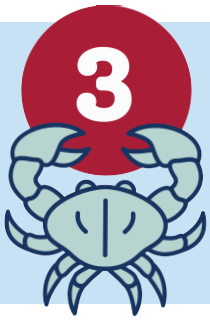
Activity 3: How Do Invasive Crabs Differ from Native Crabs?

Topic: Youth observe crab movements at different water temperatures and use elements of the scientific method to make predictions, collect data and draw conclusions.

Time: This activity should take approximately 45-60 minutes to complete. This activity may be 90 minutes or more if all parts of this activity are completed.



Materials

- Rulers
- White boards
- Dry erase markers
- Erasers
- Life size crab images
- Stopwatches
- Activity 3 data sheet
- Computer/projector/internet (to view the videos)

Learning Outcomes

At the end of this activity, youth should be able to…

1. Name ways invasive crab species differ from native crab species.
2. Explain how changing temperatures affects crab behavior differently for different species.

Background Information

In this activity youth will explore crab species differences. This activity has youth collect data from videos of crabs on a specialized treadmill and crabs flipping upright after being placed on their backs. The experiment is to determine differences after the crabs are exposed to different temperatures of water.

The native Jonah crab differs from invasive crabs (green crabs and Asian shore crabs). A visual difference is their size and color. The Jonah crab is much larger and a different color from the invasive species. This is not the only difference, the crabs react differently to different water temperatures. The invasive crabs are more thermally tolerant; they can live in higher and lower water temperatures. This characteristic makes the crabs a successful invasive species because they can survive in many different habitats. In comparison, the native crabs are less thermally tolerant, meaning they can't survive in extreme temperatures. Because of this, Asian shore crabs could outcompete native crabs as ocean temperatures rise.

Vocabulary

- **Ambient:** the natural temperature of an environment
- **Carapace:** the protective back covering of an animal, like a crab
- **Conclusion:** making meaning of data
- **Data:** information collected from observations
- **Hypothesis:** a testable explanation based on evidence
- **Invertebrate:** animals that do not have a backbone
- **Observation:** watching what happens
- **Prediction:** what you think will happen

Methods

Engage

1. Lead a discussion to review what youth have learned about crabs in Maine. Sample questions: "What did we learn about crabs last time?" "What types of crabs are there on the coast of Maine?" "How did those crabs get here?"
2. Ask youth if they think there are any differences between the native crab species living in Maine and new species that have traveled here. At this point you are planting the seed of differences between native and invasive species. Any answers are acceptable, but they should be able to explain their thinking.
3. Break the youth into groups of three or four and pass out the crab images. Ask the youth to inspect them. Have groups discuss what they notice as differences. Differences could be anything from the shape of the shell to the color of the crab.
4. Pass out rulers to each group and encourage groups to utilize their rulers to compare sizes with actual values. They will be able to notice how much the Asian shore crab and Jonah crab differ in size
5. Bring the group together to share what they observed. Ask the group if they think the crabs differ in ways that we cannot see. What might some of those ways be?

Explore

1. Explain that they are going to watch videos of the different crabs. They will be scientists investigating differences in the crab species! Example script: "Today we are going to be scientists making observations. We are going to watch videos of the crab species either walking on a specialized crab treadmill or flipping over after being placed on their backs. These crabs were collected off the coast of Maine and these videos were made by a scientist named Emily who works with these crabs everyday."
2. In this first video the scientist, Emily, introduces the three crabs: Asian shore crabs, green crabs, and the native Jonah Crab. Emily explains the equipment/activity. These crabs will be walking on a treadmill and flipping over at three different water temperatures. The first will be ambient, or the typical ocean temperature, then both warmer and cold water temperatures. The goal for these experiments is to determine which crab species reacts the best at each temperature, or which crab can move the fastest.

3. Play the introduction video: Introduction: Invasive Crabs Versus Native Crab (YouTube: https://youtu.be/dCWpjoE2SzU?si=NLzcdHZWB-59QLWQ).

If time permits you may do both of the following activities. If you are limited by time, we recommend the "Crab Walking" activity for older (5th and 6th grade) youth, and the "Crab Flipping" activity for younger students.

