

Chap 21

Nature of Microorganisms

(1)

Microorganism / Microbs are tiny organism that can't be seen without a microscope. They include Archaea + Eubacteria domain + Eucarya domain they include Kingdom Protista + Fungi (Review characteristics of these all from previous chapters.)

these microbes are found everywhere on Earth.

the biomass of microbes is \gg the biomass of all other kinds of organism.

They live in H₂O / or any moist regions.

They may go dormant for long periods of time without H₂O. When re-moistened, they become active again.

Domain Eubacteria

- Spherical / rod-shaped / or spiral shaped. Fig 21.1
- Many have flagella to allow movement.
- Some form resistant spores that withstand harsh environmental conditions.

Decomposers:

Many are heterotrophic saprophytes. Some are anaerobic other are aerobic \rightarrow CO₂ + H₂O

single organic acids

This is important for recycling of C, N, P, ...

- Most use decomposes to degraded organic matter in sewage.
- Some bacteria are used ^{to make} cheese / yogurt, Alcohol, ...
- Acetone, acid
- Other bacteria are used to eliminate oil spills.

Commensal Bacteria: (Cause no harm).

Most organisms are lined with bacteria called Normal flora like E. coli in our intestine

Feces are decomposed by E. coli.

SK odor is due to bacteria on skin.

Photosynthetic bacteria.

like Cyanobacteria. use CO_2 + release O_2 .

Chloroplastic plants are considered to be cyanobacteria

1st O_2 evolves. leading to O_2 in atmosphere

- Found in fresh + marine H₂O. / soil / moist environment

- reproduce asexually to yield an algal bloom. that is

a rapid ↑ in population of bacteria in a body of H₂O.

- Many form filaments (e.g. ↑) (21.3)

+ other kinds of colonies.

- Some species produce toxins - so in an algal bloom that yield enough toxin to harm animal + humans

- Cyanobacteria can do N_2 fixation → NH_3 that can be used

Purple + green bacteria do not carry regular photosynthesis + they do not release O_2 but they use H_2S + release Sulfur as product of photosynthesis (2)

Dysbiotic Bacteria

like some of our intestinal bacteria. they produce Vit / chemicals that inhibit growth of other harmful bacteria. they aid in digestion of nutrients.

(example of traveler's Diarrhea due to another bacteria that do not adjust to new environment.)

Other good bacteria in plant have N_2 fixation. they live in roots of plants.

Some Fish have a bioluminescent bacteria that allow them to produce light.

Disease Causing bacteria

Called Pathogens

Some commensal bacteria become harmful if $N_0 \leq 1/10^9$ to cause illness.

like Streptococcus pneumoniae grow regularly in our throat but if cold + a flu, immunity \downarrow , bacteria are too long + cause pneumonia.

Other illness are caused by toxins produced by bacteria like botulism is a deadly disease caused by bacterial toxins

Toxin cause fever, aches, pain...

- Bacterial pathogens also affect plants + lower yield.

(Fig 21.4).

Control of bacterial populations:

Low N_3 of bacteria cause no harm. However, when $N_3 \uparrow \rightarrow$ disease due to 1) reproductive rate, 2) ability to form resistant stages, 3) ability to mutate + produce resistance to antibiotic

Drugs taken interfere with bacteria ability to reproduce. Some kill them directly. This gives time to immune system to control + destroy bacteria.

Drugs that kill bacteria are Antiseptic (No growth inhibition)

- other factor that allow bacteria to survive hostile environment is ability to form endospores.

Endospore is a unique bacterial structure with a low metabolic rate that can withstand hostile environment + can germinate under more favorable conditions

- Endospores may be killed by heat, at high T 121°C for 15-20 min

- Anthrax is also an acute infectious disease caused by Bacillus anthracis. The Anthrax Spores live in soil + cause disease when they are inhaled / swallowed / invade the skin

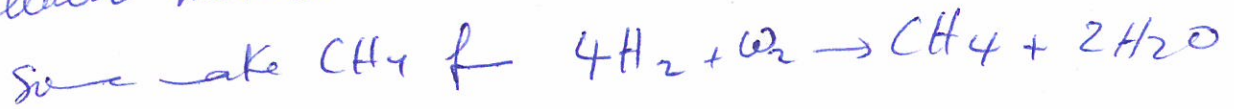
Archae Bacteria.

(3)

live in extreme T. / spherical / rod shaped / spiral /
lobed / plate like / irregular shape.

Methanogens.

strictly anaerobes. Release CH_4 (methane) as product
of cellular metabolism.



Other break down acetate.



live in mud / swamps / Intestine of animals + humans,

Anaerobic digesters can be used to produce CH_4 from

human or animal waste.

Halophiles.

live in extremely salty H_2O . need at least 8% salt to
live. grow best in 20% salt.

- Not all are aerobic heterotrophs

- Some are photosynthetic autotrophs with carotene pigment
that absorbs light + allow cell to make ATP.

