

BASIS Lesson Plan

Lesson Name: Do Your Neighbors Make You Crabby?
(Invertebrate Behavioral Responses to Climate Change Stressors)

Grade Level Connection(s)

NGSS Standards: Grade 3, Life Science (3-LS2)

FOSS CA Edition: Grade 3, Life Science (Structures of Life)

**Note to teachers: Detailed standards connections can be found at the end of this lesson plan.*

Teaser/Overview

Did you know that there are lots of creatures under the rocks at the beach? They must have to be really good friends to live so close together! In this hands-on lesson, we'll learn about what happens when some organisms are forced to move in with their neighbors!

Lesson Objectives

- Students will learn about how climate change indirectly affects invertebrate behavior
- Students will participate in a group activity collecting data representative of real experiments happening in cutting-edge science using real field techniques
- Students will learn to interpret their data with bar and line graphs and compare them to existing knowledge

Vocabulary Words

- **Climate change:** Climate describes weather over a long period of time and right now Earth's climate is warming up faster than it ever has before
- **Stress:** The body's method of reacting to a challenge
- **Direct effect:** How temperature affects the body directly
- **Indirect effect:** How direct effects change the way animals interact
- **Intertidal:** The place where the waves meet the beach
- **Interaction:** The effect that animals have on each other
- **Temperature gradient:** Temperature changes based on sun, shade, water, and wind



Materials

Scientist Volunteers will bring:

Disposable cups (12)
Large aluminum trays (12)
Marbles (two colors, 22 of each color)
Bouncy balls (two colors, 22 of each color)
Datasheets (see below, one for each student)

Materials teachers should provide:

Students should have pencils ready

Classroom Set-Up

The class should be split into two groups, but within these groups the students will be working in pairs. If they can be paired up before our arrival, that would be ideal. We would like access to the chalkboard/whiteboard to record data. Desk space is needed for materials set-up, but normal orientation of desks in groups of 3-4 will work well.

Classroom Visit

1. Introduction (15 minutes)

Role Model Introduction:

Being a role model for students is an important part of being a BASIS volunteer. Begin your lesson by introducing yourselves! Every team member should take a moment to explain who they are and what they study/do as a scientist. A bonus will be to tell your “story,” as if giving an elevator pitch to 8-year-olds: Why did you become a scientist? What made you interested in your topic? Why should students relate to you, or be interested in you? And remember, you can also weave your story throughout your lesson through examples from your own life, and/or return to it with Q&A at the end.

Topic Introduction:

After you introduce yourselves as role models, take some time to introduce the topic of this lesson: *indirect effects of climate change*. It may be helpful to keep the suggested take-away in the back of your mind throughout the lesson: **temperature changes can affect animal behavior directly and indirectly.**

Your topic introduction should follow the outline below. As much as possible, try to frame this information as questions posed to the class, rather than as a lecture. This helps activate students' prior knowledge and facilitate student-guided conversation.

- Today we are going to talk about the direct and indirect effects of temperature change for animals.
- When you're sitting in a room and it gets too cold, what's something you can do to make yourself warm again? (put on a sweater, turn on the heat, do some jumping jacks) What about when you're too cold? (take off a sweater, drink something cold, etc.)
- Unlike us, animals and plants in their natural environments can't do these things and the environments on our planet are starting to get warmer and warmer due to climate change.
- Lots of scientists are interested in the **direct effects** of **climate change**. [Define, write on board] How does the body change on the inside to deal with stressful conditions, such as it being too hot outside. [Define **stress**, write on the board]
- But today, we're going to talk about something that scientists are only now beginning to investigate: indirect effects of climate change.
- Let's simulate an indirect effect in the classroom here today. We're going to play a simple game. This desk group is the ideal place in our classroom habitat because it's closest to the window. When I say the magic word "crabby", then I want everyone to try and be in this part of the habitat. To be "in" the habitat, you must have one hand touching the desk. You cannot stand or sit on the desk. Ready? "Crabby!"
- Have students move to one desk or small cluster of desks. How did that work? Is everyone in the habitat? Is it comfortable to have everyone at that one desk? Why not?
- The Stillman lab is looking at how this problem is showing up in tiny crabs under rocks at the beach. These crabs get hot and they try to find shade under rocks. But even if a crab finds a rock, that rock usually has lots of other crabs under it too. This leads to other problems between individual crabs. These problems are called **indirect effects**. [Define, write on board]
- Scientists are studying the indirect effects and interactions between big crabs and small crabs, between male crabs and female crabs, and between different types of crabs. They also study where these crabs move in their habitats based on temperature stress. Did you know that there are lots of different habitats on a single beach? We call this an **environmental gradient**. [Define environmental gradient, write on the board] Understanding these interactions helps us to understand how climate change will continue to impact all different types of animals around the world.
- Today we are going to do our own investigation of crabs in the water to see if we can find patterns in how they behave and react to climate change.

