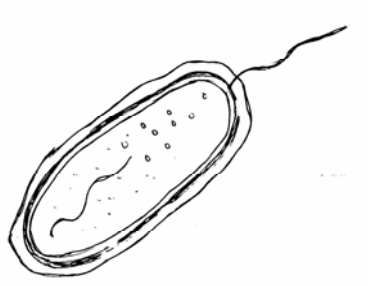
MICROBES REVISION CARDS

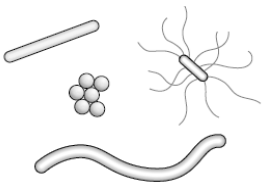
Suggestions for use

Print!
Fold down the middle (vertical) & glue.
Cut into individual double sided cards.
Spare cards are provided for your use.
The cards are not in any particular order.

BACTERIA



Bacillus / rod shaped



Range of shapes

<u>"Typical" Bacteria structure</u>

Flagellum – for movement
Slime capsule – protection
Cell wall – shape and support
Cell membrane – controls what enters/leaves cell
Cytoplasm – where cell reactions occur
Chromosome – genetic instructions

Feeding terms

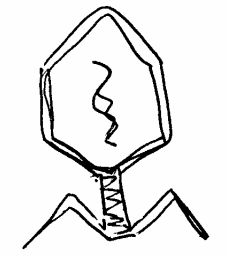
(bacteria & fungi)

Decomposer – micro organism causing decay

Saprophyte – lives of dead plant/animal matter

Parasite – living off another living thing eg Tinea, athlete's foot

VIRUS (BACTERIOPHAGE)



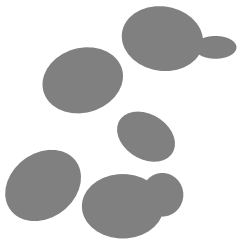
<u>Structure - Viruses</u>

Protein coat or *caspid*

Nuclear material (DNA or RNA)

The bacteriophage is a virus that attacks bacteria

YEAST CELLS



Yeast cells reproduce asexually by BUDDING

<u>Reproduction – Yeast</u>

A small cell pinches off from a larger cell.
This type of mitosis where a smaller and a larger cell are produced is called *budding*.

Yeast can reproduce fast: the rate is controlled by:
• food availability; • temperature; • pH; • and removal of products.

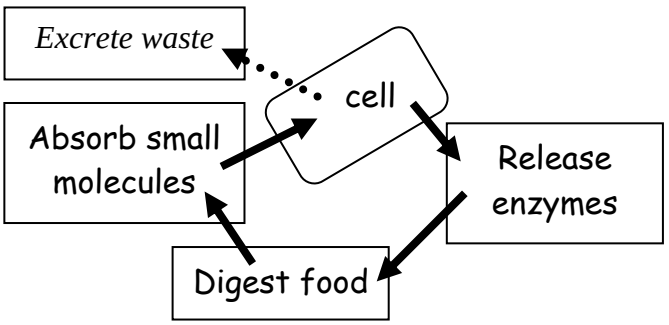
Antibiotics

Chemical substance/drug/medicine that stops/controls the growth of bacteria. Produced naturally by some micro organisms (especially fungi) eg Penicillin. Antibiotics kill the disease causing microbe or stop it multiplying. Have no effect on viruses.

<u>Antibiotics & Antibiotic Resistance</u>

Bacteria may become resistant to antibiotics (result of random mutations). Resistant bacteria survive - reproduce - pass on characteristics to offspring. To limit development of resistant bacteria, antibiotics must be used carefully eg don't feed to farm animals, complete any course, do not use for virus infection/minor infections.

