INQUIRY & INVESTIGATION

Do You See What I See? Using Ethograms to Observe Animal Behavior

MARY CARLA CURRAN, AMBER SILER, MICHELE B. SHERMAN

ABSTRACT

The process of exploration and the methods that scientists use to conduct research are fundamental to science education. In this activity, authentic scientific practices are used to develop hypotheses to explain the natural world. Students observe grass shrimp in aquaria and construct an ethogram, which is a compilation of the observable behaviors an animal exhibits. They then conduct an experiment, just as real scientists would, to determine how changes in the environment alter shrimp behavior. This activity is designed for a fourth-grade science class and allows students to experience the excitement of observing a live organism while learning about scientific inquiry, and also reinforces quantification and graphing skills. "Do You See What I See" covers Next Generation Science Standards and addresses the science and engineering practices of engaging in argument from evidence.

Key Words: *Animal behavior; ethograms; graphing; inquiry; science education; NGSS.*

○ Introduction

Teachers and education leaders are becoming more aware that the process of exploration and the methods that scientists use to conduct research are fundamental to science education, as indicated by the *Next Generation Science Standards* (NGSS Lead States, 2013). These new standards focus less on following a set scientific process and more on using the knowledge and skills that scientists use to investigate and explain scientific phenomena. Scientists employ many of the same tools in their research that teachers utilize in the classroom: models, charts, and graphs. One particular tool that can easily be implemented in life science units is an ethogram, which is a compilation of the observable behaviors an animal exhibits. The frequency of these behaviors can be recorded and displayed in graphs.

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Ethograms have been used by scientists to study a wide variety of organisms: mammals, fishes, amphibians, reptiles, birds, and even protists (see Torr & Shine, 1994; Ricci et al., 1999; Scheer et al., 2004; Gokula, 2011; Cavraro et al., 2013; Cikanek et al., 2014). The resulting information can be used for conservation, because ethograms can provide scientists with information on how animals normally behave and how changes in the environment can affect their behavior. Ethograms can fit easily into any observational investigation that students perform in the classroom and are a connection to real-world scientific practices. Several examples of educational ethograms can be found on EthoSearch (http://www.ethosearch.org). In the present activity, students construct their own ethogram, conduct systematic observations of grass shrimp, and perform an experiment to determine how changes in the environment alter shrimp behavior. Then, they model shrimp behavior by creating bar graphs that depict how frequently each behavior was exhibited. This activity is designed for a fourth-grade science class and addresses *Next Generation Science Standards* (Figure 1).

Background: Grass Shrimp

Grass shrimp are decapod crustaceans that are abundant in estuaries along the East Coast of the United States and in the Gulf of Mexico (Morgan, 1980). They can be collected from marshes using dip nets or can be found at some major chain pet stores or bait shops. Grass shrimp are easy to collect, handle, and maintain (Kunz et al., 2006) and have been used in many scientific studies (Welsh, 1975; Pung et al., 2002; Chaplin-Ebanks & Curran, 2007; Williamson et al., 2009; Partridge, 2010; Sherman & Curran, 2013, 2015; Garcia et al., 2014; Brinton & Curran, 2015a). For example, Kunz et al. (2006) examined how the behavior of the daggerblade grass shrimp (*Palaemonetes pugio*) was affected by the presence of a fish predator. In other studies, grass

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Next Generation Science Standards **(NGSS Lead States, 2013)**

4-LS1: From Molecules to Organisms: Structures and Processes (p. 33)

Performance Expectation: 4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Activity Objectives	Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Conduct systematic observations of grass shrimp • Model shrimp behavior by creating bar graphs • Utilize bar graphs to form an argument	• Engaging in argument from evidence • Construct an argument with evidence, data, and/or a model (4-LS1-1)	• LS1.D: Information Processing	• Systems and system models • A system can be described in terms of its components and their interactions (4-LS1-1)

National Science Education Standards **(National Research Council, 1996)**

Standard: Science as inquiry (p. 105):

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Standard: Life science (p. 106):

- Characteristics of organisms
- Organisms and environments

Ocean Literacy **(National Marine Educators Association, 2013)**

- The ocean supports a great diversity of life and ecosystems

Figure 1. Standards addressed in this activity.

shrimp were observed to determine whether the behavior of the animal was altered by a parasite (Chaplin-Ebanks & Curran, 2005; Brinton, 2014; Brinton & Curran, 2015b), potentially increasing its susceptibility to predators (Brinton, 2014; Brinton & Curran, 2015b). Grass shrimp have also been used in K–12 activities to teach students about marine organisms and scientific research, because they are ideal organisms for young students to observe (Aultman & Curran, 2008; Aultman et al., 2010; Siler & Curran, 2011; Gunzburger & Curran, 2013; Gerido & Curran, 2014).

