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# K-12 Partnership Lesson Plan

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# *The Good, the Bad and the Ugly*

# *Species Interactions*

## Overview

Interactions are a way of life. All organisms interact with many other organisms on a daily basis. Some of these interactions are positive, benefitting all organisms involved. Some of these interactions are negative, which may cause harm. Plants, animals and all other living things interact, and these many interactions are readily observable in our own backyards. In this activity we will explore these interactions and predict how they will help or harm species when their environment changes (biotic or abiotic changes).

**Objectives**

At the conclusion of the lesson, students will be able to:

* Identify interactions between different species (observation)
* Name and describe the different types of species interactions
* Recognize that species may develop more than one relationship
* Predict the impact of environmental changes (biotic or abiotic) on the relationship or individual organism

**Length of Lesson**

This lesson would take two 50 minute class periods.

Day One: Make observations and gain background information

Day Two: Play interaction game and do graphing activity

Optional experiment:

3-4 weeks prep time to allow plants to grow

20-30 min to set up experiment

1 class period 2-3 days later to record data and complete graphing activity (this can be incorporated into Day Two above)

**Grade Levels**

All Grade Levels (emphasis on upper elementary and middle school)

**Standards covered (NGSS)**

Disciplinary Core Ideas:

 *Elementary School*

* **3-LS4-3**: 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

*Middle School*

* **MS-LS2-4:** construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations
* **MS-LS2-2**: construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems
* **MS-LS1-5**: construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth or organisms

Cross Cutting Concepts:

* Patterns
* Systems and system models

Science and Engineering Practices

* Planning and carrying out investigations
* Analyzing and interpreting data
* Engaging in argument from evidence

***Previous Michigan Standards Met:***

* **S.IP.04.11**: make purposeful observation of the natural world using the appropriate sense
* **S**.**IP.04.12**: generate questions based on observations
* **L**.**EC.04.11**: identify organisms as part of a food chain or food web
* **L.**EC**.06.21** : describe common patterns of relationships between and among populations (competition, parasitism, symbiosis, predator/prey)
* **L.EC.06.22**: explain how two populations of organisms can be mutually beneficial and how that can lead to interdependency
* **L**.**EC.06.23**: predict how changes in one population might affect other populations based upon the relationships in the food web

**Materials**

* Clipboards and paper for observations done outside
* Powerpoint on species interactions
* Game scenario cards (one set for each of 4 groups)
* Sunflower seeds or small object to represent seeds (you may substitute a different type of seed, but you will want them to be larger, ex. corn). 40 per group
* Handouts (game worksheet, graphing activity handout, if doing plant experiment)
* Experiment supplies
	+ Pea/bean seeds
	+ Rhizobia inoculant (can purchase online or contact KBS)
	+ Pots
	+ Fish tank/large plastic bin
	+ Light mesh material
	+ Soil
	+ Slugs

**Background**

There are five main types of species interactions. These interactions may impact individual organisms in a positive or a negative way. The five types of interaction are:

1. Predator/Prey

This type of interaction exists when one species is the food source for another. An example of this type of interaction is a fox and a rabbit. The fox relies on the rabbit as a source of food.

1. Competition

This type of interactions exists when different species compete for the same resources. Most plants compete for the same resources.

1. Mutualism

This is an interaction where both species benefit. An example of mutualism is a bee pollenating a flower. The bee receives food and the flower is able to reproduce. This is considered a relationship where both win.

1. Parasitism

In this type of interaction, one organism will benefit at the expense of another organism. Mosquitos are a familiar parasite.

1. Commensalism

In this type of relationship, one species benefits but the other species is neither harmed nor helped. An example of commensalism is the relationship between a clown fish and an anemone. The fish is provided with a safe home protected by the anemone’s stinging tentacle. The anemone is not hurt by the clownfish but it does not receive a benefit either.

