

Symbiosis: Relationships between Animals

Abstract

Can I help you? Will you help me? We hear the term **symbiosis** a lot in reference to a mutually beneficial relationship. Symbiosis is a term used to describe the long-term relationship between unlike organisms, where one or both species benefit from the partnership. There are three types of symbiosis that are found in all ecosystems. These are mutualism, where both organisms in the relationship benefit; commensalism, where only one organism benefits; and parasitism, where one organism benefits and the other is affected in a negative way. The ocean is vast with various ecosystems where inhabitants invariably rely on and help each other in many ways. On coral reefs, there are cleaning stations where resident cleaner fish advertise their cleaning services to larger animals that need to be groomed and cleaned of old tissue and parasites. At these cleaner stations, many organisms like fish, turtles, sharks, and large manta rays arrive and line up to be cleaned. The benefit for the cleaner is a constant source of food, while the animal that is cleaned receives maintenance on its body and removal of potentially damaging parasites.

Recently it has been shown that cleaner fish and cleaning stations benefit the entire coral reef ecosystem by keeping reef fish healthy. When reef fish are healthy and not expending energy against disease or parasites, they can grow larger and have more offspring, which leads to an overall healthier coral reef. In this lesson, students will investigate the role of symbiosis in organisms living on coral reefs by viewing live cleaning stations on a coral reef in the Caribbean.

NGSS*

LS2.A: Interdependent Relationships in Ecosystems

LS2.D: Social Interactions and Group Behavior

Learning Objectives

- To learn about symbiosis and mutualism from a living example on coral reefs
- To understand the benefits gained between organisms that can live together

Focus Questions

- How do client fish benefit from not eating the cleaner fish?
 - What would happen if there were no cleaner fish in coral reefs?
- Is there evidence of a display by the cleaner fish to advertise their services?

Key Terms

- Symbiosis
- Mutualism
- Biodiversity
- Habitat
- Behaviors

Key Skills

- Observation
- Data collection and manipulation

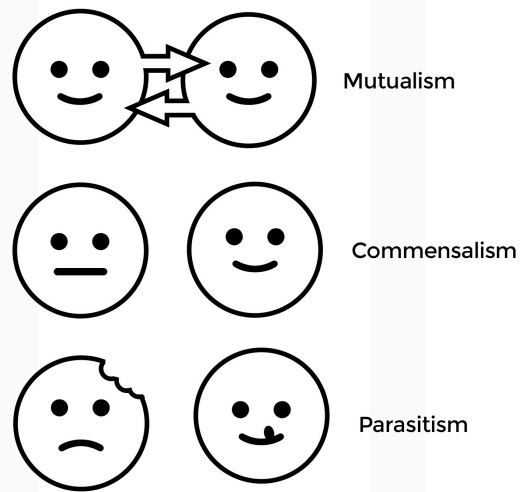
Background Knowledge

Symbiosis is defined as the living together of two dissimilar organisms. This is a fairly broad definition, but scientists often pair the word symbiosis with other words that describe the specific nature of the relationship. Mutualism occurs when both species benefit from the partnership.

Commensalism is where one species benefits and the other is not harmed or helped in any significant way. In parasitism, one species benefits and the other is significantly harmed.

There are many examples of symbiosis in the marine world. The most ubiquitous and obvious example is that which occurs at cleaning stations. Fish and some species of shrimp can occupy cleaning stations, but where you see the most action is at the cleaning stations occupied by cleaner fish.

Cleaner wrasse usually occupy these stations; however, many other species can also take part in cleaning here. In this lesson, we will focus on the cleaner wrasse.



The cleaner wrasse is a group of fishes that belong to the family Labridae (Wrasse). They usually set up stations in pairs or small groups. When a 'client' approaches the cleaner wrasse display a welcoming dance where they move their rear up and down. The client fish swims towards the cleaners, fan its gills, and spreads its fins to allow the cleaners to get access to places where parasites will reside. The client generally allows the cleaners to swim in and out of its mouth, or in the mouth and out through the gills or vice versa. This trust between the two species is essential in maintaining this partnership.

Materials

Computer with Internet connection

Advance Preparation

Visit the Blue Eyes Network data portal at www.oceanclassrooms.com and familiarize yourself with the Grand Cayman Reef Camera.

Potential Misconceptions

- Animals only eat other animals and they don't coexist.
- Symbiosis only means a mutually beneficial relationship.