Thermophiles

live Very hot T. $> 50^\circ\text{C}$ Some prefer 100°C

- Aerobes + Anaerobes -

- Some reduce $\text{S} \rightarrow \text{H}_2\text{S}$.

- Some live in low pH (very acidic conditions)

21.3 Kingdom Protista

Organisms in this Kingdom are not closely related to each other but they share simplicity of eukaryotic cells.

- Most are single celled. Some are multicellular.

Species are divided into 3 major groups based on mode of life

1 - Algae: Autotrophs unicellular.

2 - Protozoa: heterotrophs "

3 - Funguslike Protist.

See Fig 21.7 Relationship among members of Protista.

Algae

have chlorophyll in chloroplast → Photosynthesis

- Many are single celled. Some groups are multicellular.
- live in ocean - freshwater - (some in moist places in soil)

Algae are major component of phytoplankton that is are photosynthetic plankton (

A plankton is the collection of small, floating swimming organisms

Zooplankton: are non photosynthetic plankton (like protozoa)

Benthic organisms live attached to bottom or to object in H₂O.

Benthic + Planktonic Algae produce ~ 50% of O_2 in atmosphere. (4)

They are important producers in marine food chains.

As they need light - they're found on surface of H₂O.

Benthic ~~algae~~ organisms are found ^{in shallow} ~~at~~ H₂O.

Algae reproduce both sexually + a sexually.

They can cause algal bloom (like Cyanobacteria) population can become so big so H₂O become colored + if clumps they float on surface.

Single celled Algae

Example 1) Euglenoids are single celled Algae that move by flagella.

- have outer covering called pellicle that give shape but is

flexible -

Some euglenoids are Autotrophs others are heterotrophs

- Most are found in fresh water -

2) Diatoms are also single celled algae found in fresh water / marine / soil environment.

major phytoplankton + serve as food for zooplankton + whales + clams -

- No cilia No flagella. Move by gliding.

cell wall contain silicon dioxide (silica). They form fossils

3) Dinoflagellates. most important food producer in ocean.
have 2 flagella. outer cover made of cellulose plate.
many are photosynthetic, some heterotrophs or parasite.
Some produce toxins. (they're reddish in color) hence
blooms of dinoflagellates are called red tide.

Multicellular Algae.

Commonly known as seaweed. Found in shallow H₂O.

2 types $\left\{ \begin{array}{l} \text{Red Algae} \\ \text{Brown Algae} \end{array} \right\}$ marine

1 type \rightarrow green \rightarrow freshwater

Red algae are important. They're used to make agar
to grow bacteria in labs. + Carrageenan which is a
gelatinous material used in pants / cosmetics / baking

Brown Algae: Colours of brown algae can reach 100m in length

They produce Alginates used as stabilizer in frozen desserts
or thickeners. + to form gels in fruit jellies

Green Algae.

Some are single cell with flagella.

Some No flagella + form strings

- Can be found on growing trees in soil.

- They have cellulose cell walls. + store food as starch

- Plants may have evolved from green Algae.

Protozoa

(5)

- Kingdom Protista.
- Eukaryotic - heterotrophic - Single cell with No cell wall.
- In general No chlorophyll
- Classified according to locomotion.

1) flagellate

- live in any moist environment
- parasite or symbiont
- some feed by absorption of nutrients / others engulf particles
- many are mutualistic

Example of Mutualists like the flagellate that live in gut of termite. (find a place to live in + help termite digest cellulose)

Parasitic flagellate, Trichomonas Vaginalis (live in reproductive tract of men + women). + cause Sexually Transmitted Disease may cause itching + discharge.

2) Trypanosome cause sleeping sickness in Africa is a parasitic flagellate. It feeds on blood to cerebrospinal fluid ~~surrounding~~ surrounding brain.

3) Giardia lamblia is an intestinal parasite of many animals. cause diarrhea / gas / nausea.

4) Choanoflagellate: form colony, may be ancestors to multicellular animals.

Amoeboid Protozoans

have extensions on cell surface called pseudopods.

example ~~Amoeba~~ (see Fig 21.12)

- free living - feed on bacteria / Algae / small organisms.
- Some are parasitic like *Entamoeba histolytica* cause dysentery.

2 Specialized types of amoeboid $\begin{cases} \text{Radiolarians (SiO}_2\text{)}^{\text{Skeleton}} \\ \text{Foraminiferas (CaCO}_3\text{)} \end{cases}$

Apicomplexa

Non motile parasites. Disease Malaria is caused by a member of this group.

See Pg 21.13 to see how Malaria is transmitted.

Ciliates

have complex cellular structure with many short flexible extensions of cells called cilia.

Example is *Paramecium*. ~ 15,000 cilia/cell.
move 1 mm / s.

- free living in fresh H₂O / Salty H₂O / damp soil

- feed on bacteria + small organisms.