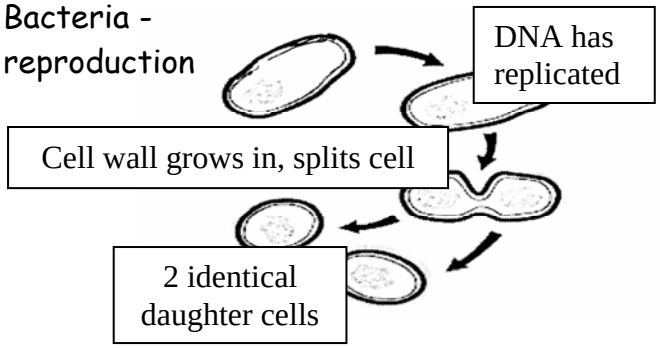
Extra cellular digestion - bacteria



Feeding - Bacteria

Extra cellular digestion in both bacteria & fungi. "Extra cellular" = outside cell. Ideal conditions – warm, moist , food source, suitable pH & O_2 (if aerobic)
1.secrete / release enzymes 2. digest food (break down large food molecules into smaller soluble ones) 3. absorb small food molecules into cell.

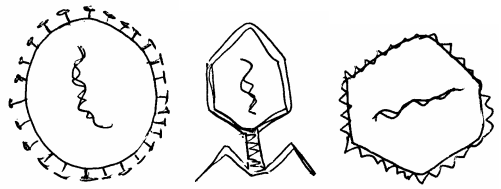
Bacteria - reproduction



Reproduction - Bacteria

Bacteria carry out binary fission very efficiently and, under good conditions (plenty of food, space and optimum temperature) can divide as often as once every twenty minutes.
Each resulting daughter cell is a clone of the parent cell – identical unless a mutation has occurred.

Typical viruses



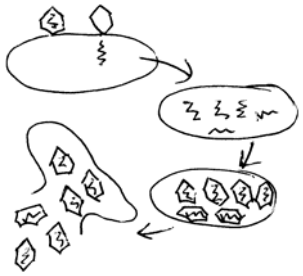
Virus structure

Protein coat or caspid

Nuclear material / DNA / RNA

Viruses are regarded as being NON LIVING – only one thing of MRSGREN they do is reproduction

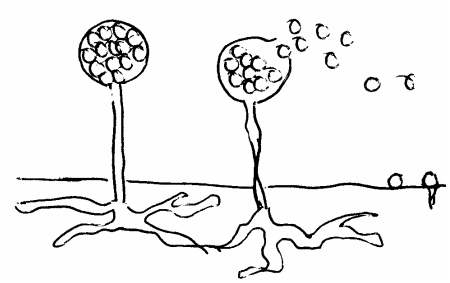
Viruses - Reproduction



Virus - Reproduction

Virus attaches to host cell & injects its DNA
Takes over host cell genetic material and cell machinery - instruct cell to make copies of viral DNA, new protein coats & to assemble new viruses
Cell bursts - viruses are released - infect other cells. Cell dies - releases toxins also.

Fungi - Reproduction



Eg bread mould (Mucor)

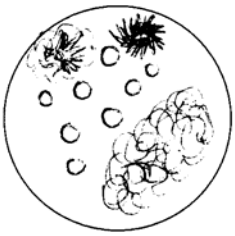
Fungi – Reproduction

Ariel hyphae develop reproductive sporangia filled with spores.

Sporangium bursts releasing spores.

If spore lands on warm, moist food source it will germinate.

Culturing bacteria and fungi



Culturing Bacteria and Fungi

Grow on a sterile nutrient agar plate
Fungi look furry - fuzzy – fluffy (because of their thread like hyphae and their sporangia).
Shiny, regular and coloured patches are usually bacterial colonies.

Viruses can't be grown on agar – need a living host cell for reproduction

Compost

Compost heaps help to break down (and recycle) dead plant material

Ideal Compost Heaps

Gaps allow air in. Also turn compost with fork. Build on soil to allow soil bacteria & fungi access to the compost. Chop up the plant material – more SA accessible. Lay stems between leaves to allow air to circulate. Keep moist but not water logged.

Compost heaps get hot due to energy being released as heat from respiring micro-organisms. The temperature may kill weed seeds in the compost.

