

Introduction to Environmental Microbiology



Why Should We Know about Microorganisms

Waste is their business

Degrade waste

“Free” environmental worker

Know their environment and
requirements

What are Microorganisms



Tiny living organisms
(microns, 10^{-3} mm)

Bacteria, fungus,
protozoa, virus, algae

Live as a community

Why are they important

Cause diseases to man and other living organisms



Chicken pox – virus

Common cold – virus

Diarrheal diseases – bacteria,
protozoa

Malaria – protozoa

Meningitis – bacteria, virus

In Wastewater Treatment

Degrade waste (organic and inorganic matters)
into simple and **harmless** compounds

Organic and inorganic matters

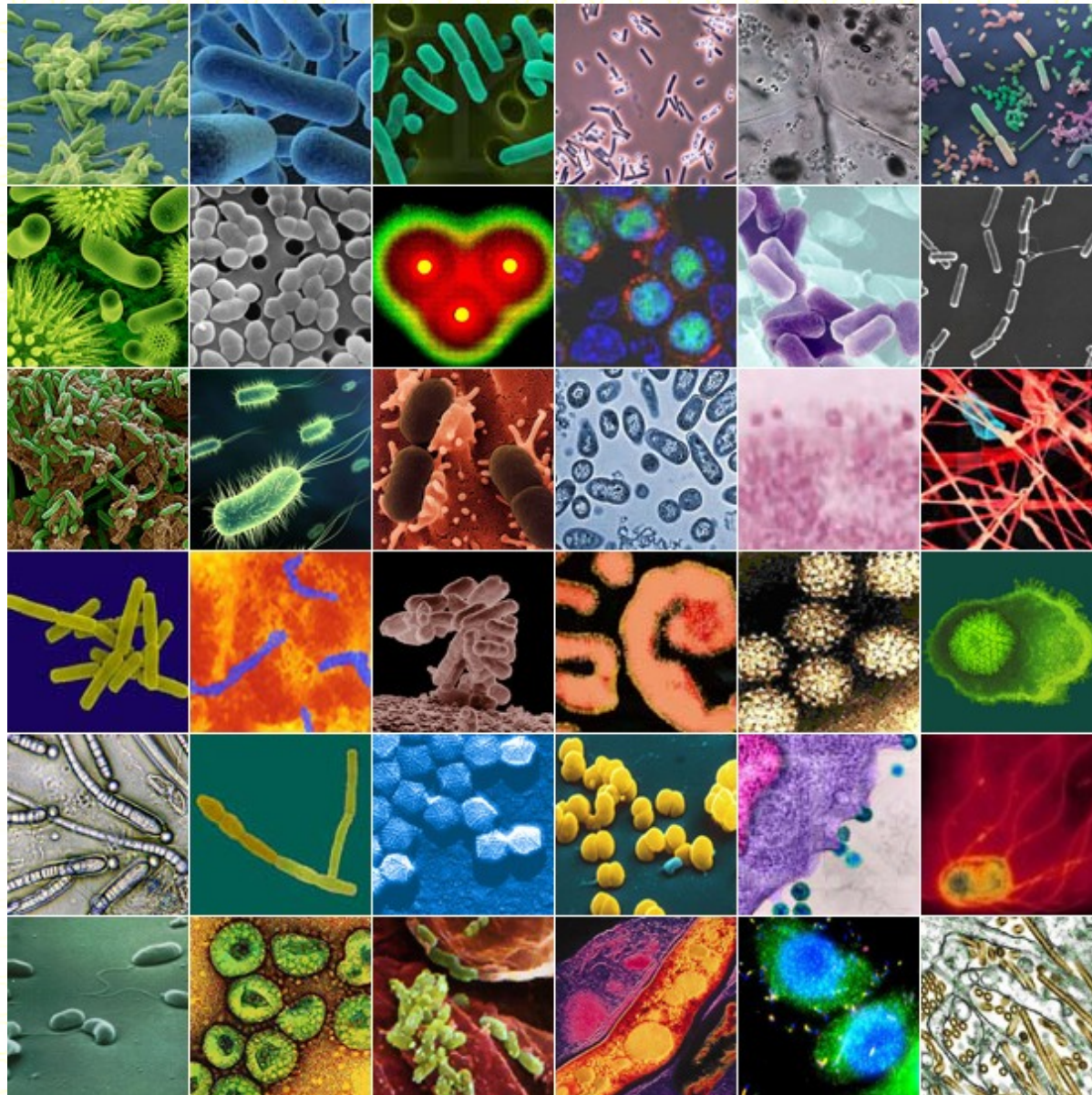
↓ (microorganisms) ↓

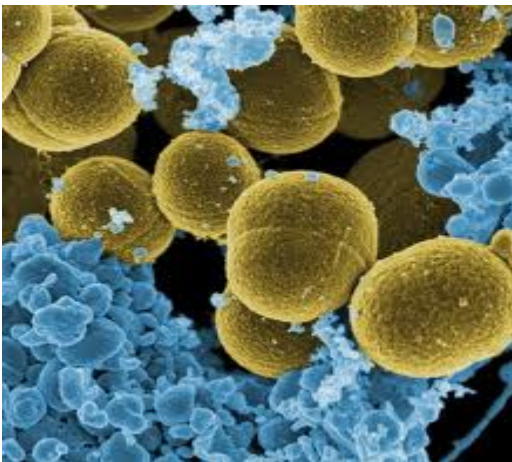
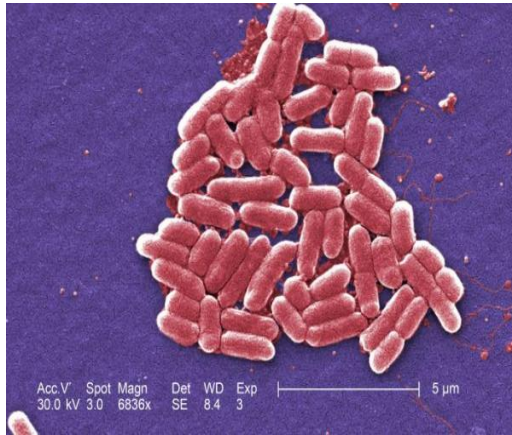
$\text{CO}_2 + \text{H}_2\text{O} + \text{new cells}$

Important component !!!!

Bacteria

(plural of bacterium)





Single-cell

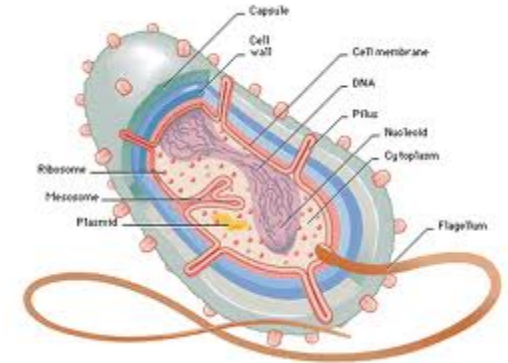
0.5 – 5.0 μm

Individual, in pairs or in chains

Different shapes

Reproduce through **binary fission**
 (Double within 15 – 30 minute)

**Important in biological wastewater
 treatment**



Classification

- ① Energy and Carbon sources
- ② Utilization of dissolved oxygen

①

Energy and Carbon Sources

For growth and reproduction

Energy – to do work

Carbon sources – raw material

(i) Heterotroph

Organic as energy and carbon sources

(ii) Autotroph

Inorganic as energy source

Carbon dioxide as carbon source

②

Utilization of Dissolved Oxygen

1. Aerobe
2. Anaerobe
3. Facultative

Aerobe

Live in the presence of dissolved
oxygen

Die without dissolved oxygen

Anaerobe

Live in the absence of dissolved oxygen

Die in the presence of dissolved oxygen

Use oxygen from compounds such as



Facultative

Can live in aerobic or anaerobic conditions

Bacterial Growth

Reproduced by **binary fission**
(i.e. by dividing, the original cell
becomes two new organisms)

Video

binary fission







Bacterial Growth Phase

- ① Lag Phase
- ② Exponential Growth Phase
- ③ Stationary Phase
- ④ Death/Endogenous Phase

