

Growth

- An increase in size
- An increase in number
- An increase in understanding
- A Development of additional skills
- Becoming more complex

The increase in cellular constituents and may result in an increase in a microorganisms size, population numbers, or both.

General requirements for growth

Time	In an enclosed environment Bacteria have four defined phases: Lag – Introduction to fresh medium (from dormant to actively growing). Time depends on species and other environmental factors. Exponential – binary fission, with no limiting factors (log used as exponential) Stationary – cell begin to die as well as being produced. Due less nutrient, toxins released critical density, etc Death – Limited nutrients and build up of toxins. Death becomes exponential. Cells revert to dormant stage or spore stage.	
Water	Like most living organisms, bacteria need water to grow. Bacteria have selectively permeable membranes and therefore can be strongly affected by the environment. If the area around bacteria is pure water then water can flow into the cell causing it to burst. If there is no water present then the bacteria can die. How much water bacteria need to live is calculated using water activity (a_w) Water activity is defined as the ratio of water vapour pressure of the substance to the vapour pressure of pure water. Water activity (a_w) affected by temperature, pressure, and chemical environment.	
Oxygen	Aerobic - need oxygen for growth as need for chemical pathways etc (superoxide dismutase and catalase protect the microbe by converting toxic oxygen products) Anaerobic – Do not have the correct proteins to deal with toxic oxygen products and therefore cannot survive in oxygen rich environments	
Nutrients and space	Requirements Carbon, Hydrogen, and Oxygen Nitrogen, Phosphorus, and Sulfur Space (culture growth) Growth Factors Are substance that are needed for growth but cannot be manufactured by the microorganism.	
Temperature	Why does Temperature have such an effect? High vs Low? Most microorganisms are unicellular Enzyme catalysed reactions Lipid Bilayer	Psychrophiles (cryophiles) (0-20° C) Mesophiles (20 – 45° C) Thermophile (over 45° C)
pH	pH represents the amount of H ions present every microorganism has a minimum, an optimum and a maximum pH for growth. Most microorganisms grow best at pH values around 7.0 Yeasts and moulds are generally more acid tolerant than bacteria and can grow at lower pH values. Foods with pH values below 4.5 are usually not easily spoiled by bacteria but are more susceptible to spoilage by yeasts and moulds. Extreme PH can disrupt the membrane and inhibits enzyme activity	
Absence of predators	Macrophage – the body Bacteriophage - Virus Antibiotics - drugs Antibacterial • natural – Garlic, honey, cinnamon • Chemical Silver (silver ions) – damage to cell membrane and enzymes	