Helpful bacteria

Helpful

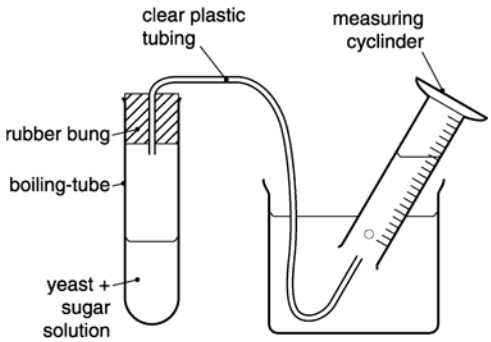
Bacteria used to make cheese & yoghurt
Bacteria in digestive system
Aerobic and anaerobic bacteria are used to decompose sewage wastes

Harmful bacteria

Harmful

Pathogens (disease causing)

cholera, syphilis, typhoid fever and tetanus



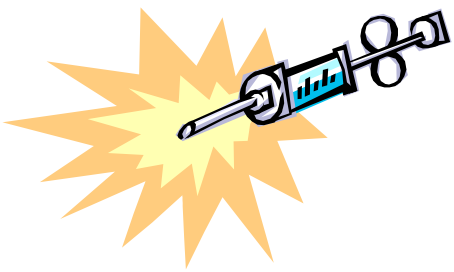
Fermentation / anaerobic respiration by yeast

This apparatus could be used to investigate fermentation. Could vary:

1. sugar concentration & yeast
2. yeast varieties
3. temperature (water bath around yeast & sugar)

Measure volume CO_2 collected at time intervals.

Vaccination

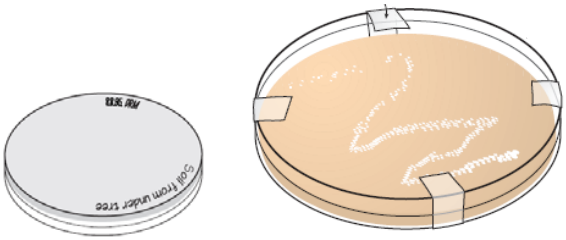


Vaccination

Injection of weakened/dead/harmless bit of pathogen. Their surface *antigens* are seen as "foreign" by the body's white blood cells which make antibodies.

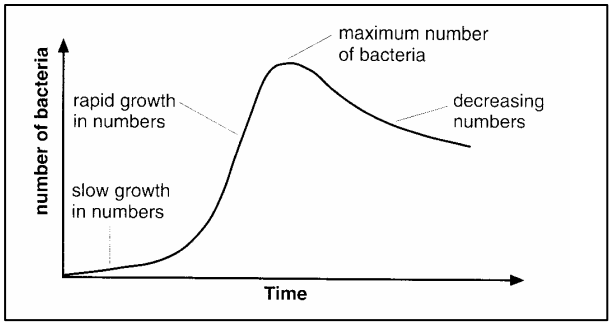
Antibodies are specific – eg when flu virus mutates the body has to make new antibodies for it which is why we can get flu time and time again.

Culturing Bacteria & Fungi



Sealing & Incubating Petri dishes

Seal top to bottom so lid doesn't fall off BUT don't "go all around" and make air tight as this encourages growth of more of the more dangerous and harmful anaerobic bacteria.
Incubate upside down do condensation does not drip onto and spread the colonies. Do at 20-25^{o}C & not @ body temperature.

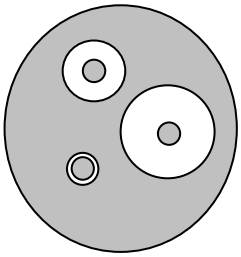


Growth of numbers of bacteria.

1. lag phase (slow growth in numbers)
2. exponential growth – rapid growth in numbers, doubling rapidly
3. a maximum is reached
4. numbers decrease

Slow down and decline as run out for food – space – maybe O_2 – and poisoned by build up of own toxins – from excretion (waste).

Testing disinfectants, antiseptics or antibiotics



Soak small paper disc in substance (leave one disc plain/use water as control).
Clear zone – where bacteria have died – or where bacteria have not grown.

