

Microbial Growth:

1. Environmental Forcing Functions:

- Temperature: Psychrophile, Mesophile, Thermophile, Hyperthermophile
Cardinal Temps: Min, Max, & Optimal
Q₁₀ Rule
- Pressure: Barophiles (Most are also psychrophiles!)
Found only in the deep ocean.....so far
- pH: acidophiles & alkaliphiles
cytoplasm still near neutral
- eH: available electron donors & terminal electron acceptors
affects the chemistry of the environment
- Salt: Halophiles
Compatible solutes: amino acid derivatives (e.g., proline & glycine)
- Water Activity: Xerophiles (live in very dry habitats)
All microbes are osmotrophs, must use organic material in solution!
- Oxygen Usage: aerobe, facultative (an)aerobe, microaerophile,
obligate anaerobe

Detox enzymes: Catalase, Peroxidase, SOD

2. The Process of Growth:

- Metabolism required for growth, both anabolic and catabolic.
- Usual Definition: Increase in cell numbers
Other definitions possible – spores, UMC's, respiration, viable but nonculturable, morphology changes (life cycle)
- Divide via Binary Fission: 3 mechanisms involved!
Cell Elongation – cell wall
DNA Replication – rate limiting step
Cell Division – septum formation
- Growth Rate: Time it takes to reproduce
 $t_{1/2} = \ln 2 / \mu = 0.693 / \mu = g$
- Phases of Growth in Batch culture
Lag, Log, Stationary, Death
- Measurement of Growth
Viable cell counts
Turbidity
Total cell counts
- Continuous Culture: The wonders of the Chemostat
Steady State
Reproducible
Fine control

Key parameters – K_s , μ_{max} , Yield
- Closed systems vs. Open systems vs. Nature!