Algae

- Algae are photosynthetic organisms which contain chlorophyll and obtain their energy from the sun and their carbon from carbon dioxide - Autotroph
- Algae exist in sizes varying from between one micron to many meters
- Algae can be found in aquaculture supplying oxygen and acting as a natural food base for such cultured animals as dinoflagellates that cause the red tides
- Divisions of Algae
  - Green algae - May be unicellular or multicellular
    - Have cellulose cell walls, contain chlorophyll a and b, and store starch like plants. Most are microscopic. Live close to water surface. Believed to be the ancestors of terrestrial plants.
  - Brown Algae or Kelp - Macroscopic (up to 50 m long)
    - Most are found in coastal waters, at intermediate depths. Rapid growth. Can be harvested regularly.
  - Red Algae
    - Live at greater ocean depths than other algae
    - Red pigments allow them to absorb blue light that penetrates deepest into ocean
    - Agar is extracted from many red algae
    - Some produce lethal toxins



## Phylum Chlorophyta - Green Algae

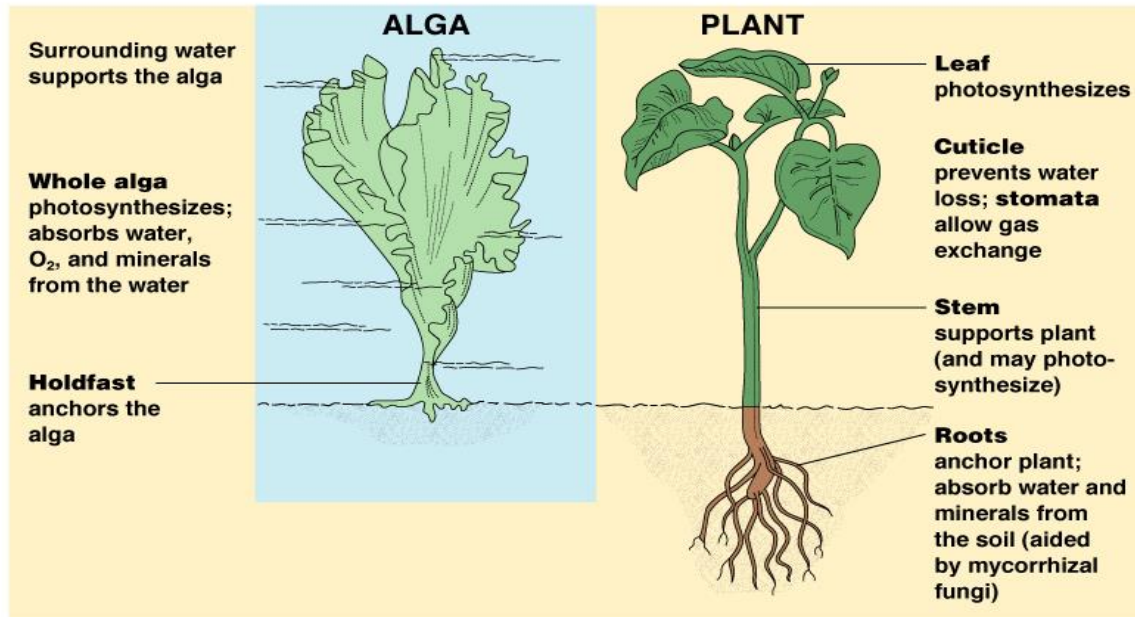
- 7000 diverse species
- Biologist reason that green algae give rise to land plants
- Both green algae and land plants have chlorophyll A & B as well as carotenoids and store food as starch
- Have walls made of cellulose

## Phylum Phaeophyta – Brown Algae

- 1500 species
- Mostly marine and include seaweed and kelp
- All are multicellular and large (often reaching lengths of 147 feet)
- Individual alga may grow to a length of 100m with a holdfast, stipe and blade
- Used in cosmetics and most ice creams

