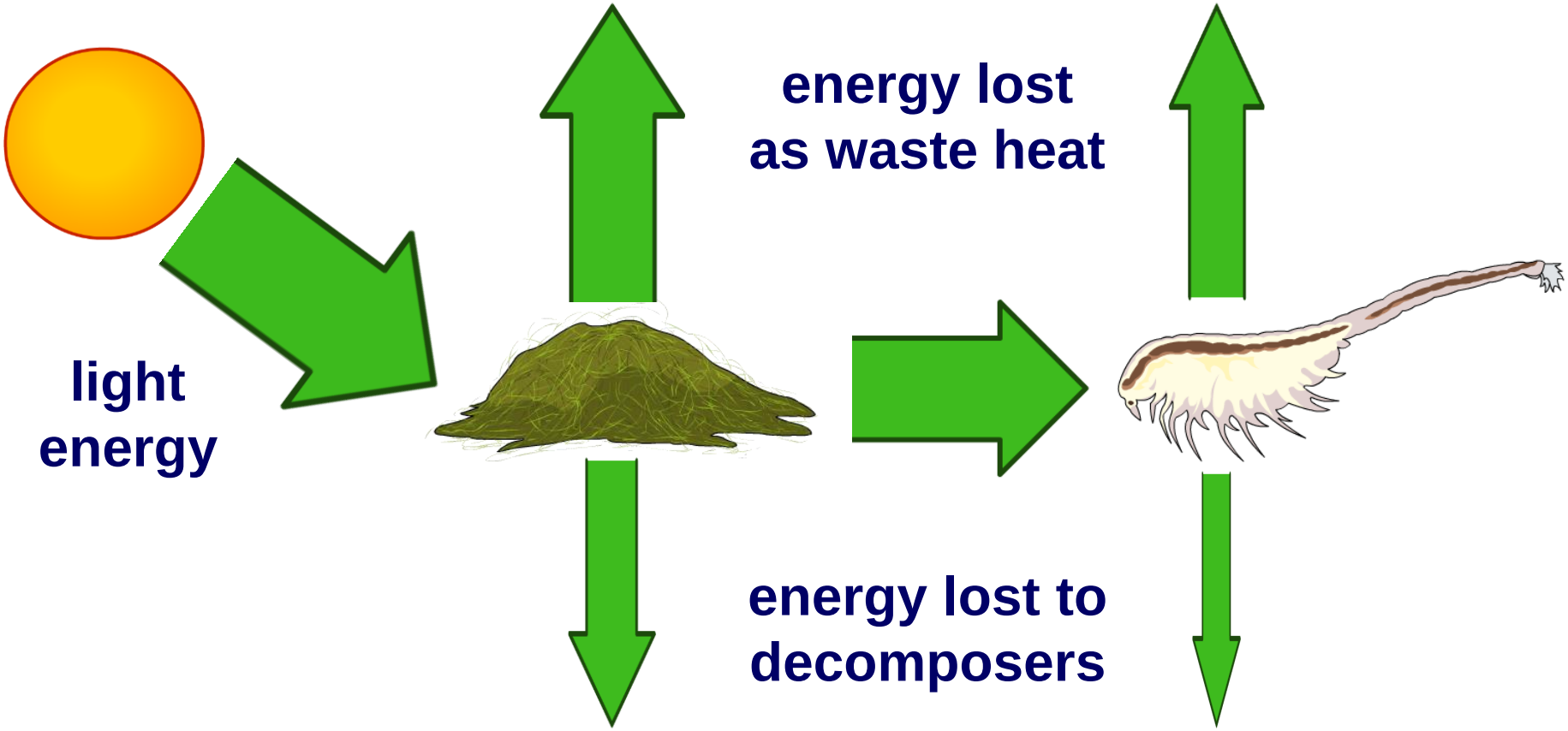
Chapter 20.3

NUTRIENT CYCLES

How does energy flow in an ecosphere?

Shrimps obtain food and oxygen from tiny algae in the water.



