# Star Grazing Activity Kit

## Overview

In this activity participants will take a closer look at global warming, keystone species, and the nutrient cycle. Sea stars (*Pisaster ochraceus*) eat mussels (*Mytilus californianus*) that would otherwise take seafloor space from water plants like seagrasses. Water plants like seagrasses provide food and oxygen for the whole ecosystem, so it is important that mussels do not overrun the seafloor. The species of sea stars and mussels in this activity live in areas between high and low tides off the northwest coast of North America. Since mussels don't have natural predators other than Ochre sea stars, removing the sea stars from their habitat would cause mussels to overtake the seagrasses, impacting all of the other species in the marine system.

## Learning Goals

The learning goals of this activity are to understand the concepts of global warming, keystone species, the nutrient cycle, and how these terms relate to each other.

1. The **keystone species** is a species on which other species in an ecosystem largely depend, such that if it were removed, the ecosystem would change drastically.
2. The **nutrient cycle** is the concept that dead things are decomposed and reabsorbed by plants and organisms, which are in turn eaten by other organisms which die and are reabsorbed.
3. A temperature increase of just 1.5 °F caused by **global warming** can destroy entire ecosystems. This temperature increase causes the sea star shells (calcium carbonate) to thin out and be more easily eaten by predators.

## Materials

- World map with velcro and animals to match
    - You will have one of two sets of animals that will be placed on your world map
- Ocean map
- Sea stars with magnets attached
- Seagrasses with colored bottoms (not all are colored, but most are)
- Mussels
- 10 inch "Predation" magnet bar
- Stuffed otter to hold "Predation" magnet bar
- Laminated pictures for guidance and presentation

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|---|---|
| Turtle or Octopus | California (interchangeable with Florida) |
| Sea Star or Seahorse | Caribbean |
| Dolphin or Shark | Florida (interchangeable with California) |
| Seal or Sea Lion | Southwest Africa |
| Orca or Penguin | Antarctica |
| Walrus or Baleen Whale | Eastern Russia |

## Set-up

Place the stars, seaweed, and mussels on the ocean map. Place the world map face up with the assorted animals on the map to be organized in their proper locations. Have the Sea Star flyer prepared as it provides context clues to the activity.

## Procedure

### Short Form

1. Begin the activity by talking about diversity in the ocean (sea lions, starfish, sea slugs etc.). Feel free to talk about Finding Nemo.
2. Hand them the otter doll that will hold the predation stick (you can use the laminated picture provided to give them guidance for understanding the relevance of sea stars, seagrass, and mussels). Tell participants to wave it over the ocean map to see what species get eaten due to temperature increase. They can guess or be given hints (**Hint:** temperature increases causing the bicarbonate calcium shell thickness of shelled sea animals to decrease). Note that the sea stars have magnets in them and will attach to the magnet bar which removes them from the map.
3. Next, have participants hypothesize which organism will decrease next, the seaweed or the mussels. Have them flip the seaweed and mussels over to search for colors underneath (to signify predation). All of the seaweed has colors and will be removed.
4. Take a moment to discuss how the absence of seagrasses will impact herbivores who rely on it as a food source. Also discuss how seagrass and other vegetation produces oxygen (you can

ask what animals eat seagrasses, what process makes oxygen etc.) and then have participants hypothesize what will happen to the mussels with all this new space.

5. Discuss the outcome of mussels taking up space so other organisms can't grow. The decrease in the biodiversity of the starfish (keystone species) leads to a disruption in the ecosystem and decreased biodiversity overall.

## Long Form

**Yellowstone Keystone Species**

Once they complete that task, you can give them various situations to predict. Provided is a laminated picture showing Yellowstone National Park.