① Lag Phase

Acclimatization period

② Exponential Growth Phase

Excess substrate promotes maximum growth rate

Limited by ability bacteria to reproduce

③ Stationary Phase

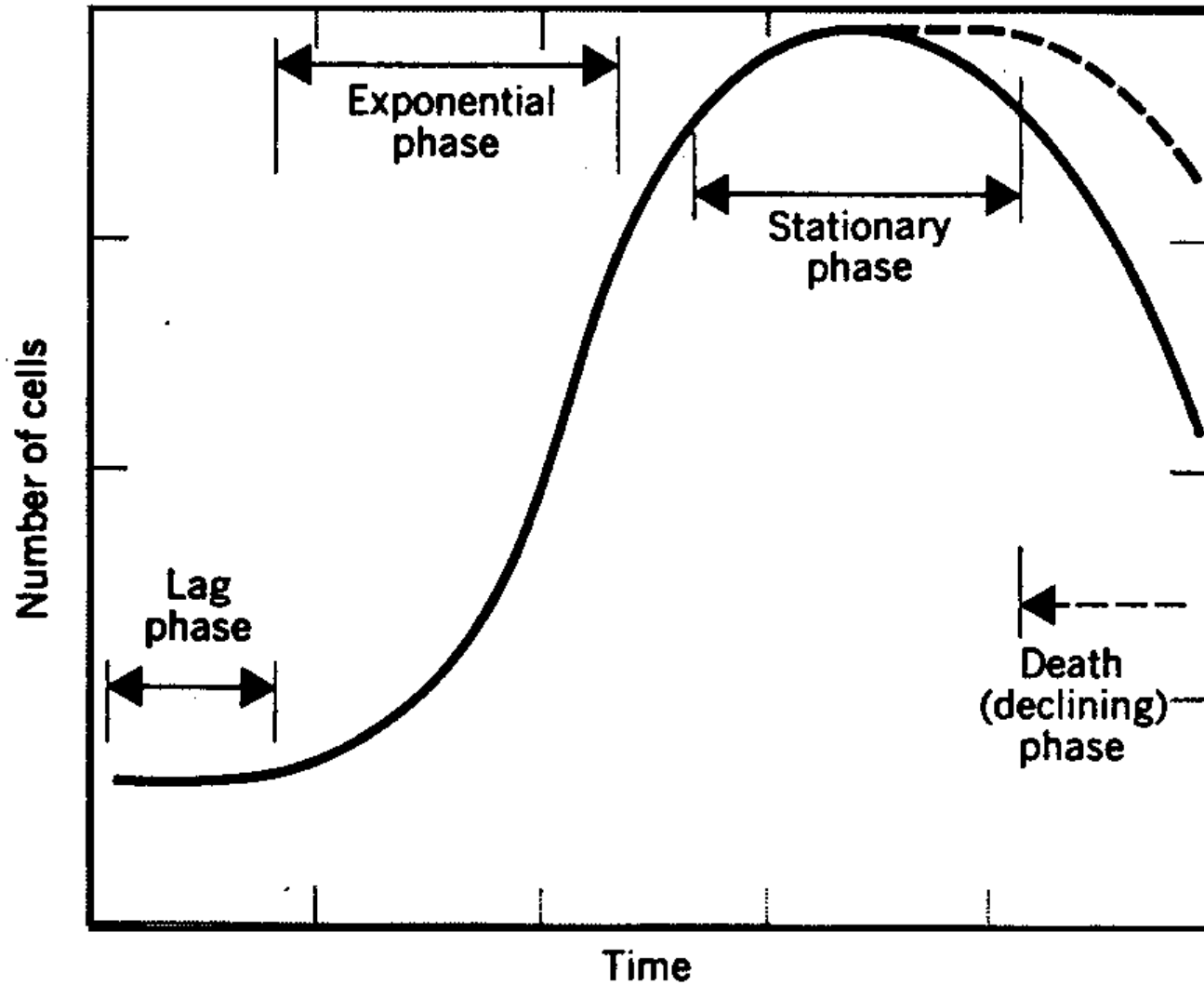
Substrate or nutrients almost finish
Growth of new cells is offset by the
death of old cells

