**The wolves of Yellowstone National Park**



Yellowstone is a National Park in America. When it was created in 1982 gray wolves were one of the predators in the park. By 1930, humans had killed all the wolves in Yellowstone National Park. In the 1990s, scientists found that aspen trees in the park had disappeared and the vegetation along the riverbanks had also vanished.

One hypothesis put forward to explain these changes is that the loss of the wolf population caused the plant populations to decrease.

Some children talk about how they think the wolf population may have caused the plant population to decrease.

**Saffron**

The wolves would help spread seeds; this would help the plants reproduce. If there were no wolves this wouldn’t happen.

**Hattie**

The woods were a habitat for the wolves. When the wolves disappeared the trees in the woods were no longer needed so they too disappeared.

**Fynn**

The wolves ate the herbivores. If there are no wolves the number of herbivores would increase. They would eat more plants until there were very few left.

**Tyson**

The faeces and dead bodies of the wolves would help provide nutrients for the plants to grow. Without the nutrients the plants would also die.

**To talk about in your pair/group**

1. Who do you **agree** with?
2. Who do you **disagree** with, and why?
3. How would you explain the right ideas to these children?

*Biology > Big idea BOE: Organisms and their environments > Topic BOE2: Organisms in their environments > Key concept BOE2.1: Ecosystem components and dynamics*

|  |
| --- |
| **Response activity** |
| **The wolves of Yellowstone National Park** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | The environmental conditions in different ecosystems, and in different parts of an ecosystem, affect and are affected by the organisms that live there. |
| Observable learning outcome: | Describe how changes in environmental conditions may lead to population change in ecosystems. |
| Activity type: | Discussion |
| Key words: | ecosystem, population, community, food chain, food web |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: Reasons why

|  |  |
| --- | --- |
| **B** | **BRIDGING**  This activity explores ideas that are usually taught at age 14-16, to build a bridge to later stages of learning. |

**What does the research say?**

Research has shown that when students are asked to predict possible effects of a change in a population within a food web, they tend to focus only on single food chains within the web, struggle to trace changes through more than one chain, struggle to think about the impact of a change in a population more than one trophic level away, and are more able to trace changes upwards through a chain than downwards (Webb and Boltt, 1990; Leach et al., 1992; Gotwals and Songer, 2010; Griffiths and Grant, 1985; Barman, Griffiths and Okebukola, 1995). These authors and others have identified specific misunderstandings about changes in food webs that are commonly held by school children, including that:

* a change in the size of a population will only affect another population if they are related as predator-prey;
* a change in the size of a population will only affect other populations in the same food chain within a food web (and will not affect populations in other food chains within the food web);
* if the size of one population changes, all other populations in the food web will change in the same way (e.g. a decrease in one population means all other populations will also decrease).

Research therefore suggests that students may not see indirect or distant connections and Hogan’s (2000) investigation into how students used systems thinking to reason about food web perturbations also found that they rarely recognised feedback loops and indirect relations in ecosystems.

An ecology concept test used in a study of elementary students revealed several misconceptions about population change in ecosystems. It found students thought that ‘a change in one population will only affect another population if the two populations were related as predator and prey’ and that ‘ if the size of one population in a food web is altered, all other populations in the web will be altered in the same way’ (Ozkan, Tekkaya and Geban, 2004). Students appeared to have difficulty determining the effect of change on population numbers when the effect was transmitted along more than one route, pupils reasoned that the populations were too far apart or not closely linked.

A study by Jin et al. (2019)investigated student ability to explain the interdependent relationships in ecosystems. Students were presented with real world phenomena about relations in ecosystems and their responses were graded based on the content within their explanations. Jin et al. found that only 3% of the students were able to discuss mechanisms in their answers and the majority of students were unable to “use systems thinking concepts to construct a causal mechanism that explains phenomena about interactions in ecosystems”. 33% of students were able to identify distant relations and interactions in ecosystems but were not able to construct explanations, whilst most students (57%), simply explained the relationships in terms of individual organism needs.

**Ways to use this activity**

Students should complete this activity in small groups. The focus of the activity should be on group discussion to consider which student provides a good explanation as to why particular plant populations fell.

It is through the discussions that students can check their understanding and develop their explanations. Listening in to the conversations of each pair/group will often give you insights into how your students are thinking. The quality of the discussions can be improved with a careful selection of pairs/groups, or by allocating specific roles to students in each pair/group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers; they may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

After their discussions, each pair/group should be prepared to report the key points of their discussion to another pair/group, or to the class.

**Expected answers**

1. **Fynn** has the right idea. The wolf population will have kept the herbivore population under control. With no wolves the herbivore population will increase, and they will consume more of the plants, eventually leading to very low numbers of particular species.
2. There are elements of each students hypotheses that are correct, the trees are habitats, dead wolves through the action of decomposers will provide nutrients for plants, and wolves could help spread seeds, however these reasons would not result in the decrease in population observed. It is important that students can pick out the correct elements of the students’ hypotheses but understand why they would not lead to the reduction of plant species observed.
3. Students could discuss a range of ideas to explain this event to children. They could draw a food web to show how the wolves are linked to the plants or even demonstrate it though role play.

**Acknowledgments**

Developed by Elizabeth Lupton (UYSEG), from an idea by Hui Jin et al.

Images: pixabay.com/veronicaannehill (2938160)

**References**

Alexander, S. K. (1982). Food web analysis: an ecosystem approach. *American Biology Teacher,* 44**,** 189-190.

Allen, M. (2014). *Misconceptions in Primary Science, 2nd* ednBerkshire, UK: Open University Press.

Barman, C. R., Griffiths, A. K. and Okebukola, P. A. O. (1995). High school students' concepts regarding food chains and food webs: a multinational study. *International Journal of Science Education,* 17(6)**,** 775-782.

Gotwals, A. W. and Songer, N. B. (2010). Reasoning up and down a food chain: using an assessment framework to investigate students' middle knowledge. *Science Education,* 94(2)**,** 259-281.

Griffiths, A. K. and Grant, B. A. C. (1985). High school student's understanding of food webs: identification of a learning hierarchy and related misconceptions. *Journal of Research in Science Teaching,* 22(5)**,** 421-436.

Hogan, K. (2000). Assessing students' systems reasoning in ecology. 35**,** 22-28.

Jin, H., et al. (2019). Secondary Students' Understanding of Ecosystems: A Learning Progression Approach. *International Journal of Science and Mathematics Education,* 17(2)**,** 217-235.

Leach, J., et al. (1992). Progression in conceptual understanding of ecological concepts by pupils aged 5-16. University of Leeds, UK: Centre for Studies in Science and Mathematics Education.

Ozkan, O., Tekkaya, C. and Geban, O. (2004). Facilitating Conceptual Change in Students' Understanding of Ecological Concepts. Journal of Science Education and Technology.

Webb, P. and Boltt, G. (1990). Food chain to food web: a natural progression? *Journal of Biological Education,* 24**,** 187-190.