    - Autotrophic bacteria dominate
- Polluted water
    - Large amounts of organic matter
    - Bacterial numbers increase rapidly
    - Heterotrophic microbes dominate
        - Coliform bacteria (E. coli) also streptococcus, proteus and pseudomonas
    - Available oxygen is used up by these bacteria until a layer of dead organisms, mud, & silt accumulates on river bottom
    - Aerobic species then thrive and produced gasses (H2S) that poisons water and effectively 'kill' river

Anaerobic growth

- Unable to grow in presence of oxygen
- Obligate anaerobic – don't tolerate oxygen (toxic)
    - Grown in special anaerobic flasks or cabinets that lack o2
        - Displaces O2 with co2 and n2 gas mixtures
        - E.g., Bacteroides clostridium Fusobacterium, Methanococcus

Osmotic pressure

- Solutes and water activity
    - Microorganisms obtain most of their nutrients form solutions
        - Sensitive to changes in osmotic pressure
    - Osmophiles
        - Need high osmotic pressure for growth
    - Osmotolerant
        - Grow in large range of salt/sugar concentrations
- Water activity = amount of water available to cell
    - Aw of 0.9 -1.0 required for microbial growth
    - Fungi grow at lower Aw than bacteria
        - Implicated in spoilage of dry foods such as bread

A_w values:	
pure water	1.00
blood	0.99
seawater	0.98
maple syrup	0.90
salt lakes	0.75
honey	0.60

Isotonic solution

- Similar salt concentration inside and outside cell = cell maintains shape

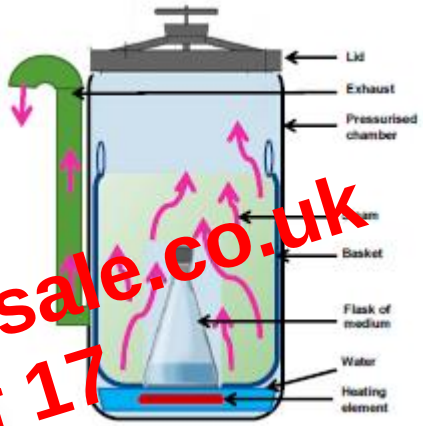
Hypotonic solution

- Lower salt concentration outside cell
- Water taken up by cell, cell swells up, may burst = osmotic lysis

    - Many organisms are viable but not culturable since we don't understand their growth requirements
    - In consortia, different species are inter-dependent
- Growth and survival depend on sufficient nutrients and favorable environments
    - Growth media = nutrient solutions prepared in lab
    - Environment = right pH, oxygen, osmotic pressure etc.
        - Fungi: pH 4.5
        - Bacteria: pH 7
- Add required components to water, sterilize medium
    - Autoclaving: 15min @ 121°C @ 100 kPa

Autoclaving

- Fastest most reliable way to sterilize things in a lab in a large pressure cooker (called autoclave)
- When an autoclave boils, produces steam which is held under pressure with a lid and safety valves
- High pressure raises boiling point of water to 121C which is enough to kill all microbial cells and spores
- All instruments



Growth media types

- Chemically defined (synthetic) medium
    - Known ingredients in specific concentration
        - E.g., 0.2% glucose, 0.5% (NH4)2SO4
    - Auxotrophic growth (mutation, essential nutrient must be added
    - Heterotrophic organism that doesn't have stringents nutrient requirements
- Complex (undefined) medium
    - Rich in vitamins and other nutrients
    - Precise chemical composition of this media is unknown
        - Varies depending on the supplier
        - E.g., Yeast extract, blood agar

Types of growth media

Liquid media

- Turbidity or opaqueness in liquid media
- Pellicle formation – mass of cells float on surface of liquid media
- Sediment formation where cells deposit on bottom of tube