④ Death/Endogenous Phase

Death rate $>$ production of new cells

Depletion of nutrient/food

Toxic by-products



Algae





Generate energy by photosynthesis
Increase DO level in water under sunlight

Rapid production at high N and P

Too much algae cause:

Taste and smell problems

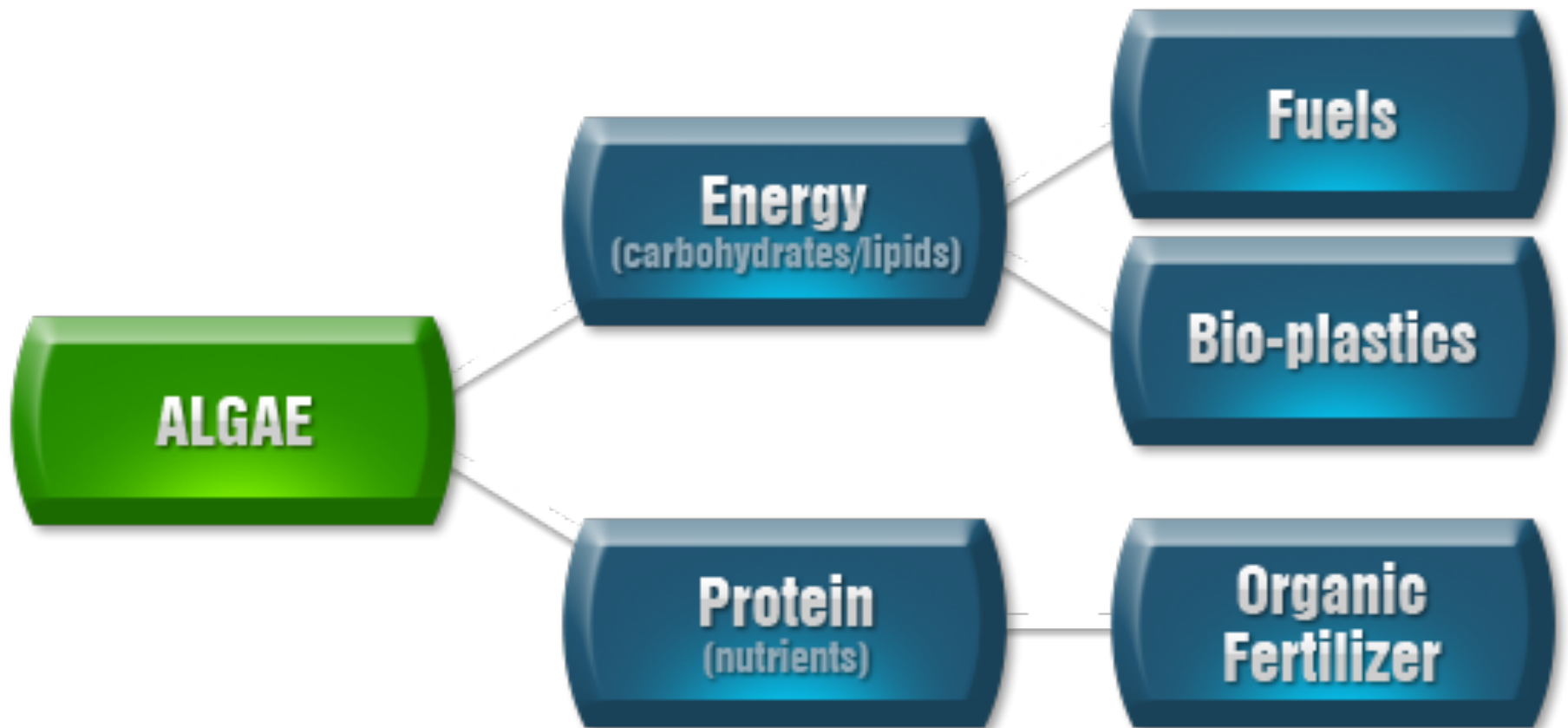
