

This activity was adapted from the Earth: A New Wild | Teacher Guide – Wolves of Yellowstone

DEFINING TROPHIC CASCADES

Purpose: The purpose of this activity is for students to discover how the absence of wolves impacted the Yellowstone National Park ecosystem. Students will explore the concepts of a trophic cascade through a short video clip and through a brief analysis of data from a scientific study conducted in the park after wolf reintroduction in 1995.

Next Generation Science Standards:

LS2.A: Interdependent Relationships in Ecosystems

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

Time:

One 45-minute class period

Objectives:

The student will...

- Describe the conditions of the Yellowstone National Park (YNP) ecosystem in the absence of wolves.
- Explain the trophic cascade that occurred in YNP.
- Predict what would happen to YNP if environmental conditions changed.
- Examine and analyze data on the wolf, elk, and plant populations in YNP and describe how the populations are interdependent.
- Analyze the change in resource availability in YNP and construct an explanation of the subsequent changes in animal populations.

Lesson Part 1:

1. Show students the Wolves of Yellowstone | EARTH A New Wild video clip from the beginning and stop at 2:36 minutes.
2. While students are watching the video have them start to list the changes in the ecosystem of YNP in the absence of wolves. Have them list as many as possible. Repeat the video in order for them to add more.
3. Go over the responses with the students.

Answers:

- **Wolves ABSENT**
- **Elk gathered on river banks and ate shrubs/trees**
- **Less shrubs/trees on banks and elk hooves causes stream banks to erode**
- **Erosion caused water to get muddy and fish suffered**
- **Less shrubs/trees = beavers can't build dams**
- **Without beaver dams – fish, amphibians had no protection**
- **Pollinators had fewer flowers**
- **Elk population doubled**
- **Elk overgrazed entire park, lots of vegetation gone**

- **Mammals like mice & rabbits had nowhere to hide, population declined**
- **Grizzly bears suffered without berries as food source**
- **Elk ate berries**
- **Songbirds had fewer trees for nesting**

Discussion: Ask the following questions:

1. With the elimination of wolves from the ecosystem, how was the population of plants (producers) indirectly affected?

Answer: The population of plants was reduced because of the overgrazing of plants by elk. Overgrazing occurred because the elk population was no longer controlled or checked by the wolves (their predator).

2. Predict what would happen to the wolf and elk populations if there was a drought that caused many of the plant species to dry up and/or die.

Answer: The elk population would decrease because its food source is decreased. This would also cause the wolf population to decrease because they would have less food (elk)

Lesson Part 2: Evaluate Solutions for Maintaining Ecosystem Services and Biodiversity

Show the rest of the video and have students list the changes to the ecosystem when the wolves were reintroduced. This will help to illustrate ecosystem changes.

While students are watching the video have them start to list the changes to the ecosystem of YNP after wolves were reintroduced.

Answers:

- **Wolves PRESENT**
- **Elk are chased from river bank by wolves**
- **Stream banks stabilizing, less erosion**
- **Water quality improving**
- **More trees for beavers to build dams**
- **Fish and amphibians have protection from dams**
- **More plants mean more flowers for pollinators**
- **Elk population reduced from 17,000 in 1995 to 4,000 in present day**
- **Fewer elk means less overgrazing**
- **Mammals like mice & rabbits have more hiding plants and population increases**
- **Grizzly bears have more food available**
- **More berries available to bears**
- **Songbirds had more trees for nesting**
- **Trees (aspen/willow) growing again**

Discussion: Answer the questions below:

1. How have wolves helped the economy in the Yellowstone National Park area?

Answer: In 2005, there were over 100,000 visitors to YNP who came to see wolves. This brought about 30 million dollars into the local economy.

2. What are other consequences of wolf introduction that have been good for the humans in the area?

Answer: For the 106,000 residents of Billings, Montana, the Yellowstone River is cleaner and provides better drinking water for the community; Only healthy elk survive – wolves kill weak and old; Elk population stronger, healthier; Elk carcasses benefit scavengers and bears

Part 3: Twenty Years After Wolf Reintroduction to Yellowstone

Discuss with students some of the pros and cons that the U.S. Fish and Wildlife Service needed to consider during the 1994 decision-making process on whether or not to reintroduce wolves to Yellowstone National Park.

Vocabulary:

Apex predator: a top-level predator with no natural predator of their own; resides at the top of a food chain.

Browser: an organism that eats the shoots, leaves, and twigs of trees or shrubs; elk are browsers (and grazers).

Browsing: the act of eating shoots, leaves, and twigs of trees or shrub.

Cottonwood recruitment: the growth of seedlings or sprouts above the level of browsers. In other words, the trees are able to grow taller than the level at which elk and other browsers can eat them.

Grazer: an organism that feeds on grass; elk are grazers (and browsers).

Habitat: the home or environment of a plant, animal, or other organism.

Keystone species: a species that has a disproportionately large effect on its environment compared to its relative abundance. When a keystone species is removed from a system, the ecosystem may change drastically, even if the species removed was a small part of the entire ecosystem.

Trophic cascade: a trophic cascade occurs when the impact of a predator on its prey affects one or more feeding or trophic level. Predators control the populations of their prey and thus indirectly benefit and increase the abundance of their prey's prey. When the apex predator is removed, the lack of population control at the next trophic level down can affect the populations at the trophic level below. Trophic cascades must occur across a minimum of three trophic levels (e.g. secondary consumer, primary consumer, and producer). Trophic cascades can also happen from the bottom up; for example, the removal of a producer may affect population sizes in the trophic levels above it.