Abiotic factors

4.7.1.2 · Ecology · revision notes

Abiotic factors are the non-living conditions that affect a community, such as light intensity, temperature and soil pH. Expect recall of the list, then 2 to 4 mark questions asking you to explain how a change in one factor affects organisms, often using data from a table or graph.

Key facts

- Abiotic = non-living
- Temperature → rate of enzyme-controlled reactions
- Soil pH and mineral content → which mineral ions plants can get → growth
- Carbon dioxide level: can limit photosynthesis (plants)
- Light intensity → rate of photosynthesis → plant growth
- Moisture: water for photosynthesis and to keep plant cells turgid
- Wind: increases water loss and can damage plants
- Oxygen level in water: needed for aerobic respiration (aquatic animals); warm water holds less

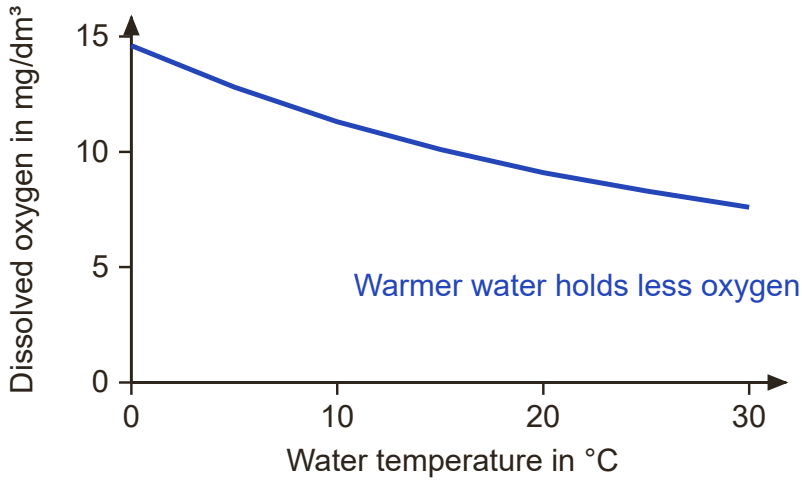
Notes

The abiotic factors to learn

- Abiotic factors are **non-living** factors that can affect a community.
- They are: **light intensity**; **temperature**; **moisture levels**; **soil pH and mineral content**; **wind intensity and direction**; **carbon dioxide levels** for plants; **oxygen levels** for aquatic animals.

How each factor affects organisms

- **Light intensity**: plants need light for photosynthesis. In shade, plants photosynthesise more slowly and grow less.
- **Temperature**: affects the rate of enzyme-controlled reactions such as photosynthesis and respiration. Each species survives best within a certain range.
- **Moisture**: plants need water for photosynthesis and to keep their cells firm (turgid); animals need water too. Waterlogged soil has little oxygen for roots.
- **Soil pH**: affects which mineral ions plants can absorb, and the enzymes in plant cells work best at a particular pH.
- **Mineral content**: plants need mineral ions for healthy growth, e.g. nitrate ions to make amino acids for proteins.
- **Wind**: strong wind increases water loss from leaves and can damage plants. Trees in very windy places are often short and bent away from the main wind direction.
- **Carbon dioxide**: plants need it for photosynthesis, so a low level can limit their growth.
- **Oxygen in water**: aquatic animals need it for aerobic respiration. Warm water holds less dissolved oxygen than cold water, so some species cannot survive in warm water.



As water warms, it holds less dissolved oxygen, so animals that need a lot of oxygen cannot live there.

Effects on the whole community

- A change in an abiotic factor often affects plants first. Animals that eat those plants, or shelter in them, are then affected.
- Example: when the tree canopy of a wood comes into leaf, less light reaches the ground, so fewer small plants grow and there is less food for the insects that eat them.
- In a field study, measure the abiotic factor (e.g. with a light meter, thermometer or pH probe) at the same places where you count the organisms.