## Phylum Rhodophyta – Red Algae

- 4000 species
- Most are marine
- Smaller than brown algae and are often found at a depth of 200 meters
- Contain chlorophyll A and C as well as phycobilins which are important in absorbing light that can penetrate deep into the water
- Have cells coated in carageenan which is used in cosmetics, gelatin capsules and some cheeses



## Fungi

- Similar to algae except that they do not contain chlorophyll and they rely upon pre-formed organic matter as their primary source of energy and carbon (i.e., sugars, fat, protein, and other carbohydrates)
- Fungi, which range in size from a few microns to several centimeters, either grow independently by feeding on decaying matter or that which has been developed in association with plants and animals
- Fungi live everywhere
- They grow best in warm, moist places
- They are not green and do not possess chlorophyll
- Fungi can grow on vegetables, bread, meat, fur, wood, leather, or anything that is in a warm and moist area
- Saprobies are fungi that obtain nutrients from non-living organic matter
- In contrast, parasites are fungi which obtain nutrients directly from a living host
- Within both types, enzymes are secreted by fungi which allow digestion to take place outside of the fungal body
- Along with bacteria, fungi which include yeast, bread mold, and mushrooms, are considered to be the decomposers of the earth

## Fungi - continued

- Fungi are made up of a fungal body or what is known as mycelium--defined as a mesh of filaments that branch out in any direction living over or within the organic matter
- Within each filament is a transparent thin walled tubes (hypha)
- Reproduction of Fungi generally occurs asexually either through the formation of spores, fragmentation of the mycelium, or by budding



## Fungal Diseases

- Cutaneous mycoses: Fungal infections of the skin, hair, and nails.
  - Secrete keratinase, an enzyme that degrades keratin
  - Infection is transmitted by direct contact or contact with infected hair (hair salon) or cells (nail files, shower floors)
  - Examples:
    - Ringworm (*Tinea capitis* and *T. corporis*)
    - Athlete's foot (*Tinea pedis*)
    - Jock itch (*Tinea cruris*)
- Subcutaneous mycoses: Fungal infections beneath the skin.
  - Caused by saprophytic fungi that live in soil or on vegetation.
  - Infection occurs by implantation of spores or mycelial fragments into a skin wound.
  - Can spread to lymph vessels.
- Superficial mycoses: Infections of hair shafts and superficial epidermal cells.
  - Prevalent in tropical climates.



## Fungal Diseases

- Opportunistic mycoses: Caused by organisms that are generally harmless unless individual has weakened defenses:
  - AIDS and cancer patients
  - Individuals treated with broad spectrum antibiotics
  - Very old or very young individuals (newborns).
- Examples:
  - Aspergillosis: Inhalation of *Aspergillus* spores.
  - Yeast Infections or Candidiasis: Caused mainly by *Candida albicans*.
    - Part of normal mouth, esophagus, and vaginal flora.



### Economic Importance of Fungi

- 25-50% of harvested fruits and vegetables are damaged by fungi
- Fungal infections of plants are commonly called rots, rusts, blights, wilts, and smuts
- Beneficial fungi
  - *Candida oleophila*: Prevents fungal growth on harvested fruits
  - *Saccharomyces cerevisiae*: Makes bread and wine
  - *Trichoderma*: Makes fruit juice
  - *Taxomyces*: Produces anticancer drug taxol
  - Engineered yeast strains are used to make proteins (Hepatitis B vaccine)

### Protozoa

- Primarily comprised of free-living heterotrophs, protozoa fortified via the consumption of smaller microorganisms
- Ranging in size between two and 200 micron meters, a predominant group of protozoa, known as the Sporozoa, are parasites
- Small numbers of protozoa contain chlorophyll and, based on light conditions, switch between autotrophic and heterotrophic modes of feeding



### Helminthes

- One of the most extensive branches of the animal kingdom, the helminthes (worms and flukes) includes a vast number of species, most of which are parasitic
- Helminthes are multi-cellular with complex reproductive systems and life cycles involving intermediate hosts for the development of larval stages and a definitive host during the adult stage
- Adult helminthes may be either with individual sexes or hermaphroditic
- Predominately the Helminthes encompass a large collection of worms ranging from those that they are relatively simple to those that are incrementally more complex
- They differ dramatically in their morphology, life-history and bionomics

## The following pictorial gallery shows what a few of the commonly contracted parasites, that call the human body home, look like...



