



#3: Activated Sludge Microbiology

Dr. Larry Moore, PhD., P.E.
WEF Fellow
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Outline for Activated Sludge Microbiology

- Bacteria
- Protozoans
- Metazoans
- Heterotrophs and Autotrophs
- Food-to-Microorganism Ratio

Types of Microorganisms

- Bacteria
- Protozoans
- Metazoans
- Algae

Bacteria

- Floc-forming
- Filamentous
- Heterotrophic
- Autotrophic
- Aerobic
- Anaerobic
- Facultative

Bacterial “Eating” Process

- Adsorption
- Exocellular Digestion
- Absorption

Protozoans

- Amoeba
- Flagellated
- Free-Swimming
 - Bulk Liquid
 - Crawler
 - Carnivore
- Stalked
- Suctoria

Metazoans

- Rotifer
- Nematode (round worm)
- Tardigrade (water bear)
- Annelid (Aeolosoma worm)
- Ostracod (Seed shrimp)
- Copepod
- Water fleas
- Water Mites

Mixed Liquor Volatile Suspended Solids (MLVSS)

MLVSS is the organic fraction of the suspended solids in activated sludge mixed liquor that can be driven off by combustion at 550 °C.

Heterotrophic and Autotrophic Bacteria

Heterotrophic and autotrophic bacteria differ in the source of nutrition they require.

Heterotrophic Bacteria

- **Aerobes** require free dissolved oxygen (DO)
- **Anaerobes** require an absence of free DO
- **Facultative bacteria** prefer free DO but can function in its absence

Autotrophic Bacteria

- Use carbon dioxide as a carbon source
- Oxidize inorganic compounds for energy

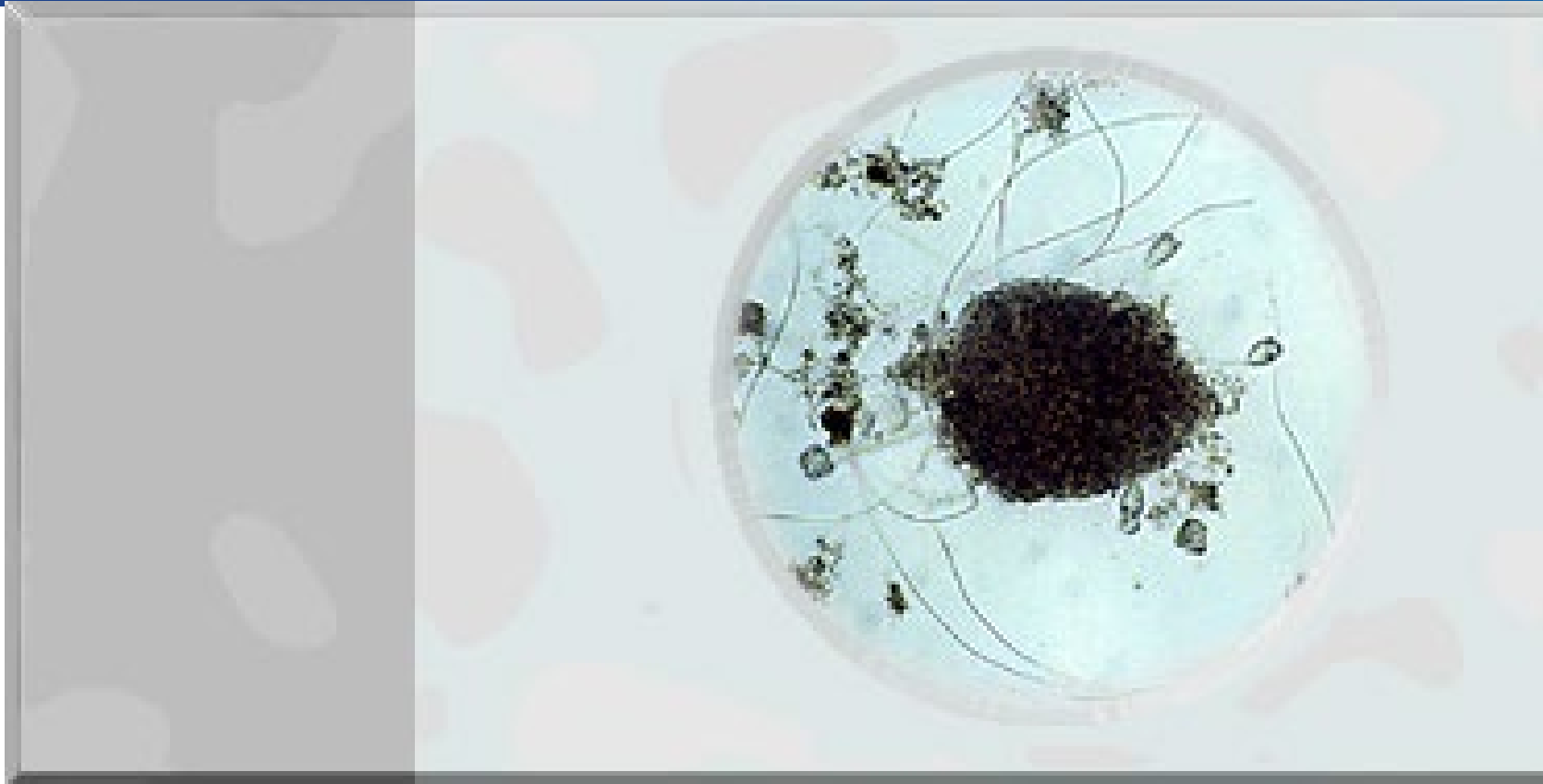
Food-to-Microorganism Ratio

F:M - The ratio of organic loading to microorganisms in the activated sludge system.