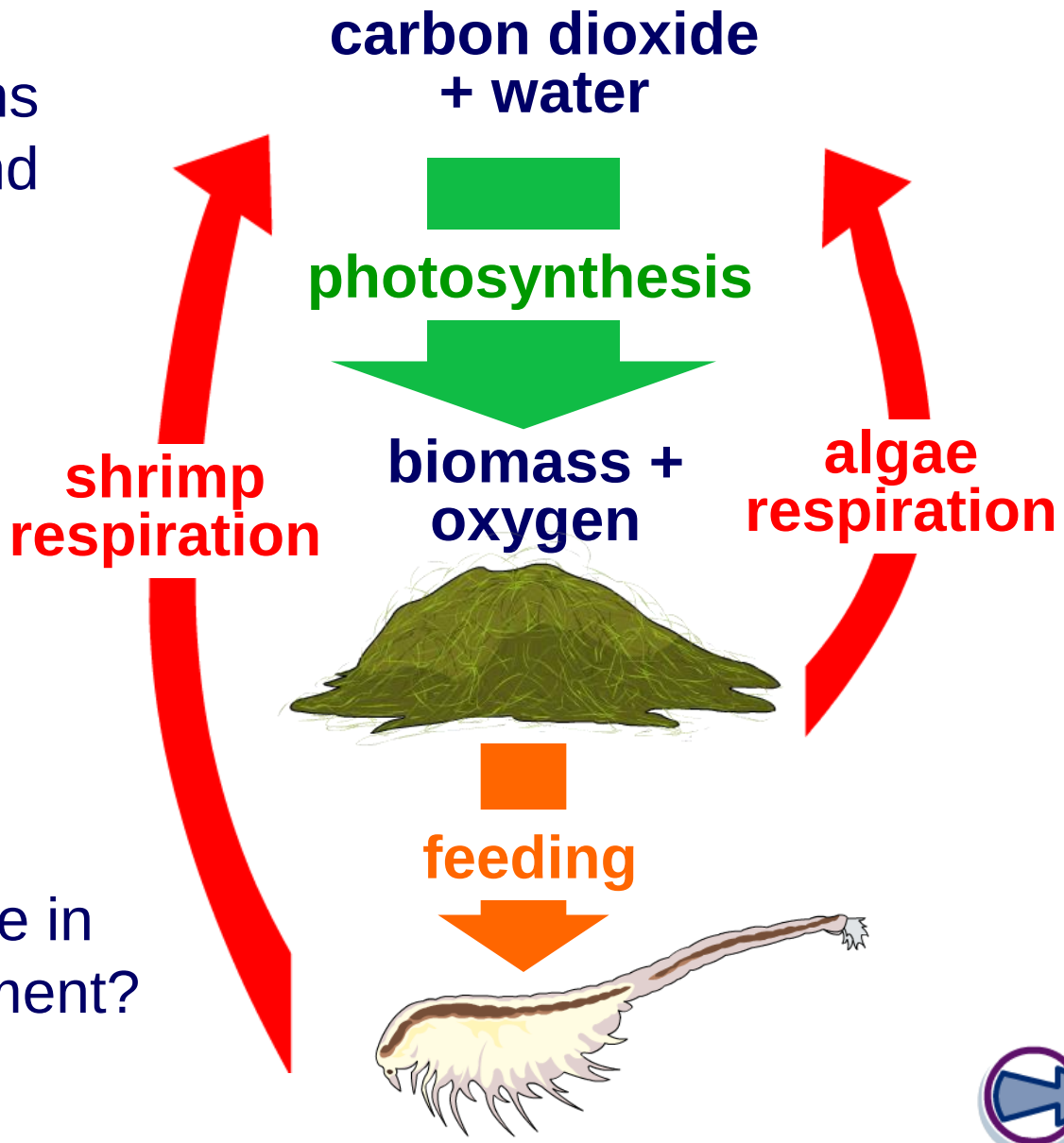
The algae use solar energy to build food molecules.
Where do their carbon dioxide and minerals come from?