- Have 2 kinds of nuclei $\begin{cases} \text{Macronucleus} \\ \text{1 or more Micro nuclei} \end{cases}$

$\begin{cases} \text{involved} \\ \text{(Normal metabolism)} \end{cases}$

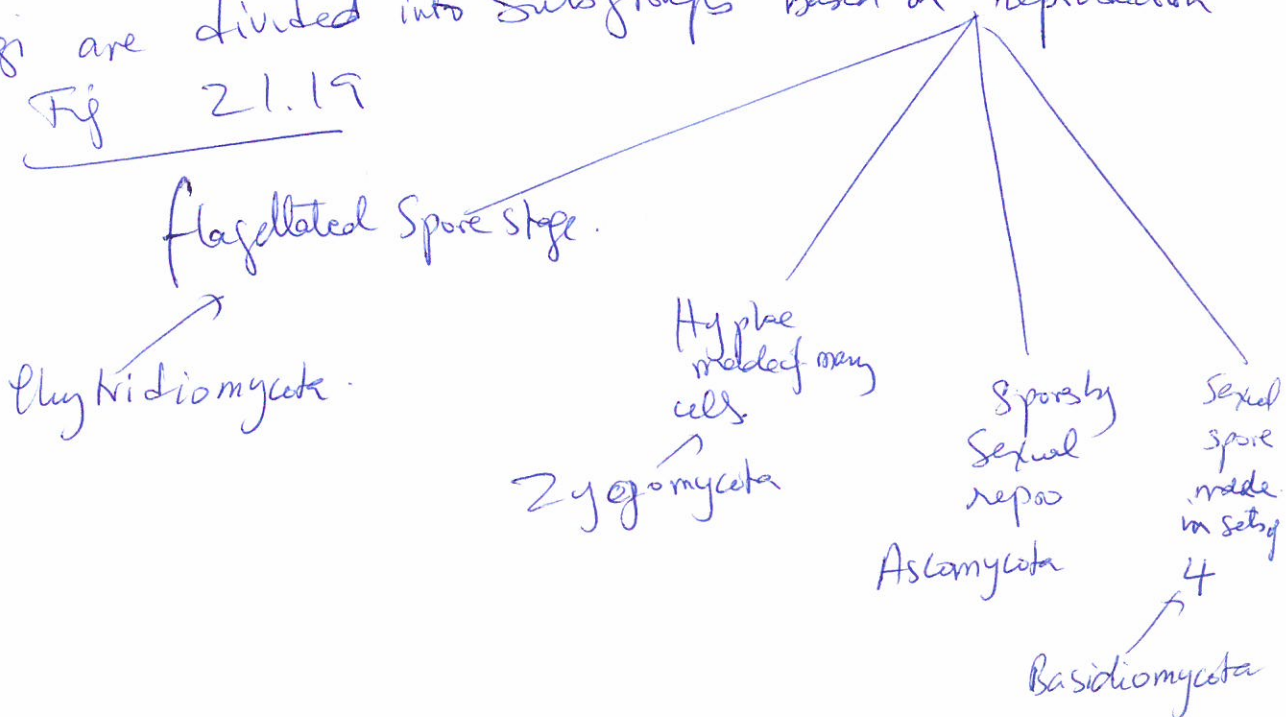
$\begin{cases} \text{involved in} \\ \text{Sexual reproduction} \end{cases}$

- Sexual reproduction is by a process called Conjugation that lead to exchange in genetic material but no division.

21.5 Kingdom Fungi.

- Non Photosynthetic, Eukaryotic, rigid cell wall made of chitin.
- Most Multicellular.
- a fungus has ~~filaments~~ filaments composed of many cells. Each filament is called a Hypha.
- Form Network known as Mycelium Fig 21.18.
- Non Motile but They disperse as spores.
- Spore reproduced by sexual reproduction / or asexual.
- Spore are transported by wind or H₂O
- Can stay in air \rightarrow spore log tree.
- Heterotrophs. - secrete enzyme that digest large molecules to small one that can be absorbed by the fungus.
- free living / Parasitic
 - ↳ Mushroom
 - ↳ cause plant + human disease
 - ↳ Athlete's foot - vaginal infection, ...

Fungi are divided into Subgroups based on reproduction Fig 21.19



Significance of Fungi

(7)

- Decomposers
 - Food: (Mushroom - ^{old.} soy sauce) ^{blue} Cheese - Alcohol -
 - Mycorrhizae found in 80-90% of plants help in absorption of Nutrients. - give hormones -
 - lichens are a combination of fungus + Algae or Fungus + cyanobacteria -
↓
do photosynthesis
- Fungi provide moist environment.
lichens do not require soil to grow as Nutrient is provided by algae / cyanobacteria.

Pathogenic Fungi cause big harm to plants

Toxic Fungi: mycotoxins are deadly toxin produced by

Fungi

Amanita verna cause death.

Other cause hallucination - Residue spores, insanity -