Suggested Prior Understanding

- Rudimentary understanding of the environment and the concepts of species and ecosystems
- Basic understanding of evolution

Eliciting Prior Knowledge

- Get the class to discuss any examples of symbiosis they are aware of, and help them identify which of the three types of symbiosis they are and why.
- If they cannot think of any, mention some of these common ones: mosquitoes and humans (parasitism), cattle and cattle egrets (egrets forage on the insects the cattle disturb while they eat the grass, commensalism), dogs and humans (mutualism).

Process and Procedure

1. Ask students to recall the last time they went to a zoo. Did they visit the primate area? What behaviors did they see when they observed the primates interact with one another? Keep probing until a student mentions that the primates spent time picking insects off one another and eating them. If students have not had this primary experience, use a video from the Internet to show the students this behavior.
2. Discuss the purpose of the primate behavior. How does the behavior benefit or hurt either of the participants? What would happen if the primates did not engage in the behavior at all?
3. Using an in-class projector or large monitor, display the Blue Eyes Live Webcam pictures from the Grand Cayman Reef Camera. Ask students to discuss similarities they observe between the activities of primates they noted in step 1 and the activities of the fish captured by the camera.
4. Once students have noticed that there are fish that appear to be “cleaning” other fish, introduce the terms cleaner fish, client, and cleaning station.
5. In pairs, using individual computers or the in-class projector or large monitor, have students record their observations in their science journals. Have them record what they see (and how many) and try to identify the number of species that come to the cleaner station to get cleaned.
6. Have students look for behavior of the cleaner fish. What do they notice? Ask students to record all behaviors of fish at the fish site. *[Hint: After students observe for a while, point out the welcoming dance and see if there are similar behaviors exhibited by the fish being cleaned.]*
7. Review the principles of symbiosis and the three general states of symbiosis: mutualism, commensalism, and parasitism. Which of these three states of symbiosis is the primate relationship? The fish relationship?
8. Have student teams return to the website and continue to observe the fish in the Grand Cayman Reef Camera. Ask them to generate ideas about other things that they can observe and record them in their science notebook. *[Hint: Students might suggest other things such as time spent on each fish, how many cleaners on each fish, and whether there were any sudden changes in behavior.]*
9. Ask students to work in small groups (combine pairs) and have them discuss their observations and the following questions: How are these relationships important for the individuals and the ecosystem? Why do the clients refrain from eating the cleaner fish?

10. Draw students together to share their ideas about the symbiosis of cleaner fish and clients in the Grand Cayman Reef ecosystem. Remind students that there are other types of symbiosis (parasitism and commensalism) in addition to the mutualism that they observe at the cleaning stations.
11. Direct students to work with a partner and research other organisms in the ocean that maintain a symbiotic relationship. Give students options for delivering information to their classmates (via brochure, poster, Facebook post, Prezi, etc.). Have the students use the table below to help guide them in their research. They should be able to fill in each cell.

Organisms	Environment	What benefits (if any) are there for this organism in the relationship?	What costs (if any) are there for this organism in the relationship?	Type of Symbiosis

Formative assessment strategies

- Split the class into two groups: the cleaner fish and the clients. Within each of these two groups, form several smaller teams. Ask each team of students to write a hypothetical thank you note to the other group, recognizing the role that the other group plays in the health of their group. Require specifics. Once all teams are finished, pair up a cleaner fish team with a client team and have them share their notes.

Summative assessment

- Why are cleaner fish stations important for the ecosystem? Create a diagram to help explain your answer. Make sure you include key terms from this lesson in your explanation.
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*Next Generation Science Standards addressed

Performance Expectation MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.		
Disciplinary Core Idea(s) MS-LS2 Ecosystems: Interactions, Energy, and Dynamics LS2.A: Interdependent Relationships in Ecosystems <ul style="list-style-type: none"> Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of 	Science and Engineering Practices <ul style="list-style-type: none"> Engaging in Argument from Evidence 	Crosscutting Concept <ul style="list-style-type: none"> Cause and Effect

<p>organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)</p> <p>HS-LS2 Ecosystems: Interactions, Energy, and Dynamics</p> <p><i>LS2.D: Social Interactions and Group Behavior</i></p> <ul style="list-style-type: none"> Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HS-LS2-8) 		
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NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.

Teaching Notes