

GROWTH , METABOLISM , & SURVIVAL OF MICROBES

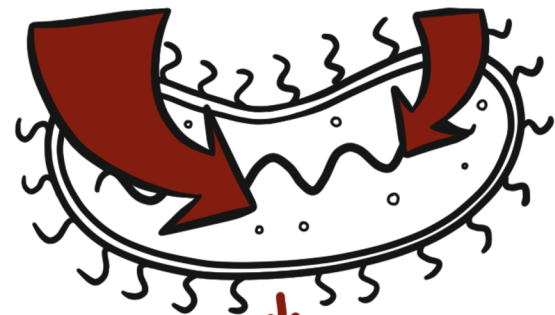
NUTRITION AND GROWTH

MACRONUTRIENTS

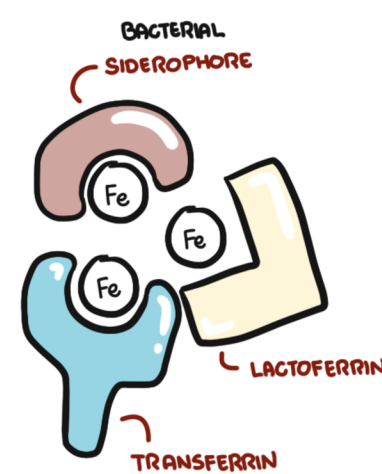
- CARBON
- NITROGEN
- PHOSPHORUS
- SULFUR
- OXYGEN
- HYDROGEN

TRACE MINERALS

- IRON
- ZINC
- MAGNESIUM



PROTEIN , NUCLEIC ACIDS , CELL WALLS , ENZYME COFACTORS



NUTRITIONAL IMMUNITY

ENERGY SOURCE

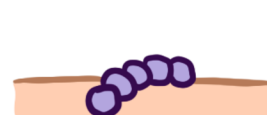
PHOTOTROPHS

- USE LIGHT



CHEMOTROPHS

- RELY ON CHEMICAL REACTIONS



CHEMOORGANOTROPHS

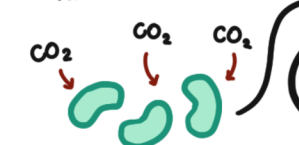


CHEMOLITHOTROPHS

CARBON SOURCE

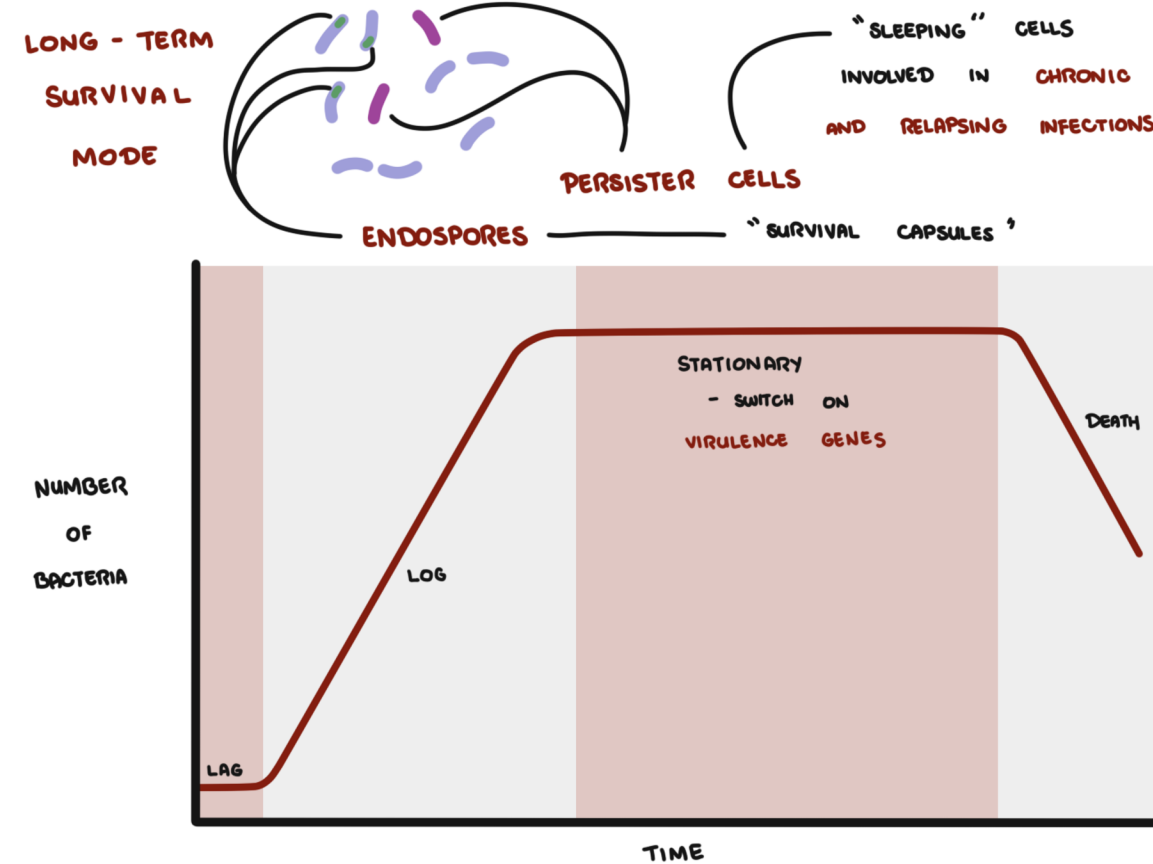
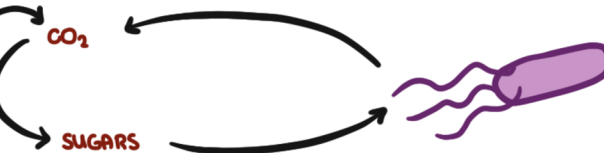
AUTOTROPHS