Testing disinfectants, antiseptics or antibiotics

Inoculate plate with bacteria. Use this basic design

- to compare different antiseptics or disinfectants & their ability to kill bacteria.
- To investigate the effect of concentration of disinfectant.
- test which antibiotic is best at killing a particular bacteria

Drinks/Foods made using Yeast (fungi)

Yeast – in manufacture of wine, beer & bread

Anaerobic respiration / fermentation

Glucose → ethanol + carbon dioxide
$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

Ethanol is chemical name for alcohol.
CO_2 gas makes the bread rise.

Yeast – beer making

Beer brewing
Barley grains contain starch. During malting (when the barley grains are germinating), the starch is broken down by enzymes into a sugar solution. The sugar solution is extracted from the mixture. Hops are added to give the beer its flavour. The yeast uses the sugars during anaerobic respiration and ethanol is produced.

Yeast – wine making

Wine making
Grapes contain natural sugars. The yeast uses these sugars during anaerobic respiration. Ethanol is produced. When the alcohol reaches a certain concentration, the yeast cells die and fermentation stops.

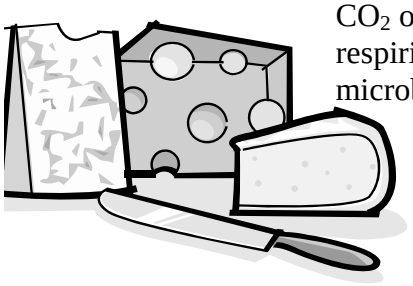
Digestion – by fungi

Extra cellular digestion by fungi

Fungi secrete / release enzymes.
Enzymes digest the food into small molecules.
The small molecules are absorbed back into the hyphae.

Cheese making

Blue cheese - Curds inoculated with aerobic fungi.

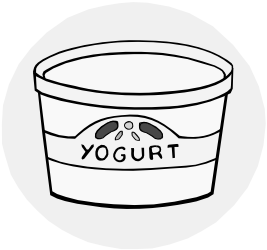


Holes from CO_2 of respiring microbes

Cheese making – role of bacteria and fungi

Milk pasteurised to kill pathogens.
Bacteria added - increase milk acidity – turn lactose sugar into lactic acid
Enzyme - rennin - added to curdle the milk.
Solid part (curds) – is separated from the liquid (whey). Curd is "aged and ripened" = cheese.
Mould on outside of cheeses (eg camembert) gives characteristic flavours.

Yoghurt making



Yoghurt making

Milk is **pasteurised** - heat to 80-90°C - to kill all bacteria so no other microbes compete with the starter culture. Add starter culture to warm milk.
Bacteria ferment milk sugar (lactose) producing lactic acid. Milk curdles (thickens) to become solid.
The lactic acid gives the yoghurt its sharp taste and extends the storage life of the milk.

Sewage

Sewage

Aerobic and anaerobic bacteria are used to decompose sewage wastes.

Aerobic - Break down organic matter to "clean" liquid
Anaerobic - Digest sludge to harmless sludge.

Anaerobic bacteria – sewage treatment

Takes place in the "digestor".

Sludge becomes the food source for anaerobic bacteria (no oxygen) which consume the organic material and produce methane gas as a by-product of respiration. The methane gas is used as energy source in the sewage works.

Aerobic bacteria – sewage treatment

Waste water is aerated in a tank.

Bacteria are encouraged to grow by providing: Oxygen, Food, Correct temperature, & Time.

As bacteria consume the sewage, they grow and multiply.

Nitrogen fixation

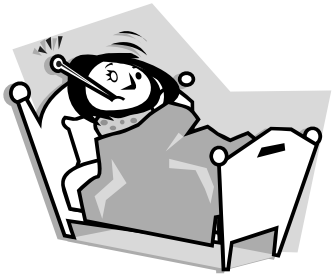
$\underline{N_2}$ fixation

Legumes / Leguminous plants (pea, clover, beans) live in a symbiotic relationship with bacteria.
The bacteria "fix nitrogen" from the air,

$N_2 \rightarrow$ nitrate (NO_3^-)

providing "fertilizer" for the plant, whilst obtaining nutrients to help their own growth from the plants.