Reduce light penetration

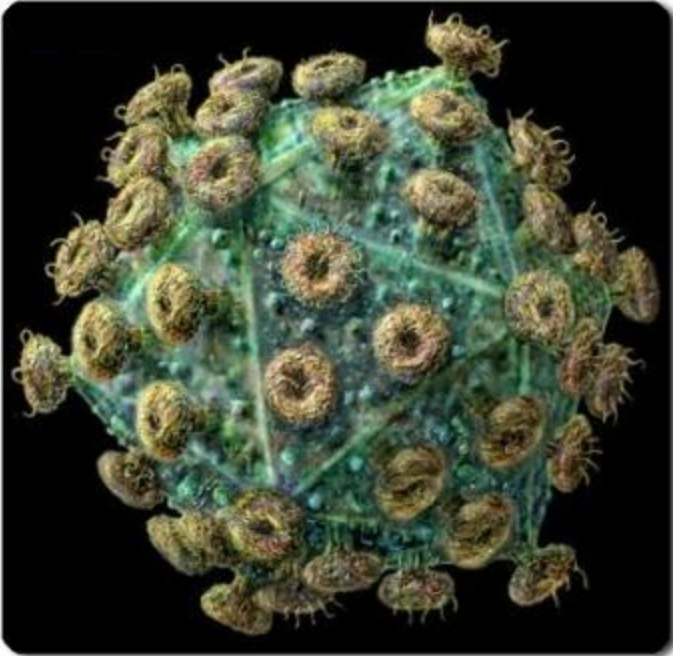
Die – degraded and cause anaerobic condition





(Cultured 1/17)
I Colson (2/10)

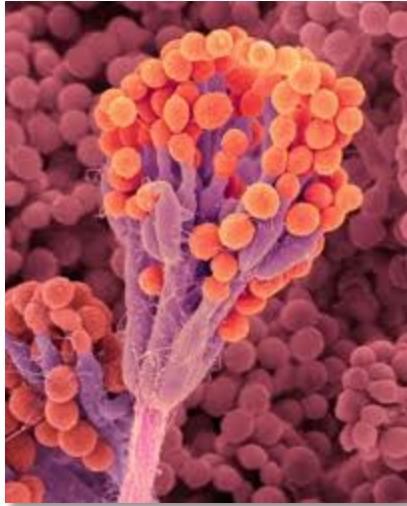




- **Smallest** micro-organisms
- 0.01 – 0.3 μm
- **Parasite** - require host for survival
- Hepatitis, flu, jaundice, polio, AIDS



