

Growth and Death of Microorganisms

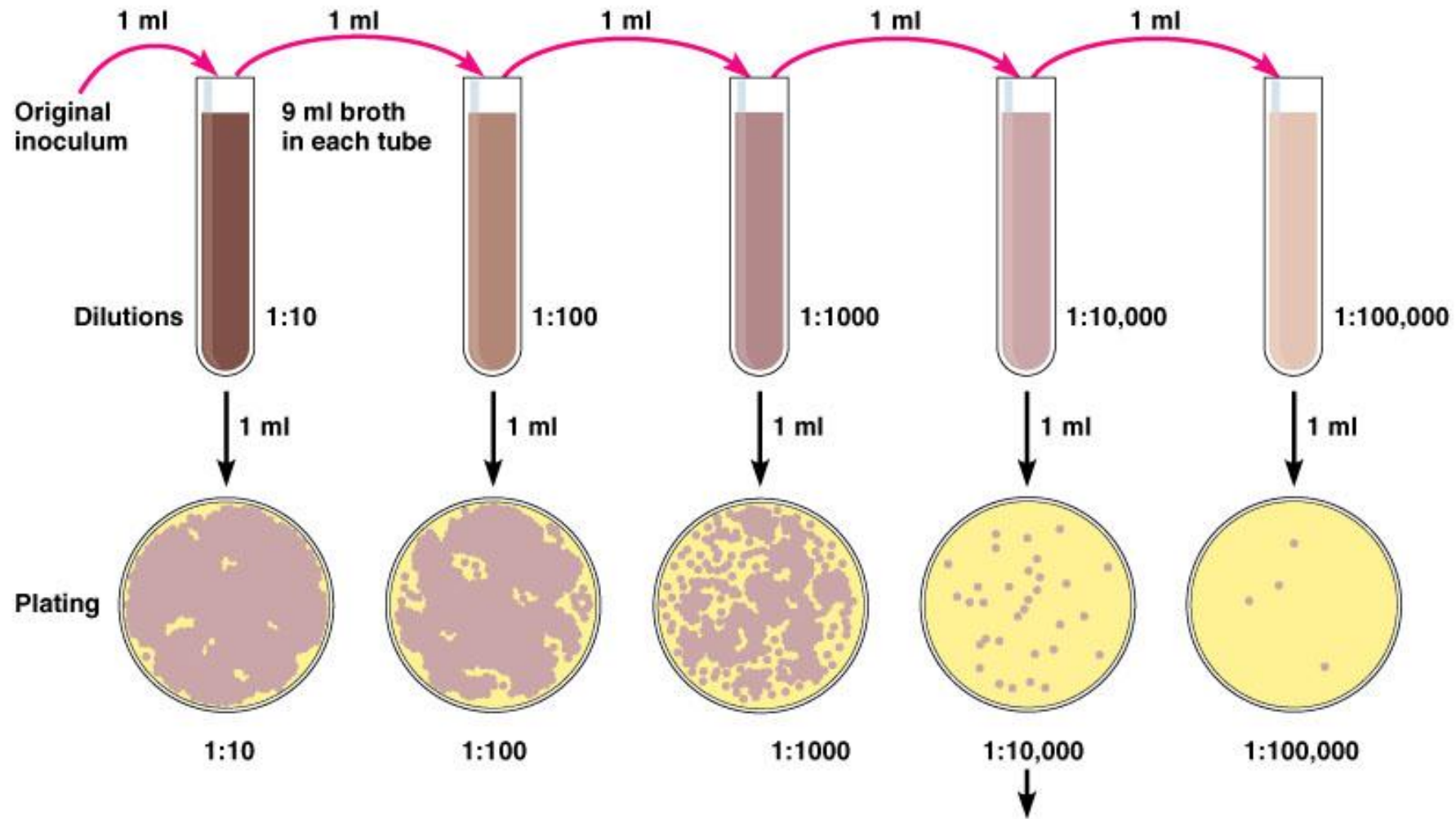


The Meaning of Growth

- Growth is the orderly increase in the sum of all the components of an organism.
- Thus, the increase in size that results when a cell takes up water or deposits lipid or polysaccharide is not true growth.
- Cell multiplication is a consequence of growth; in unicellular organisms, growth leads to an increase in the number of individuals making up a population or culture.