Activated Sludge Microbiology

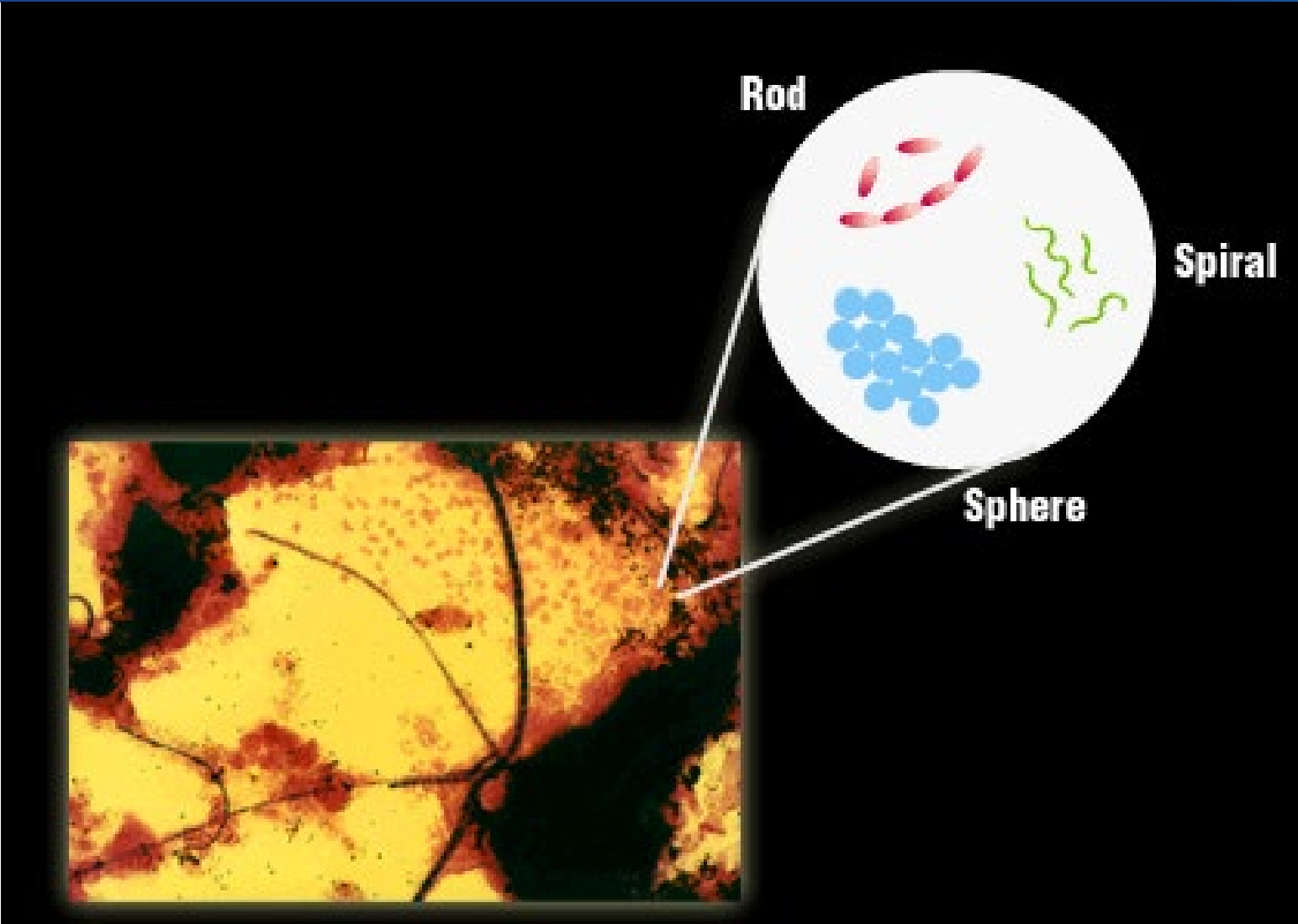


Microorganisms

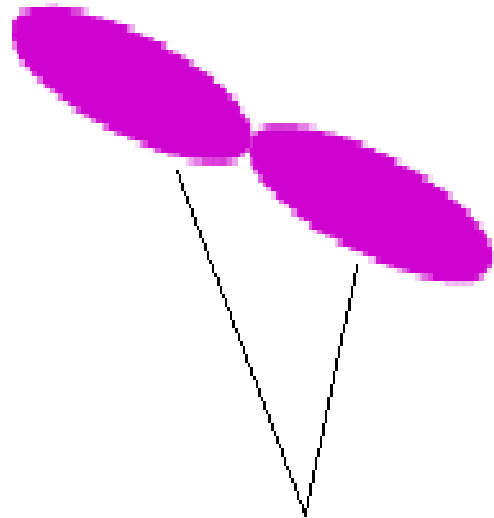


A single drop of healthy mixed liquor contains a diverse population of microorganisms.

Examples of Bacteria Found in Wastewater



Binary fission is the process by which one mature cell divides into two new cells.