Safety

Teachers should determine whether any students have seafood allergies prior to using grass shrimp or any other aquatic organism for this activity. Students will only be observing animals during this activity and will not need to handle them. However, appropriate caution should be taken if the teacher permits the students to hold the organisms.

○ Conducting the Activity

Approximate Teaching Time

The activity will require three class sessions, each lasting ~45 minutes.

Materials

- Plastic aquaria (1–2 gallon; one per group of three or four students)
- Freshwater obtained from sources such as lakes, rivers, and ponds ***or***
- Saltwater collected from sources such as a marsh, ocean, or marine lab. Saltwater can also be made in the classroom by using synthetic sea salt, which is designed for animal husbandry and can be purchased from national chain pet stores and aquarium specialty stores. The teacher should acquire water that has approximately the same salinity as the water from which the organism will be collected.
- Refractometer or hydrometer
- Grass shrimp (other aquatic organisms such as ghost shrimp [*Palaemonetes* sp.] can be used if grass shrimp cannot be obtained; ghost shrimp can be acclimated to either saltwater or freshwater and can be obtained from most national chain pet stores)
- Pencils (one per student)

Name:					Date:	
Start Time:					End Time:	
	A (ex., swimming)	B	C	D	E	F
0:00						
0:20						
0:40						
1:00						
1:20						
1:40						
2:00						
2:20						
2:40						
3:00						
Totals						

Figure 2. Observation chart. Students mark which behavior the grass shrimp is exhibiting at each time interval. Names of the shrimp behaviors listed on the class-created ethogram should be written in boxes A–F.

- Science journals (one per student)
- Timer (one per group)
- Observation chart (Figure 2) (one per student)
- Crayons, markers, or colored pencils (per student)
- "What Can I Conclude?" worksheet (one per student) (Figure 3)

Activity Preparation

Fill small plastic aquaria three-quarters full with either freshwater or saltwater. If making saltwater with synthetic sea salt, use a refractometer or hydrometer to determine the salinity or density, respectively, of the water. Place one shrimp in each aquarium.

Procedure

Day 1

1. Discuss animal behavior with the class and how that behavior can be observed. Begin with animals that students are familiar with – their pets. How can you tell when your pet is hungry? If it wants to play? Draw a T-H-C chart on the board (see Appendix Table 1). Ask students to think about why animals would move or behave in certain ways and how someone can best observe an animal to determine its movements and behavior. Ask the students to brainstorm about these questions in small groups for five minutes, and then discuss the possible answers as a class and record the students' responses on the chart.
2. Prior to completing this step, teachers should determine whether any students have seafood allergies (see "Safety"). Arrange students into groups of three or four. Provide each group with a timer and an aquarium with one shrimp. Instruct each group to observe the shrimp for four minutes and write down in their science journals any shrimp behavior that they see, even if the shrimp is resting. Before beginning the observation and the timer, discuss with the students the importance of remaining quiet, keeping a reasonable distance from the aquarium, and not disturbing the aquarium during the observation period, since tapping on it or making loud noises could change the behavior of the shrimp.

What Can I Conclude?

Scientist's name _____ Date _____

Using your ethogram and graphs, answer the following questions below or on a separate sheet of paper.

1. Which behavior(s) was observed by the class the most on Day 2, when a disturbance was not created in the aquarium? Which behavior(s) was observed the least? (10 pts)
2. Which behavior(s) was observed by the class the most on Day 3, when a disturbance was created in the aquarium? Which behavior(s) was observed the least? (10 pts)
3. Write two or three sentences describing some of the changes in behavior that were observed between Day 2 and Day 3. If no changes were observed, explain how the behavior(s) was the same between Day 2 and Day 3. (20 pts)
4. Hypothesize why there were or were not changes in behavior between Days 2 and 3. (10 pts)
5. Based on your findings from Day 2 and Day 3, hypothesize what type of behavior a shrimp would exhibit in the natural environment if a predator was nearby. (10 pts)
6. Were there any behaviors your group did not observe that other groups were able to observe or that were listed on the ethogram? If yes, why do you think you did not observe the behavior(s)? (10 pts)
7. Why did you observe the animal more than once and why is that important for scientific research? (10 pts)
8. What other animal could you observe in the classroom using an ethogram? Explain the steps needed to create a new ethogram. Name three behaviors the animal might exhibit that are different from the grass shrimp. Name one behavior that might be similar. (20 pts)

Figure 3. "What Can I Conclude?" worksheet.