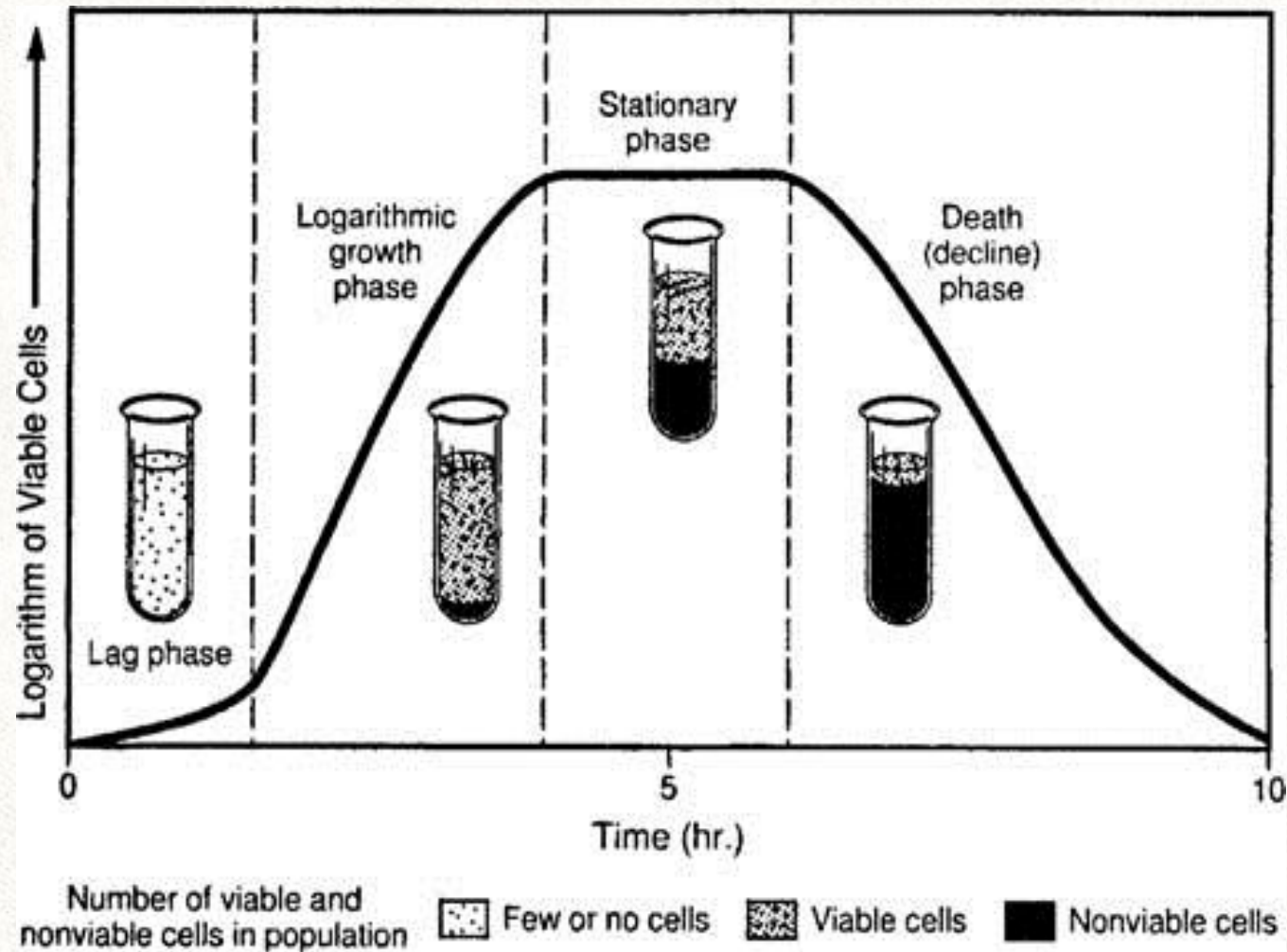
The Measurement of Microbial Concentrations

- Cell concentration (the number of viable cells per unit volume of culture).
- Biomass concentration (dry weight of cells per unit volume of culture).



Calculation: Number of colonies on plate \times reciprocal of dilution of sample = number of bacteria/ml
 (For example, if 32 colonies are on a plate of $1/10,000$ dilution, then the count is $32 \times 10,000 = 320,000/\text{ml}$ in sample.)

Phases of microbial growth curve



Phases of microbial growth curve

- **The Lag Phase:** The lag phase represents a period during which the cells, depleted of metabolites and enzymes as the result of the unfavorable conditions that existed at the end of their previous culture history, adapt to their new environment. Enzymes and intermediates are formed and accumulate until they are present in concentrations that permit growth to resume.

- **The Exponential Phase:** During the exponential phase, the cells are in a steady state. New cell material is being synthesized at a constant rate, but the new material is itself catalytic, and the mass increases in an exponential manner. This continues until one of two things happens: either one or more nutrients in the medium become exhausted, or toxic metabolic products accumulate and inhibit growth.

- **The Maximum Stationary Phase:** Eventually, the exhaustion of nutrients or the accumulation of toxic products causes growth to cease completely.
- **The Phase of Decline (The Death Phase):** After a period of time in the stationary phase, which varies with the organism and with the culture conditions, the death rate increases until it reaches a steady level.

Growth Control

- **Bacteriostatic:** A specific term referring to the property by which a biocide is able to inhibit bacterial multiplication; multiplication resumes upon removal of the agent. (The terms "fungistatic" and "sporostatic" refer to biocides that inhibit the growth of fungi and spores, respectively.)
- **Bactericidal:** A specific term referring to the property by which a biocide is able to kill bacteria. Bactericidal action differs from bacteriostasis only in being irreversible.

EXAMPLES:
Chloramphenicol
Erythromycin
Clindamycin
Sulfonamides
Trimethoprim
Tetracyclines



EXAMPLES:
Aminoglycosides
Beta-lactams
Vancomycin
Quinolones
Rifampin
Metronidazole



- **Sterilization:** A defined process used to render a surface or product free from viable organisms including bacterial spores.
- **Disinfectants:** Products or biocides used to reduce the number of viable microorganisms, or bioburden, on or in a product or surface to a level previously specified as appropriate for its intended further handling or use. Disinfectants are not necessarily sporicidal, but are sporostatic, inhibiting germination or outgrowth.

- **Septic:** Characterized by the presence of pathogenic microbes in living tissue.
- **Antiseptic:** A biocide or product that destroys or inhibits the growth of microorganisms in or on living tissue (eg, skin).
- **Aseptic:** Free of, or using methods to keep free of, microorganisms.
- **Preservation:** The prevention of multiplication of microorganisms in formulated products, including pharmaceuticals and foods.