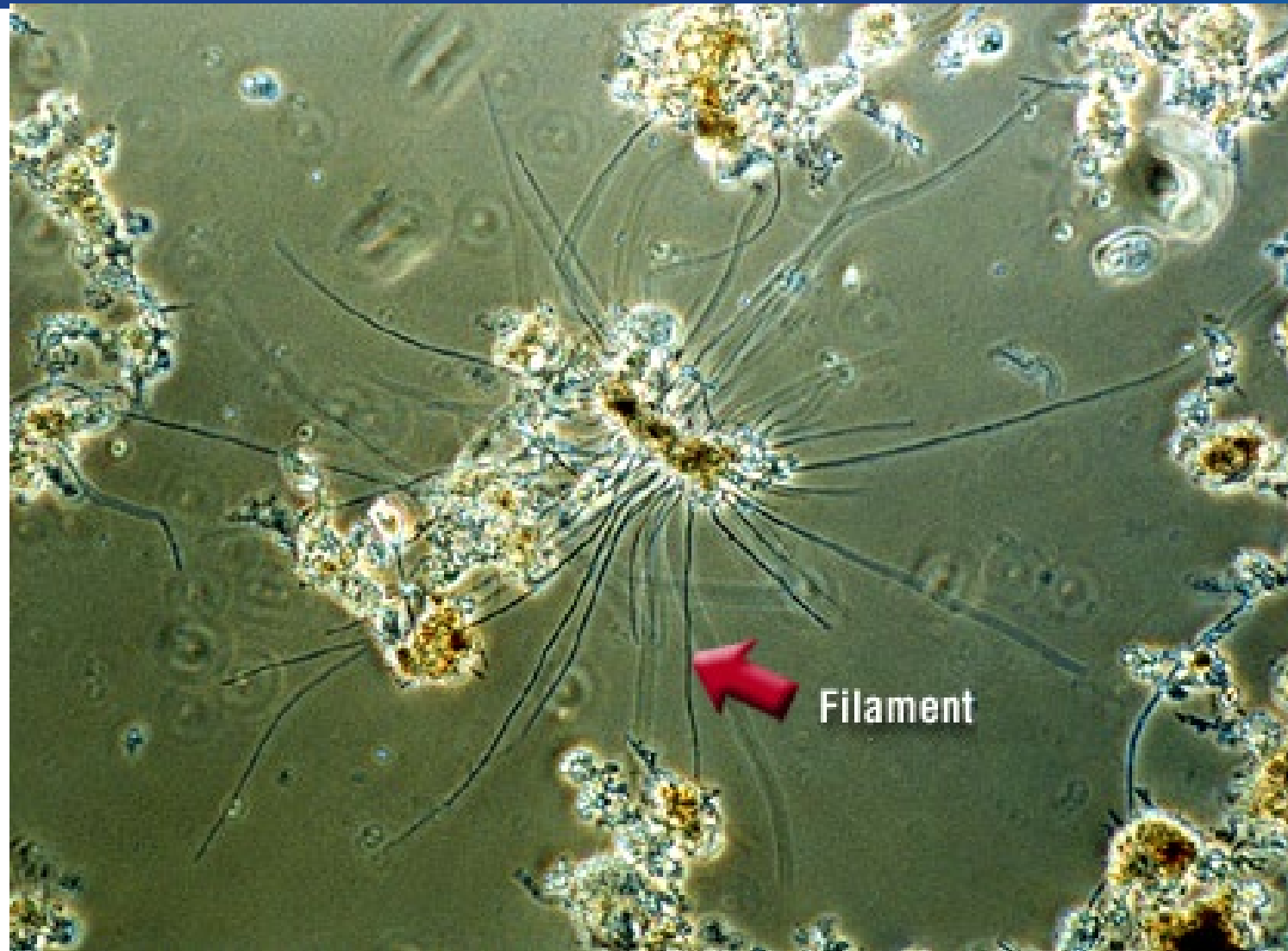
**Cell division is part
of binary fission**



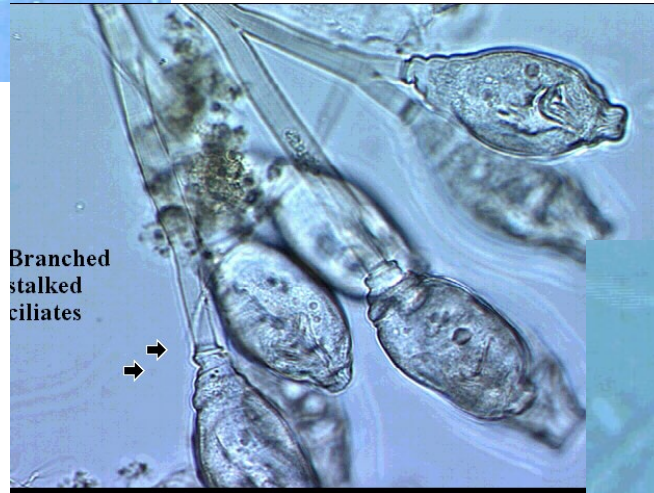
Micrograph of Bacteria and Filaments Bound Together in Floc Particles