Diseases



Body's defense against the entry of microbes

skin acts as a barrier
sticky liquid mucus which traps microorganisms (respiratory, digestive, urinary, and reproductive tracts)
blood clots to seal cuts
acid in stomach
antiseptic substance in tears

Stages in an infectious disease

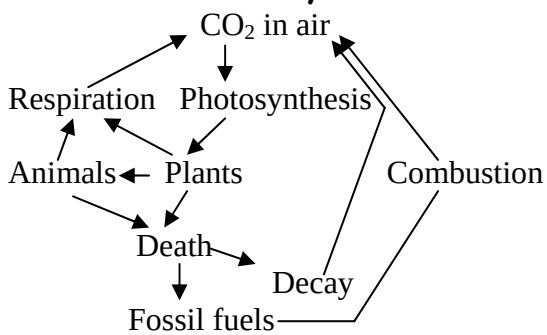
entry into the body
rapid growth - incubation period
production of many toxins
appearance of symptoms such as fever

White blood cells

Help to defend against microbes

Ingest microorganisms (phagocytes)
Lymphocytes produce antibodies to destroy particular bacteria or viruses
Produce antitoxins which counteract the toxins released by microorganisms.

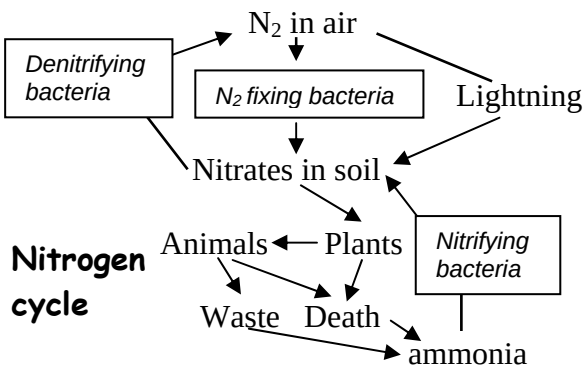
Carbon cycle



The Carbon cycle

- CO_2 removed from air by plants – photosynthesis to make carbohydrates, fats and proteins in plant.
- C returned to air as CO_2 when green plants respire.
- Plants eaten by animals and some animals eat other animals – C then becomes part of their bodies.
- Animals respire - CO_2 released into the air.
- Plants and animals die & microbes (decomposers) feed on their bodies - carbon released as CO_2 by respiration.

Nitrogen cycle



The Nitrogen Cycle.

Soil bacteria & fungi (decomposers) convert proteins and waste into ammonia; Nitrifying bacteria convert ammonia to nitrates. Denitrifying bacteria convert nitrates to N_2 gas (bad thing – lowers soil fertility). N_2 gas from the air is "fixed" (turned to nitrates) by nitrogen-fixing bacteria living in root nodules of plants called legumes or by the action of lightning.

Food Preservation Techniques 	<u>Food preservation techniques</u> Reduce the rate of decay of food • canning; • freezing; Pasteurisation & UHT • drying; • adding salt / sugar; irradiation • adding vinegar (pickling).
Canning, drying, & freezing 	Canning destroys bacteria/fungi through heating & then the food is placed in a sterilized container and sealed. Drying removes water from food that is required by bacteria/fungi to grow and reproduce. Freezing slows down the process by changing water into ice that the bacteria/fungi cannot use.
Pasteurisation, pickling & vacuum packing 	Pasteurisation destroys most of the organisms by heating the food to a high temperature for a short time Pickling or fermentation leaves the food in a too acidic environment for bacteria/fungi. Vacuum packaging uses a vacuum sealed impermeable film that inhibits molds, yeasts, and bacterial growth on the surface of the food eg meat.
Sugar & salt, UHT and irradiation 	Sugar and salt work by drawing water out of the microbes (by osmosis) and killing them. UHT - ultra-high temperature, heating the food to an even higher temperature than pasteurization. Kills microbes, resulting in a sterile product. Irradiation – radioactivity destroys insects, fungi, and bacteria. (The food is not radioactive).