3. After the observation period, ask students to share their qualitative findings and decide on universal descriptions for the shrimp behaviors. Compile a T-H-C chart on the board, with the names of the shrimp behaviors listed on the left side and the description of each behavior written on the right (see Appendix Table 1). Discuss each behavior until there is a consensus among students, just as there would be among scientists, as to what defines a specific behavior. The final list of behaviors will form the ethogram. Make copies of the ethogram so that each student can place it into his or her science journal on Day 2. See Appendix Table 2 for a list of behaviors that other students observed during this activity.

Day 2

1. Distribute the compiled ethogram and an observation chart (Figure 2) to each student. Instruct the students to write the names of the shrimp behaviors listed on the ethogram in boxes A–F on the observation chart.
2. Arrange students into groups of three or four and provide them with a timer and an aquarium with one shrimp; groups can be different than they were on Day 1 if the teacher prefers. Explain to students that they will not be using words for their observations but will only be making tally marks on the observation charts. Instruct students in each group to begin the timer and then immediately observe the shrimp briefly for

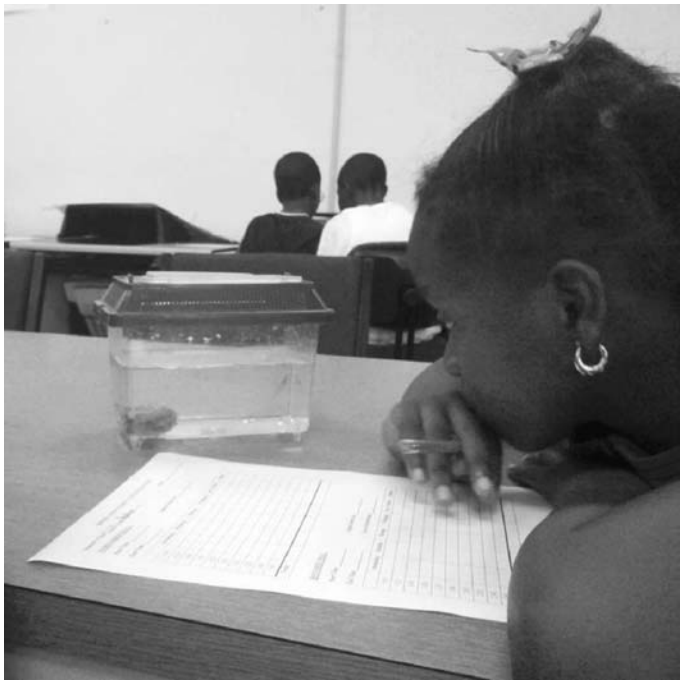

Figure 4. A student observes grass shrimp (upper right of aquarium) and records the behavior on her observation chart (Figure 2).

one or two seconds (Figure 4) and tally each behavior that the animal exhibits during that brief period on their individual observation charts next to the time "0.00" (Figure 2). Have the students continue to briefly observe the shrimp (for one or two seconds) once every 20 seconds for three consecutive minutes and tally each behavior exhibited on their observation charts. Results should be recorded instantaneously, meaning that the behavior exhibited right at the 20-second mark should be recorded, as opposed to all behaviors exhibited over the span of 20 seconds.

3. At the end of the observation period, ask each student to add his or her quantitative findings to a class tally chart compiled on the white board. This could also be compiled on a Smart Board, if one is available, or on a piece of chart paper.
4. Later in the day, instruct students to record shrimp behavior again for another three minutes on a new observation chart. Students should observe the same shrimp that they observed earlier in the day. Depending on the class schedule, it is best to allow students to make a total of two to four observations throughout the day, because animals may behave differently depending on the time of day. At the end of each observation period, instruct students to add their quantitative findings to a class tally chart compiled on a white board, Smart Board, or piece of chart paper.