How are carbon dioxide and oxygen balanced?

What is the link between the equations for photosynthesis and respiration?

One is the exact reverse of the other, so carbon dioxide and oxygen are continually recycled.

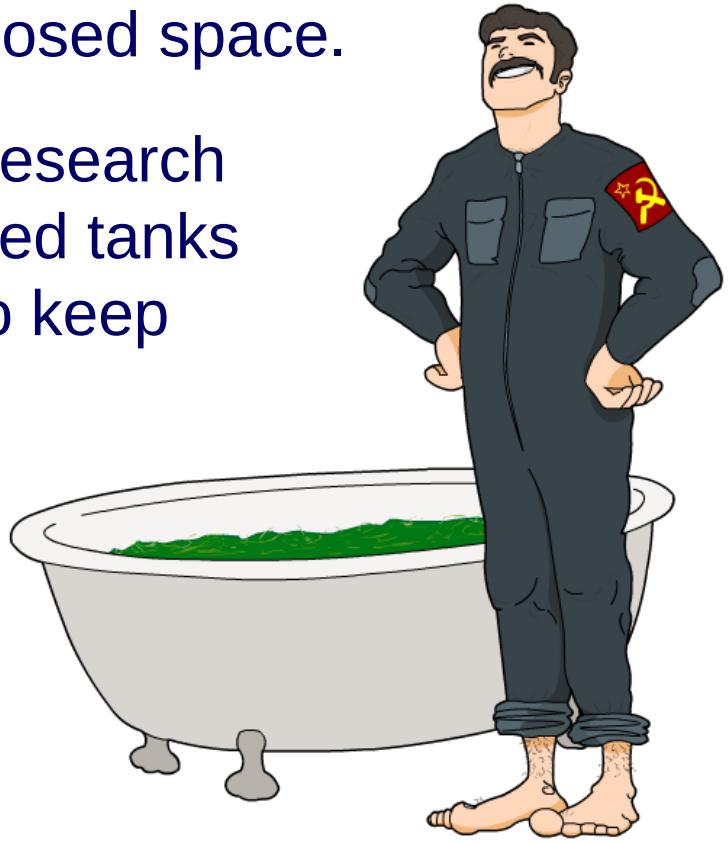
Could humans survive in an enclosed environment?



How much algae would a human need?

In the 1960s, Russian scientists investigated how much plant life would be needed to provide oxygen for humans to live in an enclosed space.

A three-man crew lived in a sealed research facility for six months. Eight bath-sized tanks of algae per person were required to keep oxygen supplies stable.



However, this was not a completely closed system:

- the scientists took food in with them instead of eating algae
- their urine and faeces were dried and stored away.

Is the Earth an ecosphere?

The record for keeping an ecosphere working is eight years because the shrimps will die eventually.

This occurs because important minerals get locked up in deposits.

Like an ecosphere, the Earth is a closed system, with sunlight as the only input. Nutrients are stored in living material but return to the system as dead material or waste faeces.

How are essential nutrients released from the dead biomass?

Can human-sized biospheres be made?

If humans colonize Mars and the Moon, completely self-sufficient human biospheres will be needed.

In the 1990s, eight volunteers stayed inside **Biosphere 2** for two years.

This glass-roofed building is designed to imitate the biosphere of Earth. It is large enough to grow crops and has specialist waste recycling.

The volunteers grew their own food but had to cheat by adding extra oxygen. What could have used up the oxygen?

Increased respiration?

The designers of Biosphere 2 wanted the crops to grow well, so they added compost and plenty of micro-organisms to the soil.

Conditions in the biosphere were warm and moist, which is perfect for micro-organisms, and so their populations boomed.

Why did that use up oxygen?

