

Thinking about systems

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A sophisticated understanding of how living things interact with the environment includes a sense of the complex and changing nature of relationships.

When analysing students' responses about relationships within a waterway ecosystem we judged students to be at an early stage in their development in thinking about systems if they did not identify a relationship or made a very general comment about a relationship without any specific detail.

Those students who either identified an appropriate direct relationship between two components (e.g., the fisherman ate the fish) or gave specific information about parts of the system that are linked without explaining the relationship were considered to be at the next level. (The detailed information about parts is essential if students are to make valid generalisations at a systems level).

Students who identified the effects of one relationship on another (e.g., The fisherman ate the fish so the birds that eat fish went hungry) were considered to be developing some sense of the complexity and balance in the ecosystem. As these ideas develop further students can identify more relationships and impacts from changes that are further away in terms of either time or distance.

In our discussions we became aware that an understanding of scale is important for increasingly complex understandings of how systems work. At an early stage for instance a student thought spilling cordial into the river at a picnic could pollute the waterway and make the water change colour.

In looking at the students' responses about waterways we identified both direct and indirect human effects on the ecosystem. Direct effects included fishing, picnicking, kayaking, swimming, walking a dog, just being there, drinking water, playing, directing polluting, littering and scaring, attacking or killing animals.

In the table below quotes from students about the impact of fishing have been used to try and illustrate different stages of development in thinking about systems.

| | |
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| May identify many parts of a system but no specific relationships | We saw eels, whitebait, and trout in the stream. |
| Appropriate direct relationships Identifies parts of the system that are linked without explaining the relationship | The fisherman catches the fish and eats it. (direct) The person is fishing for fish with his fishing rod. (parts) |
| Multiple relationships that impact on each other | The humans can eat the fish so the kingfishers etc won't have much to eat. People fishing makes the algae grow more because fish aren't eating it. |

Indirect effects of humans on the waterways ecosystem included pollution, chopping down trees and destroying habitat, introducing animals/ plants, introducing diseases, changing the course of waterways, damming, hydro power, building, waste pipes/storm water drains, erosion and impacts of farming including positive measures such as building fences to keep stock away from waterways.

In the table below quotes from students about the impact of pollution have been used to try and illustrate different stages of development in thinking about systems.

| | |
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| <p>May identify many parts of a system but no specific relationships</p> | <p>Humans who pollute the waterway could contaminate it.</p> <p>Smoke from houses pollutes the water.</p> |
| <p>Appropriate direct relationships</p> <p>Identifies parts of the system that are linked without explaining the relationship</p> | <p>Gases and acids would make the waterway toxic and kill all the plants, fish, and anything near the bank. (direct)</p> <p>Storm water drains flow into rivers. (parts)</p> |
| <p>Multiple relationships that impact on each other</p> | <p>People can upset relationships by polluting the water which kills the fish and the birds can't feed on them.</p> <p>Companies by water drop oil waste into waterways therefore killing the trout and other fish. The reeds will overgrow, algae will spread and this will cause blockage of drains. (attempts at multiple effects - dynamic) - misconceptions about feeding.</p> |

Resource List

- What do you know about the greenhouse effect?
- A garden food web
- Glaciers and global warming
- A soil food web
- Inter-relationships - a really important idea in environmental science
- Rubbish on the beach
- River in flood
- A mystery photo