Day 3

1. Arrange students into the same groups as on Day 2 and provide each with a new observation chart. Instruct each group to repeat the observation series, this time creating a disturbance in the aquarium during the observation period (e.g., inserting nets, plastic pipets, spoons, or food into the water). Again, it is best to allow students to make a total of two to four observations throughout the day.
2. At the end of the observation period, ask each student to add his or her quantitative findings to a class tally chart compiled on a white board, Smart Board, or chart paper.
3. Ask each student to make a bar graph using the information from the compiled class tally chart from Day 2. Behaviors should be listed on the x-axis and the number of times each behavior was observed on the y-axis (see Appendix Figure 5). Students can use crayons, markers, or colored pencils to color the bars of the graph.
4. Instruct students to generate a second graph using the observation data from Day 3 to illustrate how disturbing the aquarium may or may not have affected shrimp behavior (see Appendix Figure 5).
5. Finally, lead a discussion about the observations and main findings. Discuss how this information could be used by scientists who study grass shrimp. For example, scientists could use the information to evaluate how shrimp behavior would change if the environment was altered by adding more shrimp or a predator (see "Modifications" for more information on how to do this in the classroom).

Animal Care after the Activity

Shrimp that were purchased from a store should not be released into the environment; they should instead be retained in a classroom aquarium or given to someone who has an aquarium and can care for the animals. If shrimp were collected from the environment, they can be released or cared for as described previously. Shrimp can also be preserved in jars in isopropyl alcohol, which can be purchased at most grocery or drug stores.

Assessment

The ethogram, observation charts, bar graphs, and "What Can I Conclude?" worksheet (Figure 3) can be used as formal assessments of student participation, understanding, and mastery of using scientific tools and practices.

○ Discussion

Engaging students in hands-on activities is a great way to teach them about scientific inquiry. Students who participated in this activity enjoyed observing a live animal and were very excited to learn that they were conducting an experiment similar to those performed by real scientists. An audio podcast that describes the experience of bringing shrimp into the classroom can be accessed by searching for the word "shrimp" under "Episode Search" at http://coseenow.net/podcast/. In this activity, one behavior that was often observed was resting, and students thought that something was wrong with how they were conducting observations. Prior to conducting this activity, teachers should take the time to inform students that there are no incorrect behaviors for the shrimp to perform, and that resting or remaining motionless is a behavior commonly exhibited by shrimp. Some teachers and students opted to extend the activity by observing shrimp for several weeks.

Individual students were assigned observation roles at varying times throughout the day or week and then any observed changes in behavior were discussed as a class. The majority of students noted that the shrimp rested more frequently as time progressed, likely because of the static nature of their environment, but that their behavior often changed when the water in the aquarium was changed.

In "Do You See What I See," students create and use an ethogram to determine how shrimp behavior changes when the environment of the animal is altered. This activity allows students to experience the excitement that comes along with observing a live organism while learning about scientific inquiry, and also reinforces quantification and graphing skills. The NGSS places emphasis on using authentic scientific practices to teach science concepts (NGSS Lead States, 2013), and ethograms are an easy way to integrate these standards into classrooms while providing a rich, rewarding, and realistic scientific experience.

Modifications

If space or monetary restrictions limit purchase to only one aquarium, the groups could rotate use of the aquarium. If grass shrimp are unavailable, others animals such as ants, mice, hamsters, frogs, and turtles could be used for observation. Consider selecting animals that are safe, easy to keep in a classroom, and display a range of observable behaviors. Students could also observe animals outside the classroom by using web camera clips or taking trips to a local zoo. A marine scientist could be invited to class to do a presentation about an organism. If the guest speaker is not available to physically visit the class, a video conferencing session could be planned.

The time frame used in this activity could be adjusted to best suit each classroom. The activity could be completed in one day. Additionally, long-term monitoring could easily be incorporated into the daily or weekly classroom schedule because observations take only three minutes. The students could be asked if they observed any new behaviors over time through this effort.

Other experimental designs could be employed in conjunction with the use of the ethogram. Several shrimp could be placed in one aquarium, and their behavior could be compared to that of a single shrimp. A larger organism such as a fish or turtle could be added to the aquarium to determine how the behavior of the shrimp changes in the presence of a potential predator.