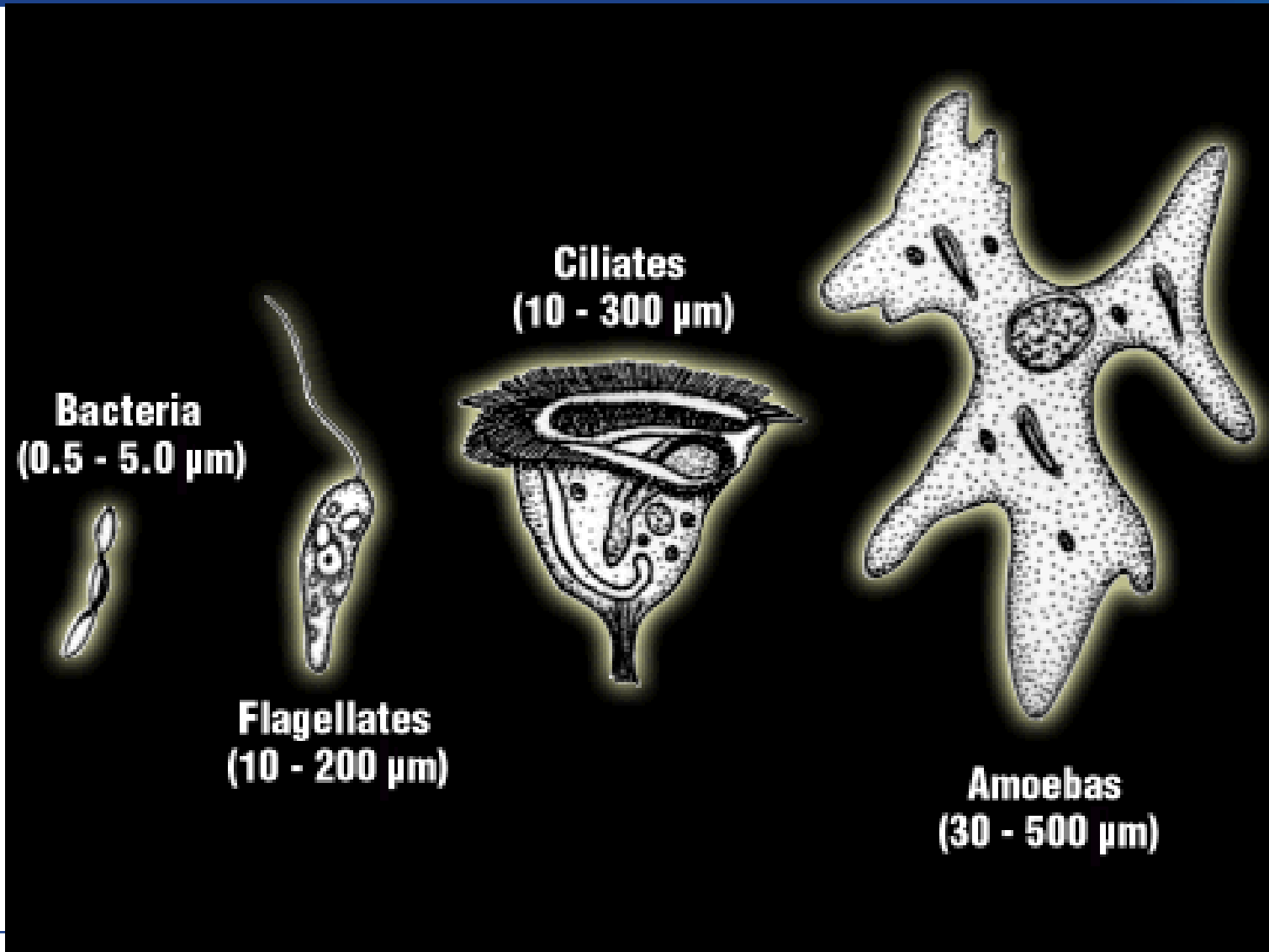
Micrograph of Floc and Filaments



Protozoa Found in the Activated Sludge Process



Size Range of Bacteria and Protozoa



