$\underline{\mathsf{Growth}}$

- 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:	
Time	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 my 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 the vapour	
	pressure of pure water. Water activity (a _w) affected by temperature, pressure and production	
Oxygen	Aerobic - need oxygen for growth as need oxygenetical pathways etc (superoxide dismutase and	
	catalase protect the microbal from verting toxic oxyger products)	
	Anaerobic – Do not have be correct protein. To deal in toxic oxygen products and therefore	
Nutrients and	cannot se when oxygen rich environments Ne un ellents	
Nutrients and space	Carbon, Hydrogen, and Txyg	
space	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?	Psychrophiles (cryophiles) (0-20° C)
	Most microorganisms are unicellular	
	Enzyme catalysed reactions	Mesophiles (20 – 45° C)
	Lipid Bilayer	Thermophile (over 45° C)
		Thermophile (over 43°C)
рН	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 a	ctivity
Absence of	Macrophage – the body	
predators	Bacteriophage - Virus	
	Antibiotics - drugs	
	Antibacterial	
	 natural – Garlic, honey, cinnamon 	
	Chemical	
	Silver (silver ions) – damage to cell membrane and enzymes	