

Indicator Species and Decomposition Notes

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Indicator species: organisms whose presence or absence can be used to indicate pollution.

The use of indicator species is one of those really cool bits of biology that we can use every day to let us know how clean or polluted an area is. For example, as you walk to school keep an eye out for Lichens 😊

Organisms used to indicate clean water

Indicator species: Stonefly larvae.

Details: The larvae (juveniles) live underwater and can remain as a juvenile for up to 4 years. They need well oxygenated water to survive.

Indicates: very clean water/ well oxygenated water.



A stonefly nymph – notice the two tails

Indicator species: Mayfly larvae.

Details: The larvae (juveniles) live underwater. They need well oxygenated water to survive.

Indicates: very clean water/ well oxygenated water.



A Mayfly larva – notice the three tails

Note: Stonefly larvae have two tails. Mayfly larvae have three tails. This will help you to tell them apart 😊

Indicator species: Freshwater shrimp.

Details: A very common shrimp found in all parts of the UK. They can tolerate slightly lower oxygen levels than the Stone and Mayfly larvae.

Indicates: very clean to clean water/ oxygenated water.



A fresh water shrimp

Indicator species: Caddis fly larvae.

Details: Definitely my favourite aquatic indicator species, they have such character in my opinion 😊

Caddis fly larvae can create their own little home by joining various bits of debris together as you can see in the image. This provides some protection from predators.

Indicates: clean water/ oxygenated water.



A Caddis fly larva

Organisms used to indicate polluted water

I'd like to first point out that the species above will be absent in polluted water as there is not enough dissolved oxygen in the water to support them.

Indicator species: Blood worms.

Details: if you're into fishing you may be familiar with these as they are often used for bait. They appear red as they contain haemoglobin, just like red blood cells.

Indicates: polluted water/ little oxygen available.



A group of blood worms

Indicator species: Sludge worms.

Details: they eat sediment (soil) on the bottom of rivers and lakes and digest bacteria present in the sediment. They also appear red as they contain haemoglobin.

Indicates: polluted water/ little oxygen present.



A group of sludge worms

Organisms used to indicate clean air

Indicator species: lichens.

Details: lichens do not have root systems. They receive all their moisture from the air and rain. As such, many of them are very sensitive to air pollution in particular sulphur dioxide.

Many different species indicate clean air. Only a few species indicate polluted air.



Images showing numerous different lichen species. This indicates good air quality.

Indicator species: Blackspot fungus.

Details: it is a type of fungus that grows on the leaves of plants. Often seen growing on rose leaves. If you're into gardening you will probably be quite familiar with this.

Indicates: Clean air as pollution will kill off the fungus.



Decomposition

Decomposition: is the breakdown of dead materials, this is often called rotting.

Decomposers: are organisms that gain their energy by feeding on dead or decaying matter.

Decomposers include microorganisms like bacteria and fungi, as well as larger organisms called detritivores (such as earthworms and woodlice).

A question in an exam could ask you to explain the effects of temperature, water content and oxygen on the rate of decomposition. Let's have a look at each so we're ready if a question on them comes up 😊

Temperature	
How does low temperature affect rate?	How does high temperature affect rate?
• <u>Low temperatures will decrease the rate of decomposition.</u> • <u>Freezing temperatures (below 0°C) will stop decomposition.</u>	• <u>Warm temperatures (between 15°C and 25°C) will increase the rate of decomposition.</u> • <u>Higher temperatures will reduce the rate of decomposition.</u>

Why does temperature affect the rate of reaction?

Decomposition is an enzyme-controlled reaction. Enzymes work very well near their optimum temperature. If the temperature is too high for too long then the enzymes will denature. This means the active site of the enzyme has changed shape and the substrate can no longer bind to it. Therefore, no products are produced.

Food preservation: cold temperatures slow down the action of decomposers. This is why we use fridges.

Composting: the production of compost is decreased by cold temperatures.

Water content/ moisture	
How does low water content affect rate?	How does high water content affect rate?
Lack of water will <u>decrease</u> the rate of decomposition.	Having enough water will <u>increase</u> the rate of decomposition.

Food preservation: lack of water will help preserve food. This is why dried meat and fruit can last.

Composting: the production of compost is decreased by a lack of water.

Oxygen Availability	
How does low oxygen availability affect rate?	How does high oxygen availability affect rate?
Lack of oxygen will <u>decrease</u> the rate of decomposition.	Having enough oxygen will <u>increase</u> the rate of decomposition.

Why does oxygen availability affect the rate of reaction?

Decomposers used aerobic respiration to break down dead decaying materials. If oxygen is not present the decomposers will switch to anaerobic respiration. This process is much less efficient and releases far less energy, so the rate of decomposition becomes significantly slower.

Food preservation: some food is stored in nitrogen gas, crisps for example. This keeps them fresh for longer.

Composting: the production of compost is decreased lack of oxygen.

Calculating the rate of decay of biological material

This is another bit of maths that could pop up in a biology paper. This quite nice and straightforward 😊

$$\text{Rate of decay} = \frac{\text{change in values}}{\text{time}}$$

Like any rate of change equation, it is the change of a certain value divided by the time that it took the change to happen. This question typically has a table of data with it. Check out the example below 😊

Three sample of milk were kept that three different temperatures. At the end of the time period a pH reading was taken. The data is presented in the table below.

	pH of the samples after they were left at that temperature for			
Degrees Celsius (°C)	12hrs	24hrs	36hrs	48hrs
5	6.8	6.6	6.4	6.2
15	6.0	5.0	4.2	4.2
30	5.2	4.2	4.2	4.2

Calculate the rate of decay for both the sample at 5°C and 15°C.

5°C	15°C
$\text{Rate of decay} = \frac{6.8 - 6.2}{36}$	$\text{Rate of decay} = \frac{\text{change in values}}{\text{time}}$
$\text{Rate of decay} = \frac{0.6}{36}$	$\text{Rate of decay} = \frac{1.8}{36}$
$\text{Rate of decay} = 0.017$	$\text{Rate of decay} = 0.05$

How many times greater is the rate of decay at 15°C than at 5°C?

$$\frac{0.05}{0.017} = 2.941 = \times 3$$

Therefore the rate of decomposition is three times faster at 15°C than it was at 5°C.