A. Explore: Crab Walking

1. Hand out white boards, markers, erasers, datasheets and pencils. Add to the explanation to prepare the youth. Example script: "In this video you will see crabs on a treadmill. The goal is to count how many steps the crab takes in a 30 second period. Pick one leg to focus on (make sure it is a leg and not a claw!) and count how many times that leg moves in a 30 second period. The video will show two different views, front and top for 30 seconds each so you will see each crab on the treadmill for one minute. You only need to count for 30 seconds so you can pick if it is easier for you to count from the front view or the top view."
2. Before watching the video explain that scientists make a hypothesis, which is what they think will happen in an experiment. Based on what we have learned so far, have youth write a hypothesis. An example of this could be "The Jonah crab will take fewer steps than the others at all temperatures." or "The invasive crabs will move faster than the Jonah crab in warmer water." Have youth make predictions: which crab do they think will move fastest or take the most steps? Which will be slowest or take the fewest steps? Do they think this will change at different temperatures? How?
3. The whiteboards or back of their data sheet can be used to make tally marks for each movement. You will show the video clip and have the youth make their tally marks. Then pause the video and give the youth time to count all of their marks and come up with a final number.
4. This activity can be challenging for some youth, make sure to let them know that this is HARD and it is okay if counts differ from person to person. The count will change based on which leg is chosen to focus on and if they are counting the front view or top view.
5. The videos show the three species of crabs completing the task at one temperature and then the next temperature. You may need to pause the video periodically to give youth a chance to write down their counts and remind them which crab and temperature they are counting.
6. Start the Crab Walking Video. After the youth have seen the three crabs at the ambient temperature pause at 5:27 so the data (number of leg movements) can be counted and collected. Collect all the data and calculate a group average for each crab at ambient temperature. Youth should record the average on their data sheets. As a group identify which crab took the most steps? Which one took the fewest steps? Which one moved the fastest? Which crab was hardest to count the steps? Why do they think it was hard to count?
    a. Play the video: Invasive Crabs Versus Native Crab: A. Crab Walking (Youtube: youtu.be/n-SWmNWkuF8?si=DMliULRwelj_HF0B)

A. Explain: Crab Walking

1. Continue watching the video and collecting data for the warm temperature (starts at 5:27) and the cold temperature (starts at 10:00). Pause the video as needed to compile data and collect numbers from youth. At the end of the treadmill videos you should have 9 average numbers of steps (3 species at 3 different temperatures).
2. Ask the youth to think about how the different temperatures affected each of the crabs. Sample questions: "Which crab moved the best in the cold water? What about the warm water?" "What was the fastest moving crab overall?" "Can you make any connections about why this is important?" "What do you think our observations mean for the crabs' ability to survive in the wild?" "What impact could ocean temperature have for our crabs on evading predators or competing for food?"

B. Explore: Crab Flipping

1. Pass out stopwatches and show the youth how they work. Have them practice timing something simple by saying "go", waiting several seconds, then saying "stop".
2. Put youth in groups of 3. Each group member is responsible for timing a different crab species
3. Before you begin the data collection explain that scientists make predictions called a hypothesis before they begin an experiment. Based on what we have learned so far, youth predict which crab they think will flip back upright slowest, and which will flip the fastest. Do they think this will change at different temperatures, and if so, how?
4. Start the Crab Flipping Video
    a. Play the video: Invasive Crabs Versus Native Crabs: B. Crab Flipping (YouTube: youtu.be/WxvNnzUPsIo?si=AuDfPqwNyGNLittF).

B. Explain: Crab Flipping

1. Discuss what they observed. Sample questions: "Which crab species was able to right itself the fastest at each temperature?" Which ones were the slowest?" "Does the temperature affect each crab species in the same way?" "How might a crab in the wild end up on its back?"
2. Connect the flipping experiment with nature: "What does the ability to flip over mean for an animal?" "Do you think crabs, or any animals, are more likely to get hurt on their back or on their stomach?" "Can crabs run away when they are on their back?" They need to flip over first! Relate this back to getting away from predators if youth don't make the connection on their own.

Elaborate

1. If you completed both parts of this activity ask: "Do you think it was easier to make a prediction about what would happen to the crabs ability to flip at different temperatures because we had done the treadmill experiment first? Why?"
2. Reflect on their predictions. Example questions: "Were the predictions we made before each experiment correct?" "What evidence do you have of this?" "Are scientists' predictions always correct?" No! Sometimes scientists are surprised by their data! They use the evidence they collect to form conclusions and come up with new questions and design new experiments to find answers.

3. Explain that after scientists collect their data they look for patterns and form conclusions about what it means. Example questions: "Do you notice any patterns in the data we collected today?" "Look at the data you collected, was the same crab always the fastest or slowest?" "Did the different crabs react to the changing temperatures the same way?" "What conclusions can you infer from what you observed?"

Evaluate/Reflect

1. Apply what they have learned to the Maine coast. Example questions to get the conversation started:

- **a.** The invasive species (green crab or Asian shore crab) moves and flips over faster in warmer water. What does that mean for Maine? Keep in mind that researchers tell us that the ocean temperature in Maine is rising.
- **b**. Which crabs do you think are the better predators or have an advantage to finding prey in the wild?
- **c.** Which crabs do you think have an advantage for survival and/or population growth? Why? What evidence did you see today to support your thinking? Think about if movement or another attribute gives a species an advantage. For example the small, fast Asian shore crab may be better able to hide from predators. The hard shells and lack of meat may make green crabs less likely to be eaten by a seagull. If individual crabs are able to better survive they have a better chance at reproducing and growing their population.
- **d.** Think about what you have learned about ecosystems and food webs. What could it mean to the food web if the invasive crabs have an advantage both as predators and in population growth? What evidence did you collect today to support your thinking?

NGSS alignment

5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics: www.nextgenscience.org/pe/5-ls2-1-ecosystems-interactions-energy-and-dynamics