Mineral ions, growth and fertiliser

Student activity • observation and reasoning

YEAR 10 / LESSON 31 / BIOLOGY + SCIENCE (DOUBLE AWARD)

The question

Why can fertiliser improve yield but also damage an ecosystem?

Use the supplied examples, record your reasoning and correct it using evidence.

Equipment

- Student booklet, paper models, pencil and ruler

Paper, modelling and written reasoning only. No chemicals or biological samples are handled.

Course coverage: Shared Biology / Double Award: 2.22, 4.17 and 5.3. Plant minerals and fertiliser effects.

Plan, model or apparatus sketch

Draw and label the apparatus or biological model; identify one limitation.

Method and reasoning

Read the whole sequence before starting

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1. Draw a causal link from nitrate ions to amino acids and proteins, and from magnesium ions to chlorophyll.

2. Compare a plant lacking nitrate with one lacking magnesium using the supplied reference descriptions; explain why a symptom alone is not a definitive diagnosis.

3. Design a comparison of complete nutrient solution, nitrate-deficient solution and magnesium-deficient solution, keeping plant variety, starting size, light and temperature constant.

4. Interpret the illustrative yield data for fertiliser levels 0, 1, 2 and 3: 2.0, 3.1, 3.6 and 3.6 arbitrary yield units. Identify diminishing benefit without claiming these are field measurements.

5. Construct a eutrophication sequence from fertiliser runoff to increased algal growth, reduced light, death/decomposition and oxygen depletion.

6. Propose evidence and management measures that balance crop benefit with nutrient loss to waterways.

Cleanup

- Return models and keep the corrected work.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Nitrate ions supply nitrogen for amino acids; magnesium is required in chlorophyll. Nitrate deficiency can limit growth and magnesium deficiency can cause chlorosis, but symptoms have other possible causes. Illustrative yield values are invented for interpretation. Fertiliser does not replace light, water or carbon dioxide.

Example / trial	Observation / evidence	Explanation / limit
Mineral / function / evidence		
Yield pattern and limits		
Eutrophication causal sequence		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Why do plants need nitrate ions?

2. Why do plants need magnesium?

3. Why might extra fertiliser stop increasing yield?

4. How can fertiliser runoff lower dissolved oxygen?

5. Why is yellowing alone not proof of magnesium deficiency?

6. Give one way to reduce nutrient loss.