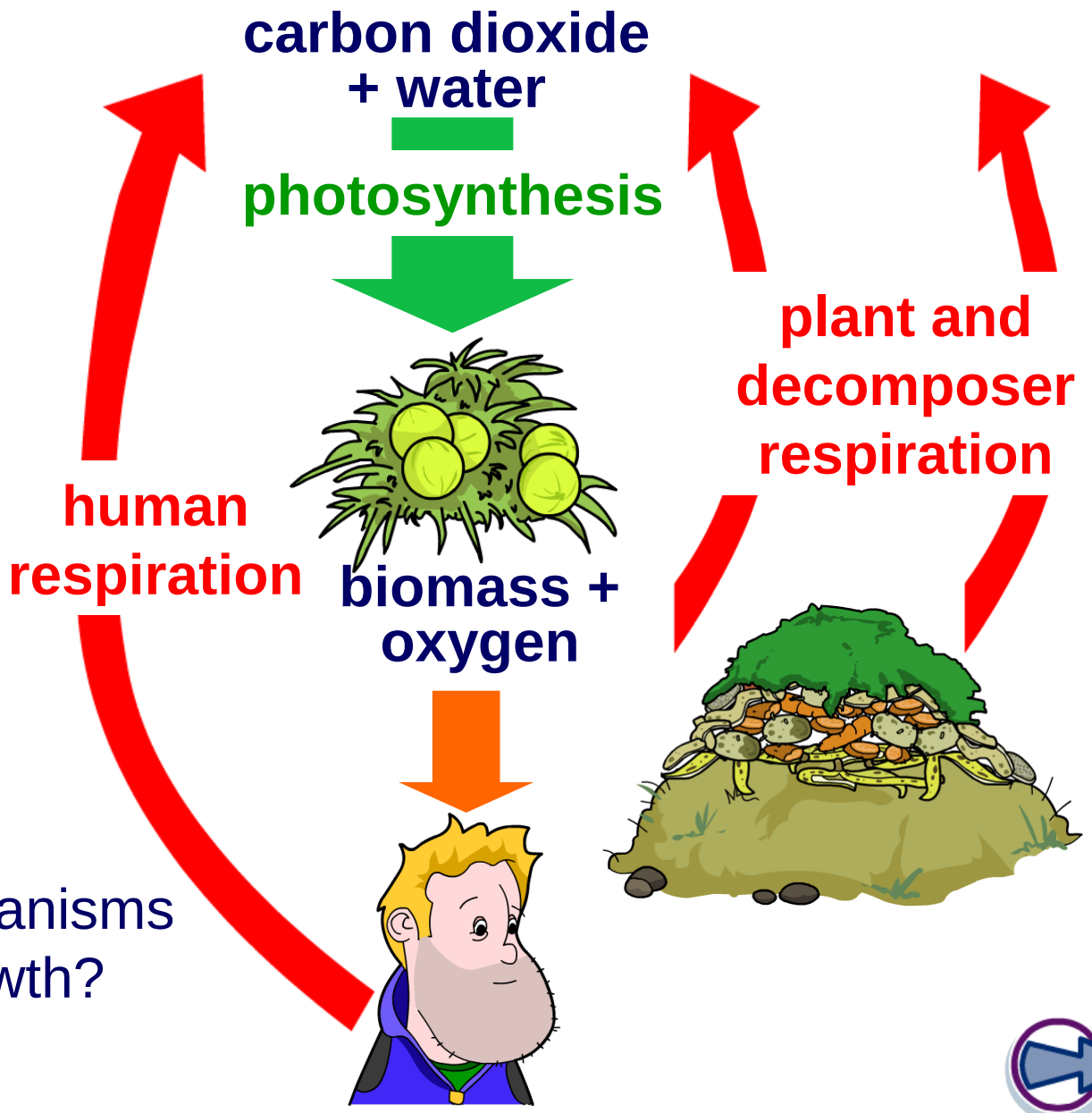
Micro-organisms respire when they decompose food. This process uses oxygen and releases carbon dioxide.

Do microbes use up oxygen?

Bacteria and fungi use oxygen when they break down organic material, leaving less for humans.

