3.1.2 Intraspecies Competition

Overview

When you think of a natural threat to an organism in its normal environment, you often think of other predatory species that live in the same area. But what about other members of the same species? Members of the same species often display social behavior that is threatening, such as fighting. Similar organisms fight among themselves when they are competing for limited resources, including food, shelter, and mates. Biologists refer to competition among members of the same species as **intraspecies competition**. You can observe intraspecies competition, specifically displays of threats, submission, or aggression, in the controlled environment of a science laboratory. We can easily obtain and observe Crayfish, *Procambarus clarkii*, which display this competition.

Learning Objectives

- Competition for resources in a biome can occur between members of the same population.
- When the most successful organisms are able to reproduce, passing on the traits that helped them survive, their reproductive success changes a population, fine-tuning it to suit its environment.

Student Activity: Intraspecies Competition

Materials

For each team of 5-6 students:

2 crayfish of approximately the same size (for comparison later in the activity, some teams should have M/F pairs and some teams should have single sex pairs M/M or F/F)
1 tank filled with a bottom layer of gravel and de-chlorinated water at a depth of 20 cm
1 plastic divider the width of the tank (cut from a flexible plastic 3-ring binder)
1 watch with a second hand or a phone with a timer
2 copies of record sheet

For the class:

1 10-gallon aquarium
De-chlorinated, room-temperature water
Stones, hollow log, PVC pipe and other hiding places for crayfish (more places than total number of crayfish)
Crayfish food

Advance Preparation

Learn how to care for live animals in the classroom. Require ethical behavior from all members of your team. The National Science Teachers Association recommends the following for teachers and students when they are using live animals in science investigations:

- Educate yourself about the safe and responsible use of animals in the classroom. Seek information from reputable sources and familiarize yourself with laws and regulations in your state.
- Become knowledgeable about the acquisition and care of animals appropriate to the species under study so that both you and the animals stay safe and healthy during all activities.
- Follow local, state, and national laws, policies, and regulations when live organisms, particularly native species, are included in the classroom.
- Integrate live animals into the science program based on sound curriculum and pedagogical decisions.
- Develop activities that promote observation and comparison skills that instill an appreciation for the value of life and the importance of caring for animals responsibly.
- Observe safety precautions for handling live organisms and establish a plan for addressing such issues as allergies and fear of animals.
- Develop and implement a plan for future care or disposition of animals at the conclusion of the study as well as during school breaks and summer vacations.
- Espouse the importance of not conducting experimental procedures on animals if such procedures are likely to cause pain, induce nutritional deficiencies, or expose animals to parasites, hazardous/toxic chemicals, or radiation.
- Shelter animals when the classroom is being cleaned with chemical cleaners, sprayed with pesticides, and during other times when potentially harmful chemicals are being used.
- Refrain from releasing animals into a non-indigenous environment.

Prepare a 10-gallon aquarium with de-chlorinated, room-temperature water to hold the crayfish until it is time to do the investigation. Add materials to make hiding places. Obtain the crayfish and allow them to acclimate to the tank according to directions from your supplier. Once in the tank, allow time to observe the crayfish all together. During this time, provide food and shelter for the crayfish according to information you received when you purchased them.

Make two copies of the following record sheet for use during the investigation:

Crayfish Observations

Crayfish A or B (circle one) Male or Female (circle one) M/M M/F F/F (circle one)

Start	X	X	X	X	X	X	X	X	X
10									
20									
30									
40									
50									
1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00

Process and Procedures

1. Prepare your team's observation tank with gravel and de-chlorinated, room-temperature water. If you are starting with regular tap water, fill the tank and allow it to sit overnight to get rid of the chlorine and warm to room temperature.

2. Meet as a team and assign roles for the investigation. One student will be the timer and call out every 10 seconds for 10 minutes (or more). Two students will each watch one of the crayfish and call out a "plus" for aggressive behavior and a "minus" for submissive behavior within each 10-second interval. Two more students will record the behaviors as a "+" or "-" on the record sheets. If there are any more students in the team, they will help the observers and recorders.

3. When you are ready to begin the investigation, temporarily place the plastic sheet width-wise in the tank to separate the two ends of the tank.

4. Select two crayfish from the classroom tank. Make sure that there are teams that have two males, teams that have two females, and teams that have a male and a female. Holding each crayfish carefully by its carapace, put them into the observation tank, one on each end of the tank.

5. Get the timer ready and then remove the plastic barrier. Record a "0" at the start and a "0" for every 10 seconds during which the crayfish do not interact. Once they begin to move, observers should call out "plus" or "minus" for each 10-second interval depending on whether the crayfish they are watching attacked or retreated. Continue to call out intervals and interactions for 10 minutes. If the interaction appears that it will injure one of the crayfish (in some cases one crayfish might use its claws to grab and tear an appendage), separate the crayfish, let them rest for a minute or two with the barrier back in place. You can then remove the barrier and resume your test. If there are fewer than five interactions between the crayfish at the end of 10 minutes, consider extending the observations for several more minutes.

6. Separate the crayfish and return them to the classroom tank. Clean up your lab area according to directions from your teacher.

7. Meet as a class to share data. Have each team make a report on what they observed. Be sure to analyze the data quantitatively by comparing the number of "plus" and "minus" entries. Continue the discussion by answering the following questions as a class:

- How would you describe the interactions of the crayfish? Did you see any wrestling (no claws) or use of claws to grab an appendage? When did a crayfish retreat? Could both crayfish be aggressive at the same time?
- Was there a difference among interactions that was dependent on the gender of the crayfish? Were F/F interactions different from M/M or M/F?
- How does agnostic behavior (social behavior related to fighting) affect the distribution of resources in a population? How would the outcome of this behavior shape a population in the long term?
- The interactions you observed were **intra**species interactions because the species were the same. Do you think the same thing can happen between different species of crayfish? What factors might influence the outcome of **inter**species competition?

Assessment

Some science teachers have been criticized for disposing of live organisms in ways that hurt the environment. Those teachers who merely release organisms into their local environment once their classroom studies are complete do not display a good understanding of many of the biological principles that they teach. What might be wrong with releasing Louisiana crayfish into a Seattle waterway, for example?

Write a letter to the editor of a fictional local newspaper explaining to these misguided science teachers why their practices often are not good for their local ecosystems. You can use the Internet to conduct research on some specific cases (many using crayfish!) to strengthen your argument.

Expected Outcomes

What's the take-away?

Resources for survival are finite. Competition for resources exists between species (*interspecies competition*) and among members of the same species (*intraspecies competition*). Physical and behavioral traits enable species to compete with other species, as well as members of their own species, for the resources needed for survival.

What does the student work product look like?

Teamwork and careful observations are key for the success of this activity. Students will work in their groups to collaboratively organize the data that is collected during their observations of the crayfish interactions into a table. Be sure all members of the group are in agreement as to what constitutes "aggressive" and "submissive" behavior.

Assessment

Look for individual student responses to use information learned during the activity and combine it with additional internet research to explain why releasing foreign species into a local environment can be harmful. Look for explanations to include specific evidence and describe cases where harm was done. For example, crayfish that have been released into local communities have successfully fed on the eggs and larvae, as well as the adult form of many fish and invertebrates, resulting in a decrease in their populations.