For lower grade levels, teachers could create pictographs and ask students to determine how many times an organism exhibited a particular behavior. See Kunz et al. (2006) for illustrations of common grass shrimp behaviors. For higher grade levels, students could create an anatomically correct drawing of a grass shrimp. They could use labels to describe how the different sets of legs aid in the shrimp's movement and which body parts are used most or least when different behaviors are exhibited. A labeled grass shrimp diagram can be found in Aultman et al. (2010). Students could also convert their data into percentages and use a circle graph to present the data, as described by Hoover and Curran (2010). In addition, students could observe more than one species throughout the year, ideally from different taxa, such as comparing shrimp (a crustacean) to other invertebrates like snails (a mollusk) or worms (an annelid). A testable hypothesis regarding differences in behavior along with a laboratory report could be developed, as described by Aultman et al. (2010).

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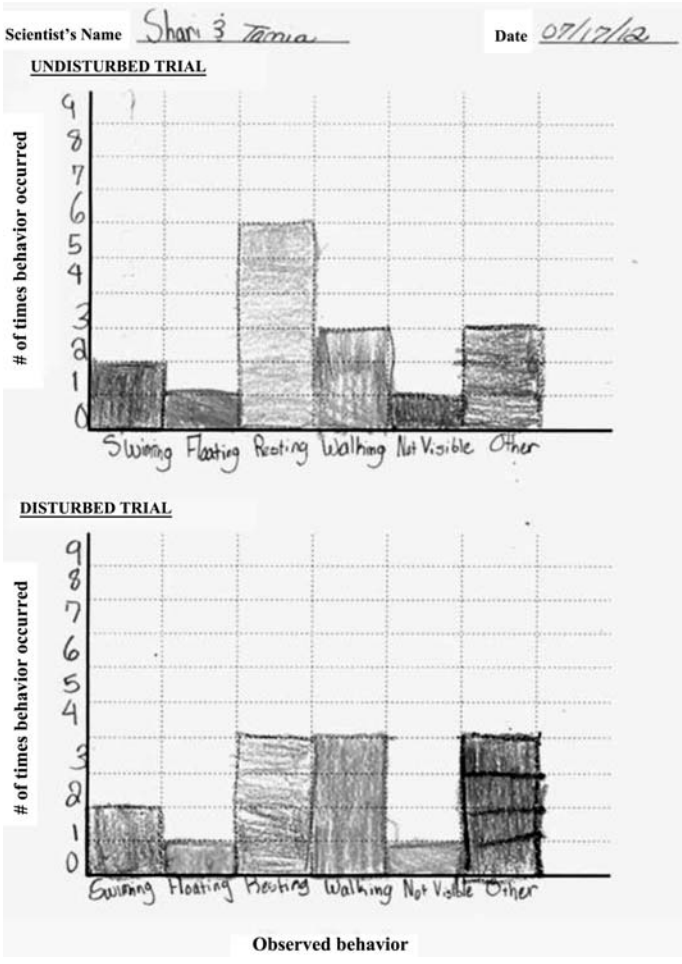
Appendix Table 1. Sample T-H-C chart (modified by Siler & Curran, 2011) representing student responses (T-H-C charts were originally described by Crowther & Cannon, 2004).

THINK of why certain animals move/behave in certain ways	HOW can someone best observe an animal to see how it moves or behaves?	What CONCLUSIONS can be drawn about this animal's movement/behavior?
• Crabs walk sideways because their legs bend that way. • Sharks use their tails to swim forward. • Sloths hang upside down because they have special hooks, and it saves energy. • Turtles pull their head and legs into their shells for protection.	• Can touch some of them (be careful). • Smell. • See. • May use microscope or magnifying glass. • Catch and put in tank or cage. • Take a video. • Visit a zoo.	• Most often observed _____. • Least often observed _____. • Uses legs to swim. • Other responses based on data collected.

Appendix Table 2. Grass shrimp ethogram of the behaviors that students observed shrimp exhibiting. Other sample ethograms can be found at a free website created by the Lincoln Park Zoo at http://www.ethosearch.org/.

Behavior	Description
Swimming	The shrimp is using its legs to move throughout the water column.
Floating	The shrimp is in the water column, not moving its legs.
Resting	The shrimp is sitting on the bottom, not moving its legs.
Walking	The shrimp is using its legs to walk along the bottom.
Backward thrusting	The shrimp is using its tail to shoot itself backward quickly.



Appendix Figure 5. Bar graphs depicting grass shrimp behavior. Students recorded the behavior of the shrimp in a normal setting (Undisturbed Trial) and when disturbances were created in the aquarium using items such as spoons and nets to stir up the water (Disturbed Trial). The name of the observed behavior is on the x-axis and the number of times the behavior occurred is on the y-axis.