

Indicator species and decomposition

Revision notes · Indicator species and pollution, factors affecting the rate of decomposition in food preservation and composting, and rate of decay calculations.

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Indicator species and decomposition **Spec 9.16B-9.19B** **Triple only**

Indicator species and pollution **Spec 9.16B**

Some species are sensitive to pollution and some tolerate it. The presence or absence of **indicator species** gives evidence of the level of pollution in an area.

Indicator species		
Pollution	Indicator species	What it shows
Polluted water	Bloodworms, sludgeworms	These can live in water with very little oxygen, so many of them suggests the water is polluted (for example with sewage)
Clean water	Freshwater shrimps, stonefly nymphs	These need water with plenty of dissolved oxygen, so their presence suggests clean water
Air quality	Different species of lichen	Lichens differ in how sensitive they are to sulfur dioxide, so the species present indicate the level of air pollution. Few or no lichens suggest poor air quality.
Air quality	Blackspot fungus on roses	The fungus is sensitive to sulfur dioxide, so it is more common where the air is cleaner

Evaluating the use of indicator species

- Advantages: cheap and easy, needs little equipment, and shows the effects of pollution over a period of time, not just at one moment.
- Limitations: gives only a rough idea of pollution level, because other factors such as temperature or habitat may also affect the species present; it does not identify which pollutant is present; and it is less accurate than measuring with instruments such as an oxygen meter or sulfur dioxide meter.

Exam tip: In an evaluation, finish with a judgement. For example: indicator species are useful for a quick survey, but instruments are needed for an accurate measurement.

Decomposition and food preservation **Spec 9.17B**

Food goes bad because microorganisms (bacteria and fungi) feed on it, grow and respire. The rate of decomposition depends on temperature, water content and oxygen availability. Food preservation slows decomposition by changing these conditions.

Factors affecting decomposition and how preservation uses them

Factor	Effect on decomposition	Preservation method
Temperature	Warm conditions speed up enzyme reactions in microorganisms, so decomposition is faster. Cold slows these reactions.	Fridges and freezers keep food cold. Heating (for example in canning) kills microorganisms.
Water content	Microorganisms need water to grow and reproduce. Less water means slower decomposition.	Drying, or adding salt or sugar, which draws water out of microorganisms by osmosis
Oxygen	Most decomposers need oxygen for aerobic respiration. Less oxygen means slower decomposition.	Vacuum packing removes oxygen, and sealed cans keep oxygen out

Exam tip: Always link the factor to the microorganism. For example: low temperature, so enzymes in the microorganisms work more slowly, so they grow and reproduce more slowly.

Decomposition and composting Spec 9.18B

Composting uses decomposers to break down plant material and waste into compost, which returns nutrients to the soil. Here the aim is to make decomposition fast, so the conditions are the opposite of food preservation.

- **Temperature:** warm, because the enzymes of decomposers work faster as temperature rises, up to an optimum. Very high temperatures denature enzymes.
- **Water content:** moist, because decomposers need water. Too dry slows decomposition, and waterlogged material has little air.
- **Oxygen availability:** well aerated, for example by turning the heap, so that decomposers can respire aerobically. With little oxygen decomposition is much slower.

Many gardeners turn the compost heap regularly and keep it moist but not soaked.

Rate of decay calculations Spec 9.19B

You can measure decay by recording the mass of the biological material at intervals. The rate of decay is the change in mass over time.

$$\text{rate of decay} = \text{change in mass} \div \text{time}$$

$$\text{percentage loss in mass} = (\text{change in mass} \div \text{original mass}) \times 100$$

Rate of decay

A sample of leaves had a mass of 12.0 g. After 6 days the mass was 7.2 g. Calculate the mean rate of decay in g per day and the percentage loss in mass.

1. Change in mass = $12.0 - 7.2 = 4.8$ g
2. Rate = $4.8 \div 6 = 0.8$ g per day
3. Percentage loss = $4.8 \div 12.0 \times 100 = 40\%$

Answer: 0.8 g per day; 40 % loss

Maths skill: Rate changes as time goes on, so read from a graph by finding the change over a short interval. A steeper gradient means a faster rate.

Quick check

- 1 . Name two indicator species for clean water.
- 2 . What does blackspot fungus on roses indicate?
- 3 . How does freezing slow decay?
- 4 . Give the conditions for fast composting.
- 5 . State the equation for the rate of decay.

Quick check answers

Indicator species and decomposition

1. Freshwater shrimps and stonefly nymphs.
2. Cleaner air, because it is sensitive to sulfur dioxide.
3. Low temperature slows the enzymes of the decomposers.
4. Warm, moist and well supplied with oxygen.
5. Change in mass $\div$ time.