Teaching Tip: Say, Write, Show

- Bring in photos and props to illustrate the topic intro
- Write new vocabulary words, key terms, and brainstorm lists on the board
- Refer back to the board to engage visual learners and English Language Learners

2. Learning Experience (35 minutes)

Students will work in table groups of 3 (some groups of 4 will also work). Remember that the activity is designed to address the take-away in a particular way: **temperature changes can affect animal behavior directly and indirectly.**

Activity 1: Capture the Crabs!

- Before passing out materials, explain what each part of the model represents in today's activity.
- Numbered cups will be filled with two sizes and two colors of balls (2 colors of marbles; 2 colors of bouncy balls). These represent large and small animals and the different colors represent the males and females for each.
- The class will simultaneously be running two different experiments. One will be looking at pill bugs (on land) and the other at crabs (in the sea).
- Each cup will be placed upside down in a large aluminum tray. Each student group will start with one cup and lift it up quickly. The goal is to collect as many of the marbles and bouncy balls as possible before they reach the edge of the tray. If they reach the edge of the tray, they have 'escaped' and cannot count in your number collected. You will have one minute to collect.
- Pass out data sheets.
- Guide students in formulating their hypothesis.
- Pass out role cards. The role card tells which student will be the collector the first round.
- Pass out materials. Ready, set, go! Everybody quickly lifts up their cups and have 1 minute to collect.
- Now take your collected balls and count up how many small, large, and different colors you have. Record these numbers on the data sheet. Make sure to also record the cup number! This is very important!
- Collect all supplies except the data sheet. Draw graph on the board. Pool all data collected after the round, separated by the groups (large, small, female, male). Discuss how to make bar and line graphs to show these data.
- Repeat this activity with a different cup each time with each student in the group – ideally three rotations.
- After three rounds, use a subset of the pooled data to demonstrate some of the patterns found in the data. Ask students what they notice. What are the patterns? Make two graphs. One for the cool and one for the warm temperatures (based on cup number) and the x-axis will have all of the categories of male, female, big, small.

Activity 2: Compare to field collected data

- Show students "real" data and discuss how field methods can often be inaccurate, which is why it is important for us to get lots of practice!
- Reiterate why we did the experiment and what questions we were trying to figure out.

- Discuss data patterns with students again.

3. Wrap Up: Review and Discuss the Learning Experience (5 minutes)

It's important to leave time to review and discuss the learning experiences at the end of the lesson. This might take the form of a review of the take-away of the lesson:

- What are behavioral interactions? What did you find out about the crabs? What about the pill bugs?
- Did temperature have an effect? What is a temperature gradient? (We found from our data that more animals will group together where it's cooler, especially females that are carrying babies inside of them.)
- What does this mean for animals when the temperature outside gets warmer? (we're all going to try and live under the same rocks that aren't hot!)
- Because of this, what do you think we might see in the future? (some animals fighting over who gets to be in a cooler place)
- Why would that be a bad thing?

4. Connections & Close (5 minutes)

Connections to the real world around students:

- Invite students to think about examples of climate change and indirect effects that might be happening around them: e.g. some of the food we like may be harder to grow or find; animals at the zoo may be more rare in the wild, humans may experience crowded interactions, just like the crabs!
- Invite students to offer other questions they have that they might want to investigate in the future, to better understand how climate change is affecting animals
- Encourage students to explore nature and learn more by participating in a citizen science project. Just make sure to put everything back where you found it!

Close:

Wrap up as a role model by leaving a few minutes for students to ask questions about science, about being a scientist, and about becoming a scientist. Then, thanks and goodbye!



Follow Up: After the Presentation

Teachers who wish to extend the impact of this lesson may find the following CRS web pages useful:

- <http://www.crscience.org/educators/helpfulreports>
- <http://www.crscience.org/educators/treasuretrove>

Standards Connections

NGSS:

- Connections by topic
 - Life Science: 3. Interdependent Relationships in Ecosystems
- Connections by disciplinary core ideas
 - Life Science: 3-LS2. Ecosystems: Interactions, Energy and Dynamics
- Connections by scientific & engineering practices
 - 2. Developing and using models
 - 4. Analyzing and interpreting data
 - 5. Using mathematics and computational thinking
- Connections by crosscutting concepts
 - 2. Cause and effect: mechanism and explanation
 - 7. Stability and change
- Connections by performance expectation
 - 3-LS2-1. Construct an argument that some animals form groups that help members survive
 - 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