Ciliates

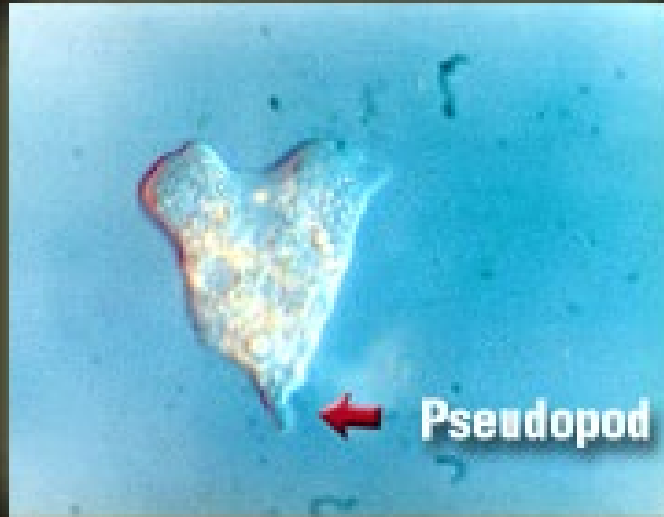


Free-swimming ciliate
Paramecium



Stalked ciliate
Epistylis

Amoeba

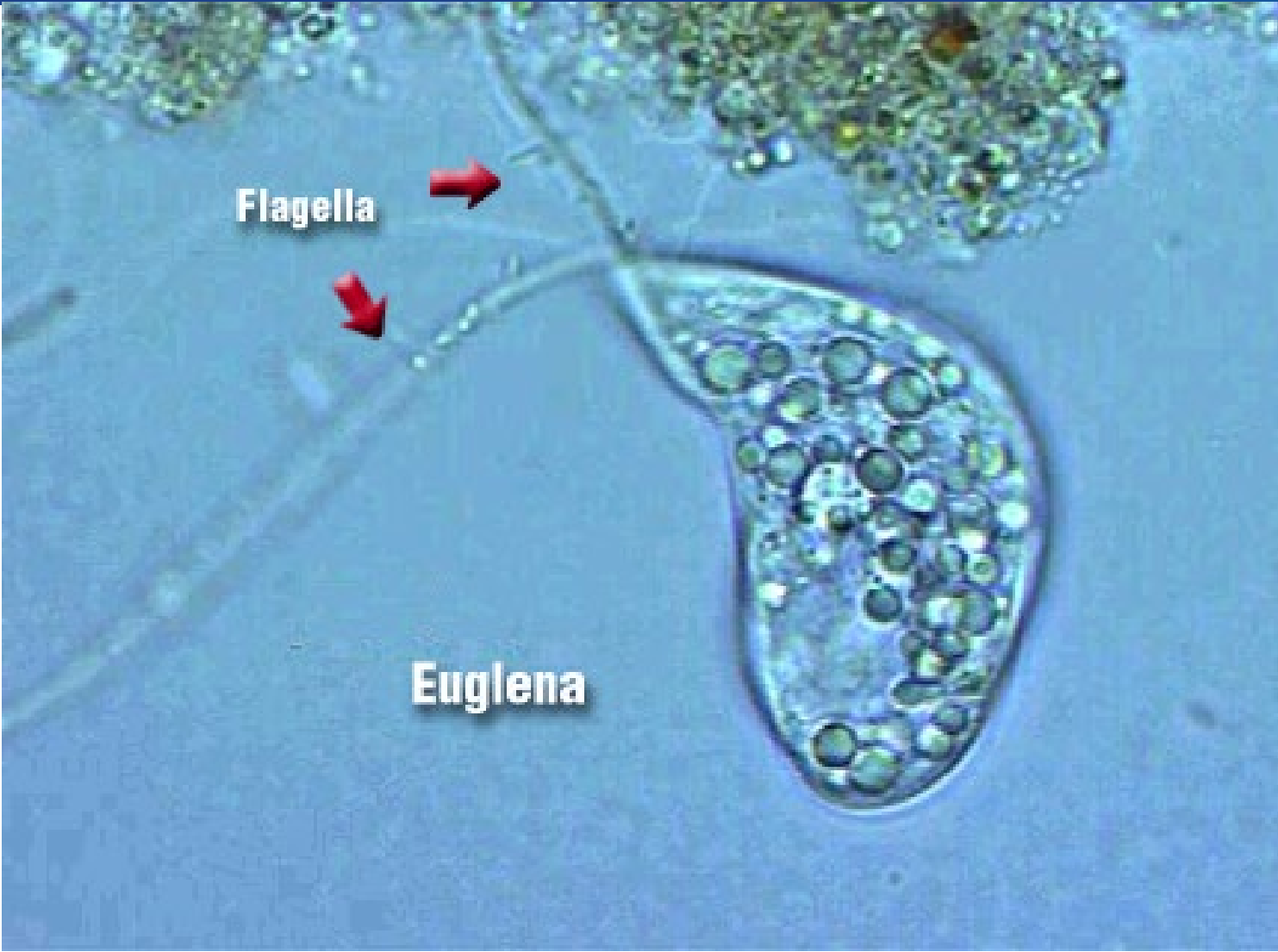