How to answer each type of question

Recall: name abiotic factors

1 to 2 marks | Grade 3

1. Choose from the list: light intensity, temperature, moisture, soil pH, soil mineral content, wind, carbon dioxide, oxygen.
2. Do not give biotic factors such as food, predators or disease.
3. Pick factors that fit the habitat in the question.

Example. Give **two** abiotic factors that could affect the plants growing on a sand dune.

Model answer. Any two from: wind intensity or direction (1); moisture level / amount of water (1); temperature (1); light intensity (1); soil mineral content (1); soil pH (1)

Describe the relationship shown by data

2 marks | Grade 5

1. State the overall trend: as X increases, Y increases or decreases.
2. Look for a change in the pattern, such as levelling off.
3. Quote values from the data to support your description.

Example. A student placed quadrats at 2 m intervals along a line from the edge of a wood towards its middle. The table shows the results.

Distance from edge of wood in m	Light intensity in arbitrary units	Mean number of dandelions
0	90	12
2	70	9
4	45	4
6	30	1
8	28	1

Describe how the number of dandelions changes with light intensity. (2 marks)

Model answer. As light intensity decreases, the number of dandelions decreases (1). For example, there were 12 dandelions per quadrat at 90 units but only 1 per quadrat at 30 units or below (1).

Explain how a change in an abiotic factor affects organisms

2 to 3 marks | Grade 5

1. Name the life process the factor affects (photosynthesis, respiration, enzyme activity, water balance).
2. Say how the change affects that process (faster or slower).
3. Link it to survival, growth or reproduction, and so to the number of organisms.

Example. A student found far fewer dandelions in the middle of a wood than at its edge.
Use your knowledge of photosynthesis to explain why. (3 marks)

Model answer. Less light reaches the ground in the middle of the wood because the tree leaves absorb it (1). So the dandelions photosynthesise more slowly / make less glucose (1). So they grow less, and fewer survive and reproduce (1).

Explain the effect of warm water on aquatic animals

3 marks | Grade 7

1. State that warmer water contains less dissolved oxygen.
2. Link oxygen to aerobic respiration, which releases energy.
3. Conclude which animals survive and how their numbers change.

Example. A power station releases warm water into a river. There are fewer freshwater shrimps near the outlet than further downstream.
Explain why.

Model answer. The water near the outlet is warmer (1). Warm water holds less dissolved oxygen (1). The shrimps cannot get enough oxygen for aerobic respiration, so fewer survive there (1).

Don’t lose marks

- Giving biotic factors (food, predators, disease) when asked for abiotic ones.
- Writing 'the weather' or 'the environment'. Name a specific factor such as temperature or light intensity.
- Describing a trend without explaining it when the question says 'explain'. Link the factor to a life process.
- Writing 'light affects photosynthesis' without saying how: less light means a slower rate, so less glucose for growth.

More tips

Memory tricks

- Abiotic = 'a' (not) + 'bio' (life): not living.
- Quick test: if the factor is an organism, or is caused by one (food, predators, pathogens, competitors), it is biotic. Physical and chemical conditions are abiotic.
- Link each factor to a process: light → photosynthesis; temperature → enzymes; oxygen → respiration; water → photosynthesis and turgor.
- Warm water holds less oxygen: think of a fizzy drink going flat faster when it is warm.

Exam technique

- When data is given, quote values with units to support your description.
- In 'explain' questions, use a chain: factor changes → process changes → growth or survival changes → population changes.
- Remember that a correlation does not prove cause: other factors may change at the same time (light and temperature often change together).

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Define an abiotic factor

A non-living factor in the environment that can affect a community.

Grade 4

List the abiotic factors in the specification

Light intensity, temperature, moisture level, soil pH and mineral content, wind intensity and direction, carbon dioxide (plants) and oxygen (aquatic animals).

Grade 5

Describe a trend in abiotic data

State how one variable changes as the other changes, quoting values from the table or graph.

Grade 5

Explain how an abiotic change affects a species

Link the factor to a life process, e.g. less light means less photosynthesis, so slower growth.

Grade 7

Explain knock-on effects through a community

Show how a change that affects plants then affects the animals that eat them or shelter in them.

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