Roundworm



Pinworm



Hookworm



Dwarf Tapeworm



Whipworm



Fish Tapeworm

### Microorganisms: Diseases

- Arthropod (insect)-borne
- Loiasis
  - Hookworms
  - Strongyloides
- Ascariasis
- Toxocariasis
- Trichurias
- Arthropod (insect)-borne infections caused by filarial worms
- The classic example is elephantiasis



### Loiasis

- Caused by *Loa loa* is an arthropod-borne microfilarial infection
- The disease is spread by biting flies whereby the adult worms migrate along connective tissue, usually reaching the conjunctiva of the eye
- Soil-transmitted, helminthic infections include two types:
  - hookworms, which experience a development cycle in the soil (the larvae being infective)
  - *strongyloides stercoralis*, a group of nematodes that survive in the soil merely as eggs that must be ingested in order for the cycle to continue

### Hookworm

- The most common types of hookworms are: *Ancylostoma duodenale* and *Necator americanus*. While male hook worms attach to the walls of the jejunum-female hook worms lay large numbers of eggs which are passed out with the feces



### **Hookworm - continued**

- The eggs hatch in the soil and infect man typically by burrowing through the soles of the feet
- The larvae then migrate to infect the heart and lungs before passing into the tracheae, pharynx and small intestine
- Ascariasis - Adult worms of *Ascaris lumbricoides* live in the small intestine where they lay large numbers of eggs passed out with the feces. Unlike the hookworms, the eggs are of the infectious form in which larvae develop
- When ingested, the eggs hatch in the jejunum, penetrate the mucosa and are carried through the hepatic circulation to the heart and lungs. They again enter the stomach via the tracheae and esophagus before growing to adulthood in the small intestine
- Pneumonitis and intestinal obstruction may accompany heavy infestations

### **Toxocariasis**

- A disease whereby a human is accidentally infected with the eggs of the ascarid roundworm of the dog, it is known as *Toxocara canis*, cat, or *T. cati*
- While the life cycle is the same as that of *Ascaris*, the invasive larvae become arrested in various tissues where they are phagocytosed (progress through the life cycle phase). In the process they induce marked eosinophilia stimulating a localized tissue reaction involving the liver and eye

**Trichuriasis**--*Trichuris trichiura* ("whipworm") inhabits the caecum where the invaders attach to the mucosa

- Eggs from the mature worms, passed out with the feces develop in the soil
- When swallowed, the eggs, after hatching in the small intestine, develop larvae and pass directly to their attachment sites in the large intestine
- Heavy infections have a tendency to cause abdominal pain and chronic bloody diarrhea which has the potential of resulting in rectal prolapse

### **Worldwide Implications of Parasites**

- Millions of people throughout the world are adversely affected by parasitic infections
- And while microbiologists and virologists attempt to keep up with the most damaging of parasites (and, hence, come up with suitable treatments and vaccines) there continue to be those parasites that are mysterious, and, hence, problematic in terms of understanding and treating
- Parasite infections are increasing throughout the world
- A culmination of the impact of Human Immunodeficiency Virus (HIV) and AIDS, these global conditions have given rise to the emergence of 'new, opportunistic' parasites along with the increased prevalence of previously known types
- Further contributing to the state of parasitic 'hysteria' are the climate changes resulting from global warming and the breakdown in sanitation brought upon by war
- Yet, due to limited space within this reference source we are unable to fully characterize all of the pertinent protozoal and helminth infections known to man. In order to learn more about the wide range of parasitic threats that abound it may be best to refer to specialized medical sources.