Amoeba



Testate Amoeba

Euglena



Rotifers



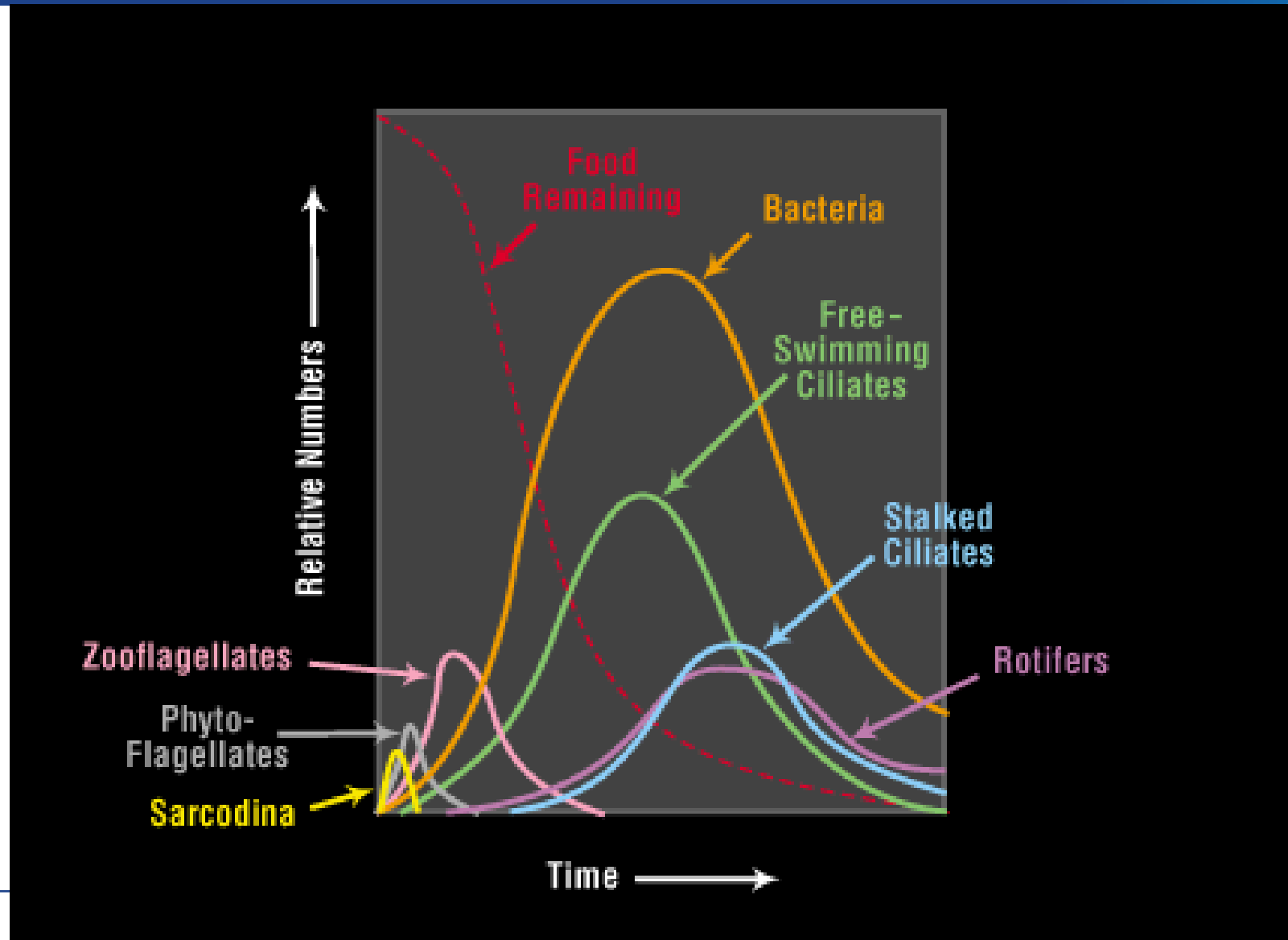
Fungi



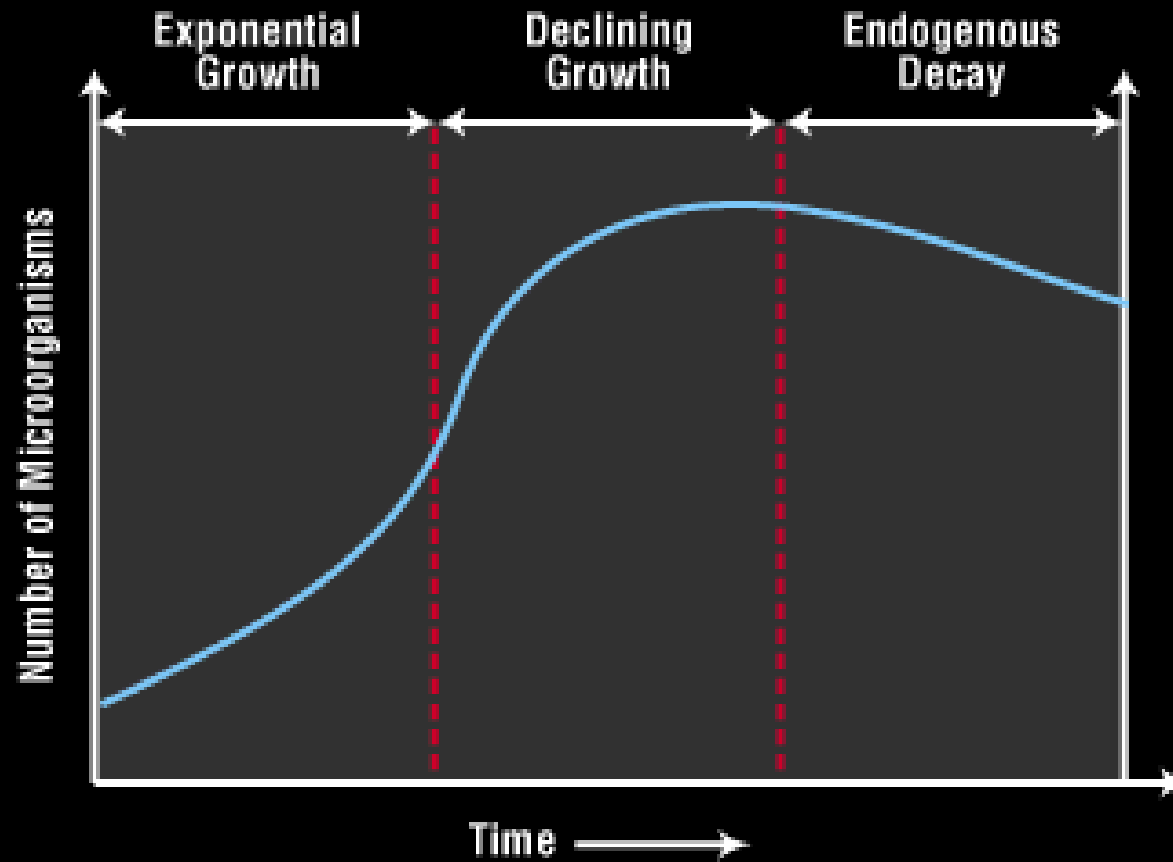
Algae