- FIX CARBON DIOXIDE



HETEROTROPHS

- RELY ON ORGANIC CARBON



STRESS RESPONSES AND SURVIVAL

HEAT SHOCK PROTEINS

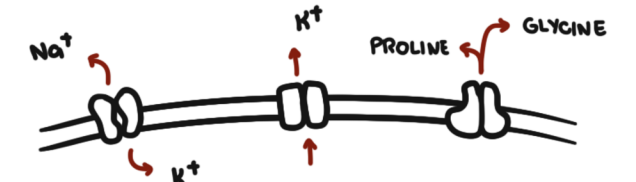


ACID TOLERANCE SYSTEMS



UREA → AMMONIA

OSMOTIC STRESS RESPONSE



OXIDATIVE STRESS RESPONSE



MICROBIAL METABOLISM

AEROBIC RESPIRATION

- MOST EFFICIENT
- 38 ATP PER GLUCOSE
- OXYGEN AS FINAL ELECTRON ACCEPTOR

FERMENTATION

- 2 ATP PER GLUCOSE

DISTINCTIVE END-PRODUCTS

- LACTIC ACID
- ETHANOL
- GAS

USEFUL FOR
DIAGNOSING
ORGANISMS



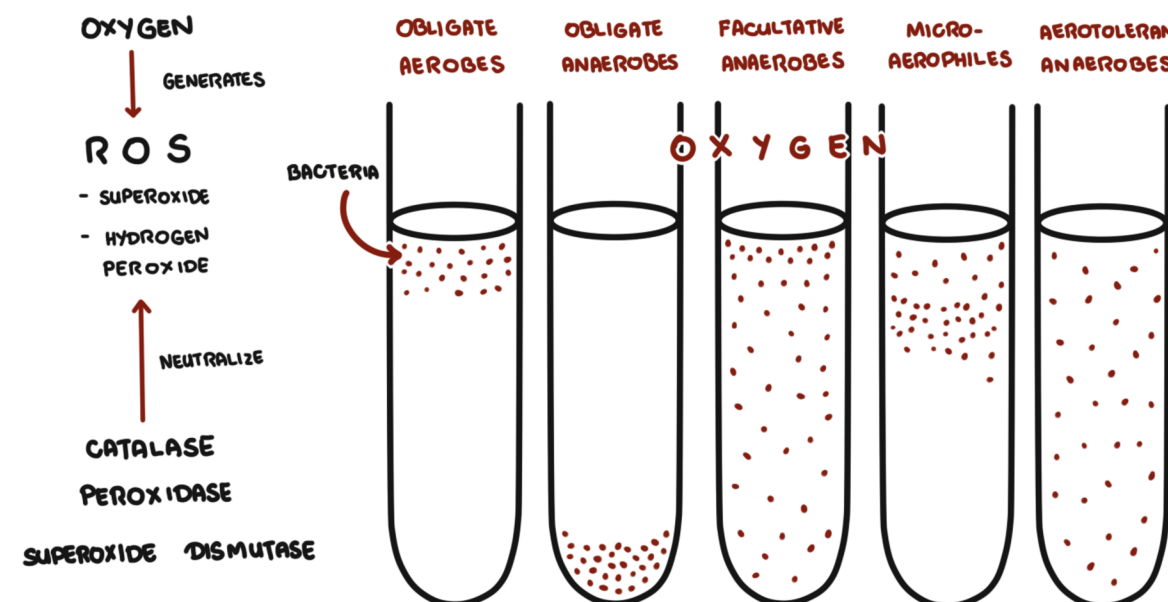
ANAEROBIC RESPIRATION

- LESS EFFICIENT
- USE NITRATE , SULFATE , OR FUMARATE

OBLIGATE INTRACELLULAR

- PARASITES - TAKE ATP FROM HOST

OXYGEN CLASSES



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