Plants grow well in soil containing certain types of micro-organisms.

How do micro-organisms improve plant growth?



Recycling and interdependence

Complete each statement about interdependence

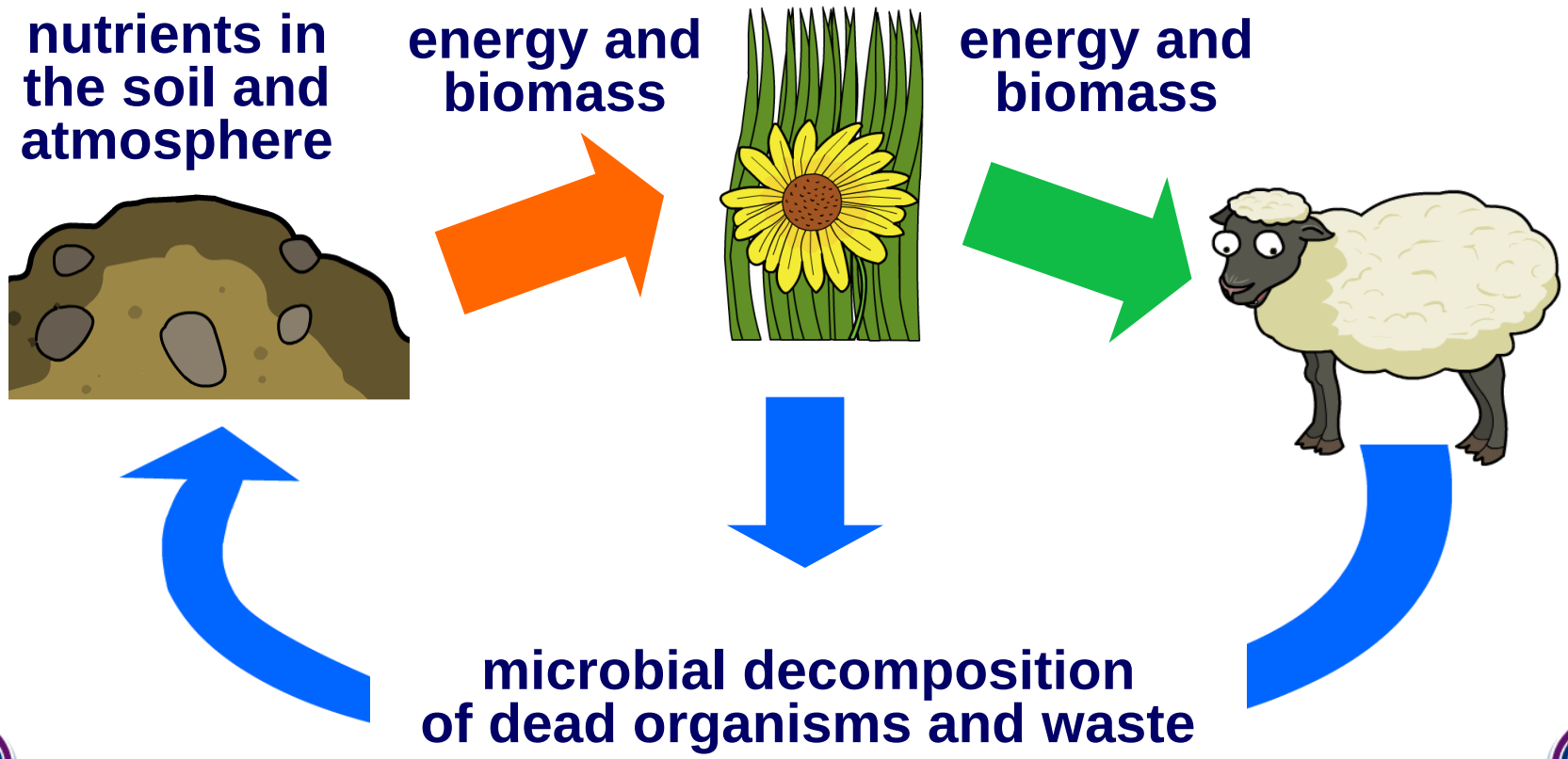
Respiration by plants and animals produces...	Photosynthesis by plants produces...	Respiration by micro-organisms produces...
?	?	?
...oxygen and glucose, and uses carbon dioxide.	...carbon dioxide and uses oxygen in some species.	...carbon dioxide and uses oxygen.