### Activities of the session

1. The class will go outside to observe/record species interaction
	1. Have students go out to a patch of plants in the schoolyard and write down all the interactions they observe. Encourage students to observe not just plants, but any insects, animals or soil organisms they can find.
2. Share and discuss observations
	1. As students share the interactions they observe, ask them to try and classify them—are interactions positive, negative, or neutral?
3. Learn about species interactions with a PowerPoint presentation
	1. The PowerPoint provides examples of many different kinds of interactions, from basic plant-pollinator interactions that we can observe in our backyards, to species interactions in African savannas and tropical forests.
4. Observe a potted plant that has multiple relationships (brainstorm the relationships specific to this plant)
	1. For this activity, we use partridge pea (*Chamaecrista fasciculata*), which has mutualistic relationships with both rhizobia bacteria and ants. However, any legume species (such as peas, beans, or clover) would be suitable for this activity.
5. Observe rhizobia nodules (each group will take a plant and look at the roots to find the nodules)
	1. Most common legume species form mutualisms with rhizobia bacteria (the plant gives bacteria carbon, and the bacteria give the plant nitrogen). Rhizobia form small nodules on plant roots that are observable with the naked eye. The teacher can bring in examples of legumes with root nodules for the students to observe (many common weedy legume species have rhizobia and can be dug up). This gives students an opportunity to see a tangible example of an interaction that is not normally observed. The teacher can also give additional information on plant nutrition, the nitrogen cycle, or soil processes if desired.
6. Play a game to illustrate the impact of the environment (biotic and abiotic) on plants that interact with other species.
	1. Divide class into 4 groups. Give each group 40 seeds, a set of scenario cards, and the game worksheet.
	2. Divide the seeds into 4 separate groups (10 per group) and label them: “Ants and Rhizobia”, “No Ants and Rhizobia”, “Ants and No Rhizobia”, “No Ants and No Rhizobia”.
	3. Divide the scenario cards into “Insects”, “Animals”, “Weather & Environment”, “Other Plants”. Shuffle within each stack and place face down.
	4. To play the game, draw a card from each stack, one at a time. Follow the instructions on the card and record the results on the game worksheet.
	5. Continue until all but one of the seed categories is eliminated. On the worksheet make sure to record the order that each category was eliminated.
	6. Repeat game 3 more times. Alternatively, record the data from the other groups in the class.
	7. Answer reflection questions on the student worksheet
7. Plant-rhizobia-herbivore experiment. This experiment allows students to manipulate species interactions and observe the outcome. Students will address the question: do herbivores prefer plants with rhizobia or without rhizobia?
	1. 3-4 weeks prior to conducting experiment, plant legume seeds (garden peas or beans are ideal). Plant seeds in 10 pots, one seed per pot. After seeds have germinated, inoculate 5 of the pots with rhizobia bacteria (commercially available for purchase online). Let the plants establish under a grow-light or on a window sill.
	2. To conduct the experiment, place all plants in a large empty fish tank or plastic bin (it needs to be deep enough that the plants aren’t taller than the sides). Crowd the pots so that they’re touching. Place two herbivores on the soil surface of each pot (slugs collected from a garden or flower bed would be ideal, but caterpillars would work too). Cover the fish tank/plastic bin with light mesh material so that herbivores can’t escape.
	3. After 2 or 3 days, take the plants out of the bin and have students estimate the percent herbivore damage to each leaf, and record their data.
8. Graphing activity
	1. Using the provided handout, have students analyze and graph the data from the experiment.

**Resources**

* Link to commercially-available rhizobia bacteria:

[http://www.amazon.com/Garden-Accessory-D9359-Davids-Seeds/dp/B003CZDBW4/ref=sr\_1\_1?ie=UTF8&qid=1405091813&sr=8-1&keywords=rhizobia](http://www.amazon.com/Garden-Accessory-D9359-Davids-Seeds/dp/B003CZDBW4/ref%3Dsr_1_1?ie=UTF8&qid=1405091813&sr=8-1&keywords=rhizobia)

**Extensions and Modifications**

The graphing activity in this lesson could be made more challenging for middle and high school students by requiring students to make/analyze graphs in a computer graphing program such as Excel.

**Assessment**

 Students’ written explanations from the game can be assessed.

 Students’ graphing activities can be assessed.