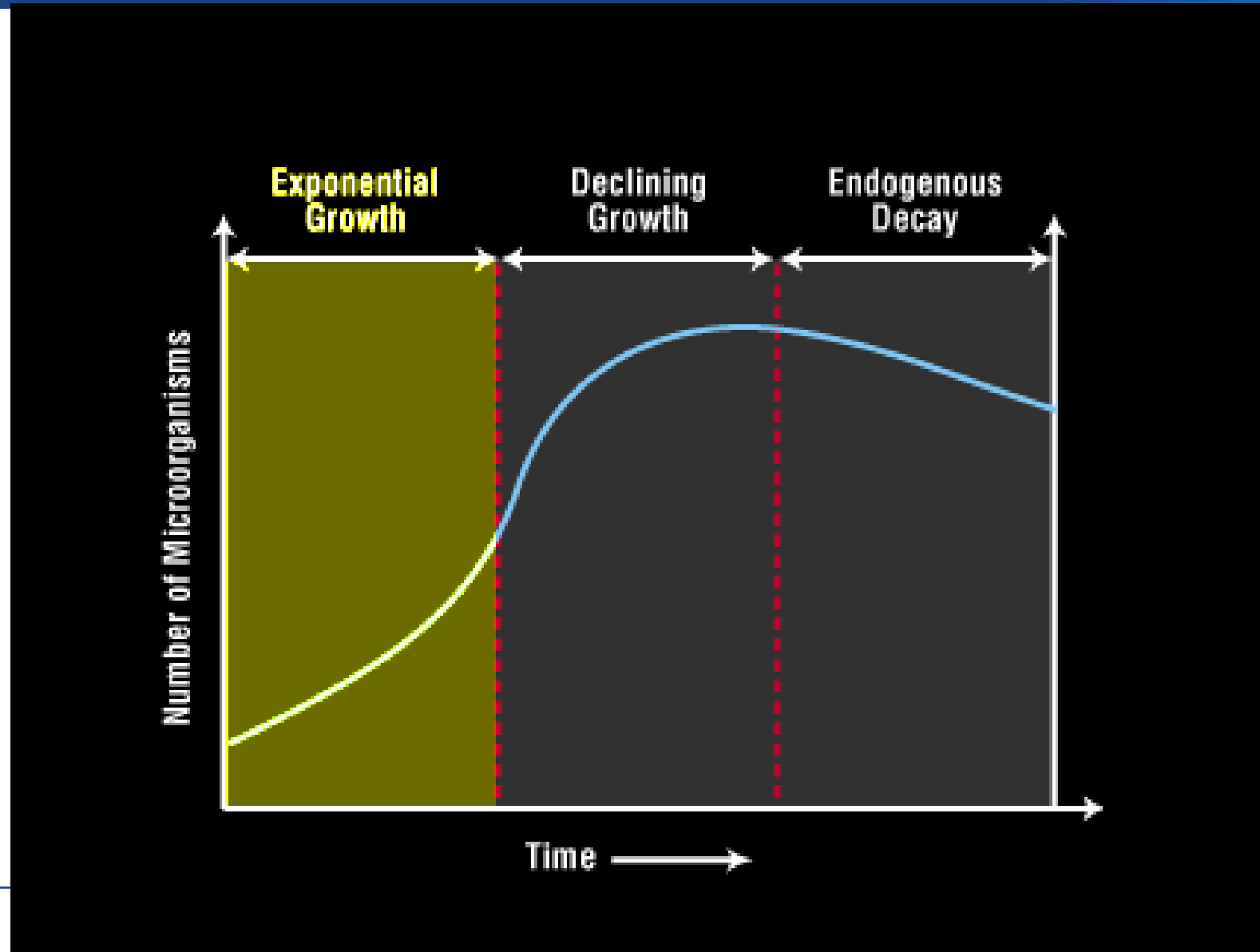
Distribution of Microbes over Time



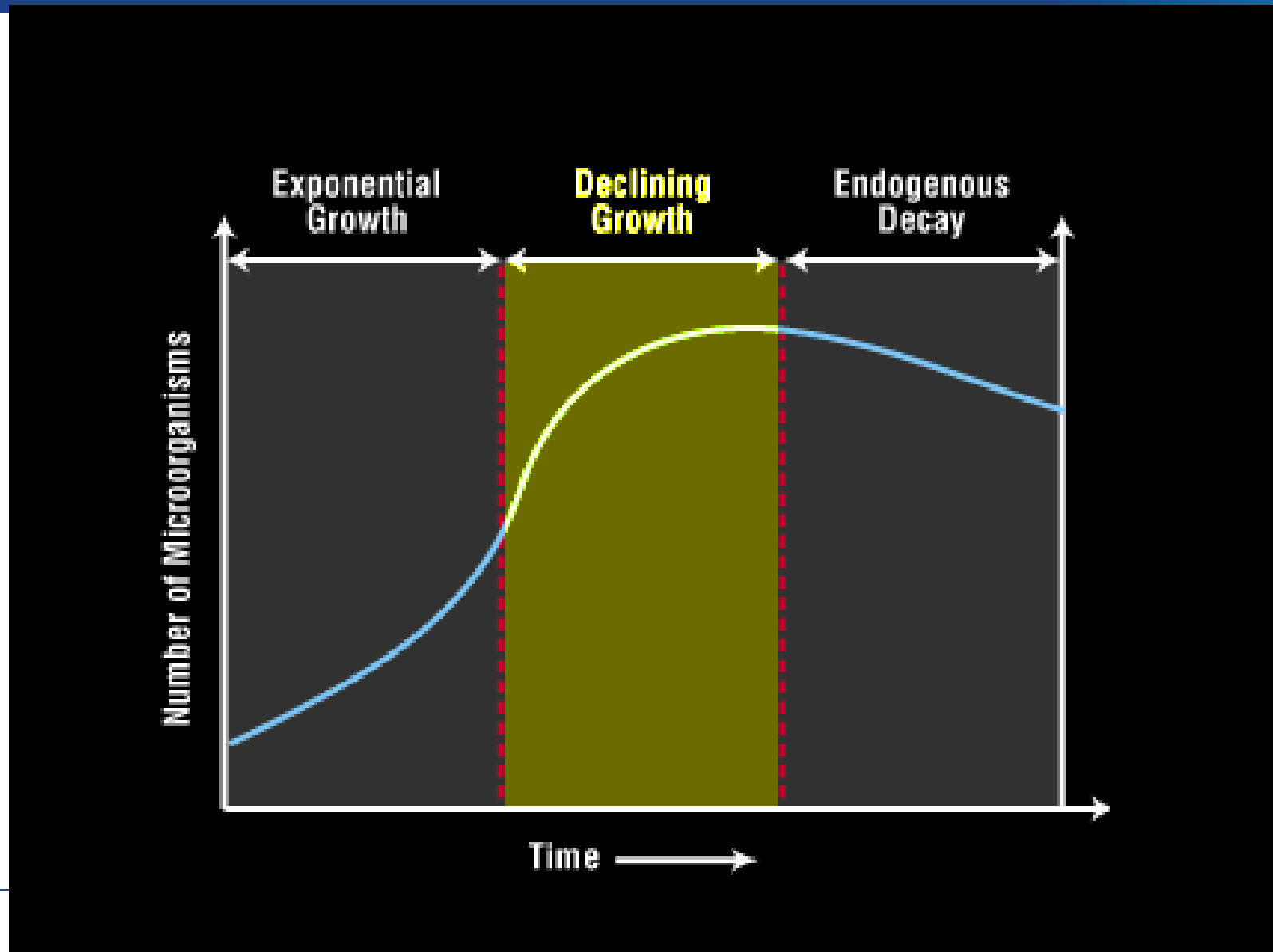
Three Phases of Microorganism Life Cycle