Decay and Recycling

Contents

What happens to nutrients?

Throughout an ecosystem, energy is constantly lost by wasted heat. In contrast, nutrients are constantly recycled through the **carbon cycle** and the **nitrogen cycle**.



What is decay?

In all ecosystems, dead organisms and waste material are broken down by bacteria and fungi called **decomposers**.

This process is **decay** or **decomposition**, and it releases nutrients back into the environment ready to be reused by other organisms.

Some food chains have decaying matter as the first stage.

Under what conditions will decay occur the fastest?

A warm, moist, oxygen-rich environment is the most favourable for decay to occur.

What is a detritivore?

Detritus is dead and decaying matter, such as dead leaves.

A **detritivore** is an organism that feeds on detritus. The detritus may already be partially decomposed by fungi or bacteria. Earthworms, maggots and woodlice are detritivores.

By gaining minerals from the decaying matter, detritivores reintroduce essential nutrients back into food chains.

What is a saprotroph?

A **saprotroph** is an organism that gains nutrients from dead organic matter. This is usually the first stage of decay.

Saprotrophs produce enzymes that break down dead matter. They can then absorb the released nutrients.

Bacteria and fungi feed saprotrophically. What would happen if they didn't exist?

Decomposers

Complete these sentences about decomposers

1. A decomposer is an organism that breaks down dead matter, releasing essential _____ .

2. Dead and decaying matter is also called _____ .

3. Organisms that eat decaying matter are called _____ . Organisms that feed in this way include _____ .

bacteria	detritus	algae	earthworms
nutrients	detritivores	enzymes	saprotrophs

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Decomposers

Complete these sentences about decomposers

4. Some decomposers release _____ to break down dead matter. These organisms are called _____ .

5. Organisms that feed saprotrophically include _____ and fungi.

bacteria	detritus	algae	earthworms
nutrients	detritivores	enzymes	saprotrophs

hide solve

Aquatic and terrestrial habitats

How much plant matter is decomposed in different habitats?

The amount of plant biomass decomposed is different in aquatic and terrestrial habitats.

Click on a habitat below to find out more.

aquatic

terrestrial

Why is food decay harmful?

Eating decaying food can cause food poisoning, which leads to vomiting, diarrhoea and, in extreme cases, death.

It is not always possible to see the early stages of decay, which is why food has ‘best before’ dates.

Placing fresh food, such as vegetables, in a refrigerator decreases the speed of bacterial growth and helps food last longer.

What other methods are used to preserve food?

What methods are used to preserve food?

Keeping food edible for longer is very important to humans because it ensures a constant supply of food, and allows food to be transported for many miles.

Click on the buttons below to find out about the methods used to keep food safe for longer.

canning | freezing | drying | adding salt or sugar | adding vinegar

Keeping food fresh

Match food preservation methods to how they work

adding salt	removes water to stop bacterial growth
adding vinegar	denatures bacterial enzymes
adding sugar	puts bacteria into suspended animation
freezing	kills bacteria and prevents contamination
canning	used to draw water out of savoury food
drying	used to draw water out of sweet food

?

solve

How do humans use micro-organisms?

The average person in the UK creates just over half a tonne of waste a year. How are micro-organisms used to break some of this down?

- Decomposers break down plant waste to make compost.
- Micro-organisms are used in sewage plants to break down human waste.
- Biodegradable plastics are broken down by micro-organisms.

How can decay help to make fuel?

Some bacteria ferment organic material to create methane.

This naturally occurs at landfill sites, but it can also take place in specialized **biogas** generators to create fuel.