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Jonathan travels to the Pacific Island of Yap to investigate the "real" Nemo, an anemone fish. Frequently called the clownfish because it has bright colors like a clown, the anemone fish lives a symbiotic, mutualistic relationship with anemones. The dangerous stinging tentacles of the anemone protect the anemone fish from predator fish. The anemone fish protects the anemone by chasing away polyp-eating fish like the butterfly fish. The anemone also gets nutrients from the feces of the anemone fish. The life cycle of the anemone fish is amazing. They are all born males but under the right conditions have the potential to change to female.

Science Lesson: The Clown Every Anemone Loves! Related to Webisodes 30 and 46

Grade Level: 6-8

Time: Two or Three (45-55 min) class periods, plus time for student research.

Introduction

This lesson helps students understand the variety and extent of symbiosis by having them conduct literature and Internet searches for different examples. Students will create a power point presentation giving at least three examples each of mutualism, commensalism and parasitism. Students will identify the type of symbiotic relationship between the two organisms, the interactions between the two organisms, and the effect of the interaction on each of the organisms.

Prior Knowledge

Students should have familiarity of using the Internet as a research tool.

Students should be able to create a power point presentation.

Science Standards

National Science Education Standards Science As Inquiry

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

Life Science

- Structure and functions in living systems
- Populations and Ecosystems
- Diversity and adaptations of organisms

Science in Personal and Social Perspectives

• Populations, resources, and environments

Ocean Literacy Principles

Principle #5: The ocean supports a great diversity of life and ecosystems.

Objectives

- Define and describe mutualistic, commensal, and parasitic, symbiotic relationships between organisms.
- Describe at least three organisms for each of the mutualistic, commensal, and parasitic symbiotic relationships.



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Background

Symbiosis means "living together." Symbiotic relationships are very common in the ocean, especially among animals living on coral reefs. There are three general types of symbiosis: *mutualism*, *commensalism*, and *parasitism*. Based on the interaction between organisms, symbiotic relationships are grouped into one of these types.

Mutualism is a mutually beneficial relationship in which both organisms benefit. Each individual provides an advantage to the other, enabling them to exploit each other and thereby enhance their chances of survival. An example of a mutualistic relationship is the cleaner fish that works with larger fish to remove parasites and diseased tissue from their scales, gills, or mouths. This cleaning may take place casually or at a cleaning station. The relationship may take place between species that are closely related, or more distantly related. One fish that act as cleaners when they are young is a hogfish, and another cleaner fish is a wrasse.

Commensalism is defined as a symbiotic relationship in which one organism benefits and the other is unaffected. Commensalistic relationships occur very often on the coral reef, many times for camouflage and for protection against predators. This relationship is important for the organism that is being camouflaged, but does not aid in the life of the organism providing the camouflage and does not harm it either. An example of commensalism is the relationship between the Anemone crab and an anemone. The Anemone crab lives in the protection of the anemone's tentacles and catches its food without ever leaving the safety of the tentacles. However, the crab does not provide any service to the anemone.

Parasitism is a relationship that is beneficial for one organism and harmful for the other. Parasitic relationships are also common on the coral reef. The parasite will use the host's nutrients or energy in order to aid its own life, and slowly kill the host, or allow the host to maintain its life in order to maintain the parasite's life. An example of a parasitic relationship is the Sacculina carcini, a barnacle that infests a host crab. This barnacle finds a hole in the exoskeleton of the crab, so microscopic hairs can penetrate the hole and the barnacle injects a few cells, and then appears as a "slug" on the underside of the crab. The barnacle absorbs nutrients from the crab's blood, but does not trigger any immune responses, so the crab continues with its daily life. The female Sacculina lays her eggs in the crab's brood pouch, and the instinct of the unsuspecting crab is to continue nurturing the contents of the pouch, and eventually aid in the dispersal of the barnacles eggs for future fertilization, which allows the parasite to continue on with its life cycle.



Anemone crab in anemone.



Helpful Vocabulary

Symbiotic: A relationship in which two organisms exist in close association, which may or may not

benefit both organisms.

Mutualism: A relationship between organisms in which both organisms benefit.

Commensalism: A relationship between organisms in which one organism benefits and the other is not

affected.

Parasitism: A relationship between organisms in which one organism benefits and the other may be

harmed.

Lesson Procedure

Materials:

- Computers with Internet access
- Reference books
- Dive magazines
- Student handout, "Symbiotic Relationship Table"

Lesson:

Introduce the lesson by asking students to define *symbiosis*.

Show the *Jonathan Bird's Blue World* webisodes, *Real Nemo* and *Symbiosis*. These two webisodes deal with the three kinds of symbiotic relationships.

Review the background information with students.

Explain to students that their task will be to research the three kinds of symbiotic relationships found in the ocean and create a Powerpoint presentation to share with the class. The Powerpoint must give at least three examples each of mutualism, commensalism and parasitism. In the presentation students will identify the type of symbiotic relationship between the two organisms, the interactions between the two organisms, and the effect of the interaction on each of the organisms. Students will complete the "Symbiotic Relationships Table" and use it as a storyboard for their Powerpoint presentations.



Follow Up Questions:

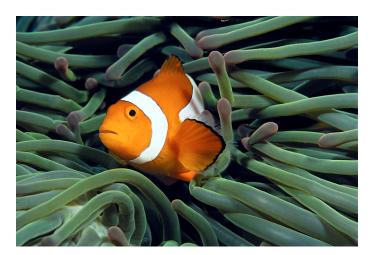
- Why would an organisms want to be in a mutualistic relationship?
- How does it benefit an organism to be parasitic?
- What are the characteristics of a "good" parasite (meaning a parasite that is very effective at being parasitic)?



• What forms of symbiotic relationships are found in streams, lakes, rivers, or the deep ocean?



Sea turtle with "hitch-hiker" barnacles-a good example of commensalism. Photo by Jonathan Bird.



False-clown Anemonefish in its host anemone-classic example of mutualism. Photo by Jonathan Bird.



An isopod on a butterflyfish-common form of parasitism in the ocean. Photo by Jonathan Bird.



Symbiotic Relationship Table

Organisms	Symbiotic Relationship	Interactions Between Organisms	Effect of the Interaction on Each Organism
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Answers to Follow Up Questions:

• Why would an organisms want to be in a mutualistic relationship?

A mutualistic relationship makes life easier for both participants. By cooperating, two organisms get something out of their relationship. For exmaple, a flower gets its pollen dispersed by a bee and the bee gets nectar to make honey from the flower. Everyone benefits.

• How does it benefit an organism to be parasitic?

The parasite gets a "free ride" from another organism with minimal work from itself. Sort of like getting your older brother or sister to do your homework!

• What are the characteristics of a "good" parasite (meaning a parasite that is very effective at being parasitic)?

A "good" parasite gets a free ride without harming its host. For example, if a parasite makes its host get sick and die, the "free ride" ends. So a good parasite causes minimal discomfort or danger to the host while retaining its benefits.