1. With too many elk, biodiversity has decreased, but what happens if we add wolves (a keystone species)?
2. Elk have been rampant in Yellowstone National Park since the removal of wolves from the area. When wolves are absent, elk will over-graze in meadows and grassy areas. How did the elk's eating habits affect the wildlife in those areas? If this impacted the beaver's dam-making, what other changes could happen in the ecosystem? These areas are being eaten to the point of harming other wildlife in the area, removing beavers which in turn lowered fish and bird populations in a catastrophic cascade.
3. In 1995, a team of biologists formed the Yellowstone Wolf Project and reintroduced wolves into the area. Wolves are the natural predators of elk. Immediately, changes in the ecosystem were noticed. What changes do you think occurred? How did the elk respond to the reintroduction of wolves?
4. The elk populations moved into heavy timber areas, breaking up into smaller groups. This migration allowed the meadows and grasses to grow again. What changes do you think occurred once the elk shifted their locations and group size?
5. Beavers had access to more food as their food sources regrew and with the production of more dams, the fish populations increased, along with birds, bears, and small animals.
6. Wolves, in this case, were important for creating a change in the whole ecosystem of Yellowstone National Park. With this in mind, why might extreme changes in the climate temperature impact ecosystems as a whole? What problems might occur if scientists have a hard time identifying keystone species prior to extreme temperature changes? What other kinds of changes can be dangerous for keystone species?

**Ocean Temperatures**

Next, give them the animal pieces (with Velcro attached) and have them place them on the map (where the Velcro is attached). Feel free to discuss the ocean habitats of each animal and why some prefer warmer environments than others.

1. Consider the temperatures of the oceans and the equator. The size of the animals and their locations can depend upon the temperatures they're used to. What might happen to these animals if the temperatures keep rising?

## Modifications and Guiding Questions

Guiding questions for mapping your organisms on the world map are necessary. Many animals can be placed in multiple spots. A suggestion could be to label the plots on the maps where velcro is placed and select two animals whose locations would be obvious and pre-select two possible spots and make participants choose which animal goes in a spot.

For example: Take the baleen whale and the shark (or dolphin and walrus) and tell participants that one of them goes next to Florida while the other goes next to Russia. Talk through the cold water of Russia versus the warm water near Florida and how that leads to the size difference between the two animals.
This example hints at Bergmann's and Allen's Rules which are as follows:

1. **Bergmann's Rule**: body size is large in cold climates and small in warm climates. Large bodies have a smaller surface area to volume ratios.
2. **Allen's Rule**: body form or shape is linear in warm climates and more rounded and compact in cold climates. Round forms have a smaller surface area to volume ratios.

## Further Resources

Global Warming Impact on Coral Reefs
https://oceanservice.noaa.gov/facts/coralreef-climate.html

Youtube Video
https://www.youtube.com/watch?v=mQ10xBl8XMQ

Nutrient (nitrogen) cycle
https://www.youtube.com/watch?v=b4rppYVkQFk

(Figure 8.24)
https://www.siyavula.com/read/science/grade-10-lifesciences/biosphere-to-ecosystems/08-biosphere-to-ecosystems-07

Keystone species
https://www.nationalgeographic.org/encyclopedia/keystone-species/


Yellowstone National Park Wolf Introduction Project
https://www.yellowstonepark.com/things-to-do/wolf-reintroduction-changes-ecosystem

Youtube Video
https://www.youtube.com/watch?v=JGcIp4YEKrc

Bermann's and Allan's Rules as it applies to humans
https://www.unl.edu/rhames/courses/ppoint/heat-110.pdf


Walrus
Turtle
Dolphin
Sea Star s
Seal
Orca


Octopus
Shark
Baleen Whale
Seahorse
Penguin
The World
HEMISPHERES

## NGSS Standards

### 3-LS4-2 Biological Evolution: Unity and Diversity

Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

### 3-LS2-1 Ecosystems: Interactions, Energy, and Dynamics

Construct an argument that some animals form groups that help members survive.

### 3-LS4-3 Biological Evolution: Unity and Diversity

Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

### MS-ESS3-5 Earth and Human Activity

Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.