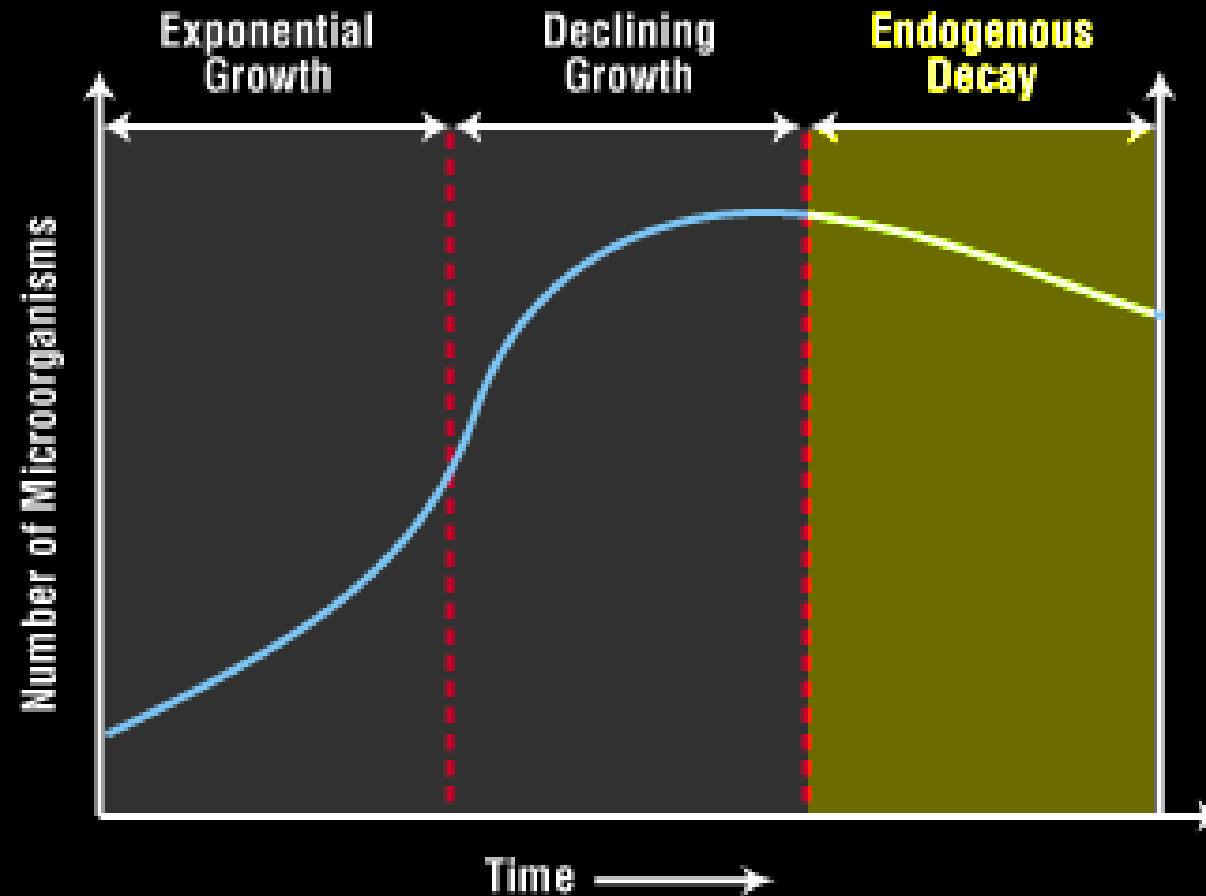
Exponential Growth Phase



Declining Growth Phase

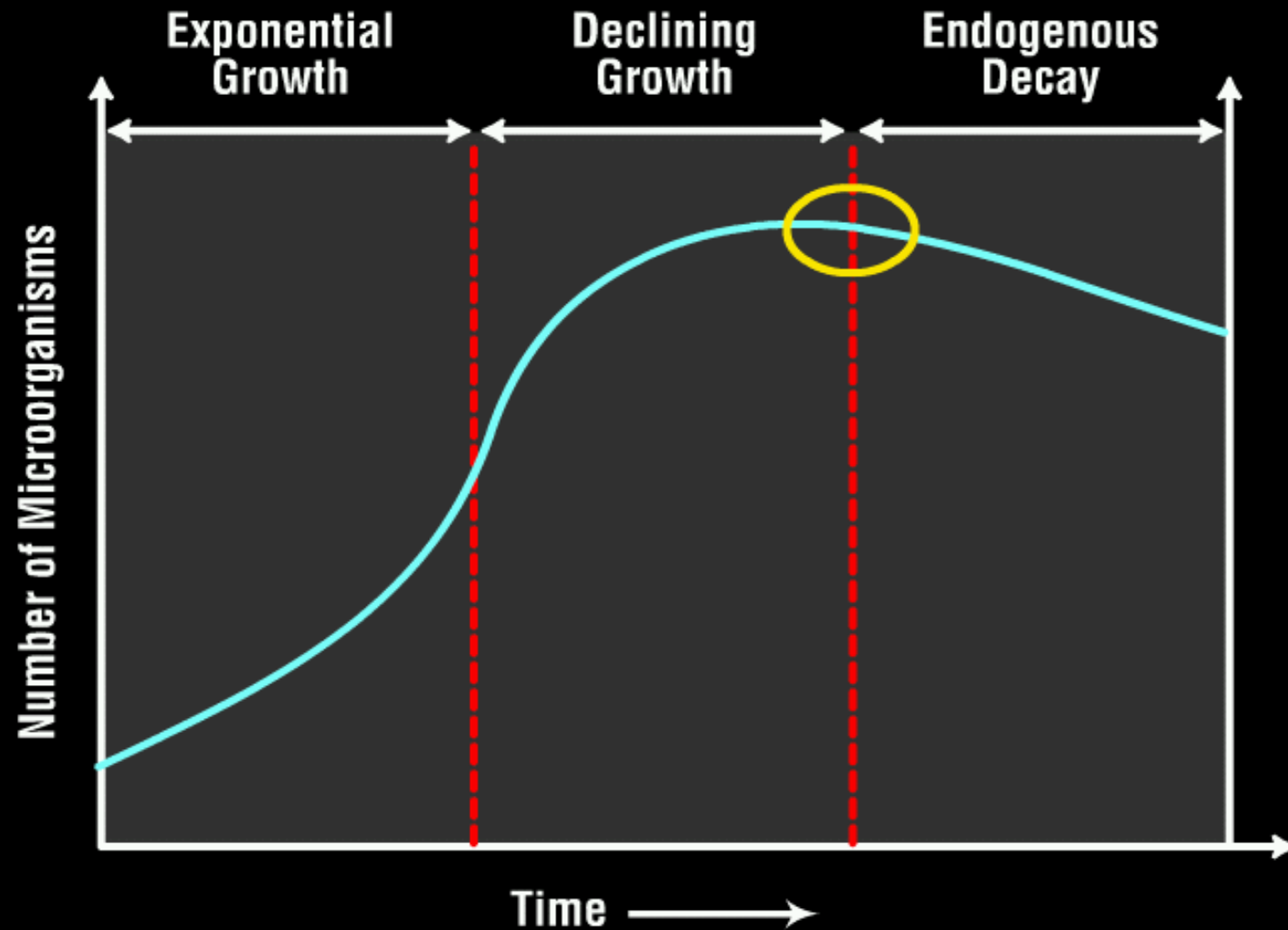


Endogenous Decay Phase



Typical Operating Range

Most activated sludge processes operate in this range



Thank you!

For Questions or Comments please reach out to the following:

Dr. Larry Moore
mlarry@bellsouth.net

Thomas Wenning
Oak Ridge National Lab
wenningtj@ornl.gov