Fungus



Plants that **unable** to do
photosynthesis

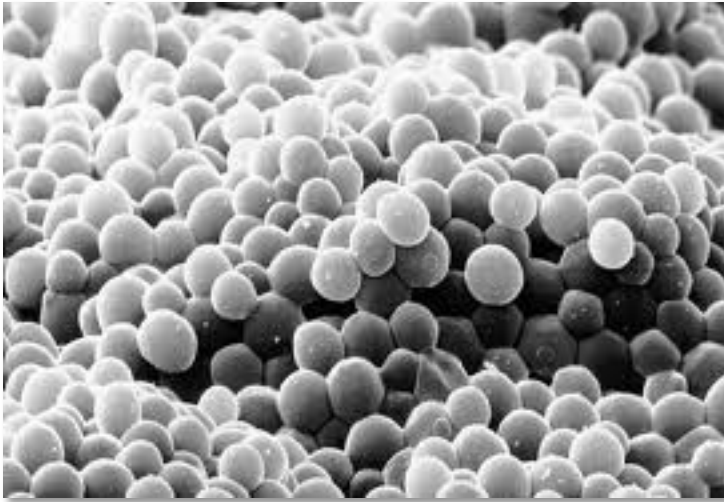
Strict aerobes

Tolerate low pH and nutrients

Yeast

Mould





Yeast

3 – 4 microns up to 40 microns

Heterothrophs

Aerobes and facultatives

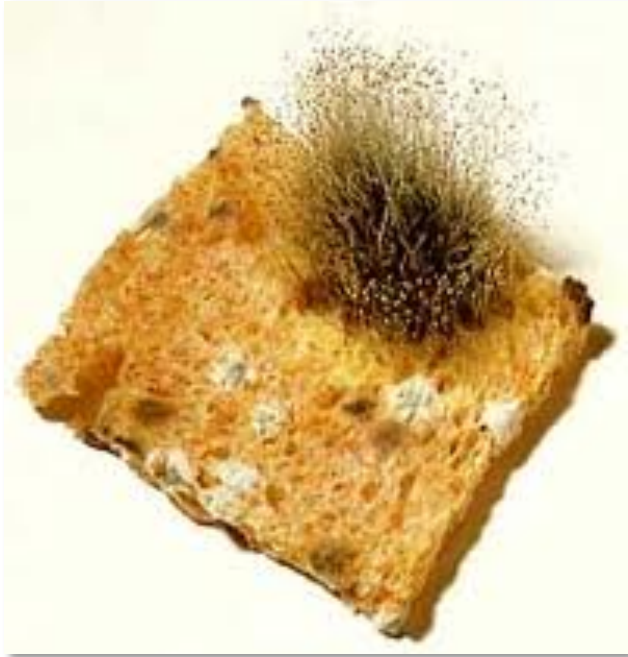
Grow as single cells

Fermentation industries -

Bread, cake and alcohol

Can cause infection





Moulds

Filamentous

Live in acidic condition

Reduce efficiency of

secondary sedimentation tank

Cause unpleasant smell and
taste





Protozoa

Unicellular organisms with size 10 – 100 μm

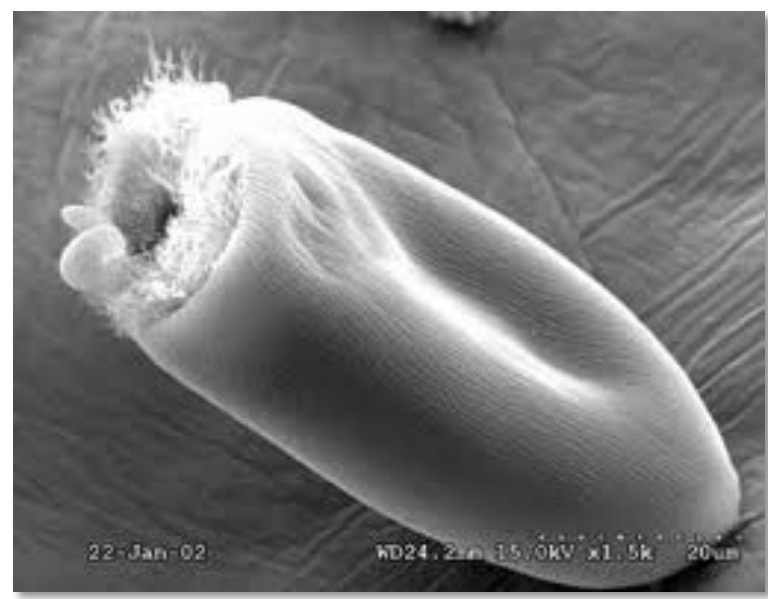
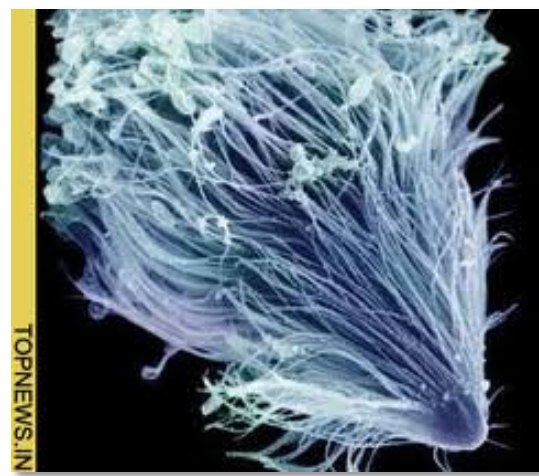
Aerobe and mobile

Digest bacteria and algae

Degrade dissolved and non dissolved organics

Act as 'cleaning agent' in treatment plant

Cause disease related to stomach



Rotifer

Multi-cellular organisms

Bacteria and organic particles as energy sources

Indicate plant efficiency
(high DO and low organic matter)

