



ECOLOGICAL RELATIONSHIPS

GRADE: 9-12

ACTIVITY OVERVIEW:

Students will be introduced to the vocabulary of symbiosis, and the information about freshwater mussels and the fish that are part of the life cycle of the freshwater mussel. Through analysis of information, students will be creating and producing an informative and persuasive argument for parasitism, mutualism, or commensalism.

OBJECTIVES:

Students will justify that the symbiotic relationship that freshwater mussels have with the fish in their lives is either that of parasitism, mutualism, or commensalism based on the information given. Students will analyze and interpret the information.

STANDARD CONNECTION

State

9.4.2.1 Ecosystems

Strand 4. Life Science

Substrand 2. Interdependence Among Living Systems

Standard: Understand that the interrelationship and interdependence of organisms generate dynamic biological communities in ecosystems.

NGSS

HS. Interdependent Relationships in Ecosystems

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

LS2.C: Ecosystem Dynamics, Functioning, and Resilience.

TIME

Two 45-minute lessons:

- Day 1: Intro to Symbiosis;
- Day 2: Debate about which relationships native freshwater mussels represent)

MATERIALS

Research folders with mussel information and information about the vocabulary words associated with symbiosis.

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PROCEDURE

Day 1:

Section 1: What is Symbiosis? (15 minutes)

Students could work individually, in pairs, or in small groups to come up with answers to the following questions:

- Do all living organisms need each other in some way to survive?
- What interactions could be included as examples?
- What is the close association between and among living things?
- Are all relationships equally advantageous to the parties involved?
- Are some relationships more beneficial to one organism over the other?

Class discussion about student answers. Hand out Model 1 at the end of the discussion.

Section 2: identifying different types of symbiosis (15 minutes)

Refer to the information given in model 1. Answer the questions at the end of Model 1. Class Discussion after everyone has had the time to answer the questions. Symbiotic Relationships will be completed in Section 4.

Model 1 - Symbiosis

Organism 1	Organism 2	Description of the relationship	Symbiotic Relationship
Dog	Flea	The flea feeds on blood from the dog. There is no benefit to the dog and the itching and bite may lead to infection.	
Fungus	Algae	The photosynthetic algae provide food for the fungus, which in turn provides a suitable living environment for the algae.	



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Termite	Cellulose digesting bacteria	The bacteria in the gut of the termite breakdown and feed on some of the cellulose taken in by the termite. The termite would be unable to digest cellulose without these bacteria and they gain an additional source of nutrition from the surplus digested cellulose.	
Shark	Remora	The Remora fish swim alongside the shark and take scraps of food that the shark drops during feeding. The shark does not eat the Remora and appears unaffected by its presence.	
Cattle	Cattle egret	The cattle egret follows herds of cattle and eats the insects that the cattle stir up as they move through the grassland. The cattle appear to be unaffected by the egrets.	
Human	Tapeworm	The tapeworm lives in the small intestines where it feeds and grows, robbing the human of essential nutrients.	

1) In the dog and flea relationship, is there a benefit for one of the organisms or for both?

Only one-----the flea.

2) Is either the dog or the flea harmed by this relationship?

The dog is harmed.

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- 3) Which other relationship in Model 1 is similar to that between the dog and flea?
Human and tapeworms.
- 4) In the fungus and algae relationship, is there a benefit for one of the organisms or for both?
Both.
- 5) Is either the fungus or the algae harmed by this relationship?
No.
- 6) Which other relationship in Model 1 is similar to that between the fungus and the algae?
Termite and cellulose-digesting bacteria.
- 7) In the shark and remora relationship, is there a benefit for one of the organisms or for both?
Only one benefits, the remora.
- 8) Is either the shark or the remora harmed by this relationship?
No.
- 9) Which other relationship in Model 1 is similar to that between the shark and the remora?
Cattle and cattle egret.

Section 3: Naming Symbiotic Relationships (Read This!)

Read This! To be read after the discussion of questions in number 2.

Symbiotic relationships are identified by how they affect the organisms involved. The three types of symbiotic relationships are discussed below.

The first type of species interaction, mutualism, occurs when two species interact and both benefit. For example, Yellowstone is home to 4,600 bison, the largest land mammals in North America. Bison have a mutualistic relationship with the black-billed magpie. Pests such as ticks burrow into a bison's short, dense hair to suck the beast's blood, but hungry little magpie perch on top of the bison and eat those ticks. Thus, both the bison and the magpie benefit from close interaction with one another. Mutualism is common and important in ecosystems all over Earth: many species receive benefits from, and provide benefits to, other species. These benefits increase the survival and reproduction of both interacting species.

When they aren't perched atop bison, black-billed magpies can be found in large nests atop deciduous or evergreen trees, where they reproduce once a year. These trees, another member of the community, share a commensal relationship with the magpies. Commensalism happens when one partner benefits while the other is neither helped nor harmed--in this case, the magpie benefits from having a safe place to lay eggs, and the interaction has no effect on the tree.



Parasitism is when one species benefits and the other is harmed. A parasite lives in or on the organism it harms, its host. An important group of parasites is pathogens, which cause disease in their hosts. The bacteria that cause strep throat, tuberculosis, and pneumonia are pathogens, for example. Many organisms have evolved mechanisms to avoid being hosts, such as immune systems to help fight off parasitic diseases and infections.

Using the information above, label each of the relationships in Model 1 as mutualism, parasitism or commensalism.

Answers:

Dog and Flea: Parasitism
Mutualism
Mutualism
Commensalism
Commensalism
Parasitism

Day 2:

To review, assign one of the organism pairs from Model 1 to each group and have them justify why they categorized the relationship as they did. Students should explain how the description meets the definition of the symbiotic relationship.

Section 4: Symbiosis and native freshwater mussels

Read the information about freshwater mussels and their life cycles and watch the video clip and take notes on the relationship between mussels and fish.

Reading:

Although their lives appear boring, their reproductive strategies are quite fascinating. After the male has dispersed sperm that is carried by currents to the female where fertilization occurs, the fertilized eggs are transformed into a larval state inside the female. She then packages the larvae into an enticing lure that will attract a specific fish. When the target fish approaches, she will expel her larvae at the fish. The larvae attach to the fish's gills or fins, and hitch a ride for a few weeks while they continue their transformation into a juvenile mussel. When the transformation is complete, they drop off of the fish and begin life as a young adult mussel. Not only is this method of reproduction interesting to biologists and students of nature, the fact that mussels require specific species of fish to reproduce means that mussels are also good indicators of the health of their host fish populations.

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Show video:

<https://tpt.pbslearningmedia.org/resource/nat16.sci.lisci.mussel/selection-deception-and-reproduction-mimicry-in-freshwater-mussels/#.W0T421VKjIU>

Assessment

Section 5: What type of symbiotic relationship do mussels have with fish?

Each group should choose one of the symbiotic relationships that They think describe the mussels and the fish involved in their life cycles. Have the students justify why they categorized the relationship as they did.

Students will be creating talking points that shows the relationship between freshwater mussels and fish in their life cycles. The talking points will act as a means to communicate with the rest of the class evidence that is used to interpret the information. Students should also include a written summary that provides examples that support their argument.

Extension

1. To show the symbiotic relationship of freshwater mussels to other organisms, the students will research the information and write a conclusion paragraph including organisms involved and supporting evidence.

(Humans, raccoons, otters, herons, egrets, aquatic insects, worms and invertebrates, zebra mussels, waterfowl and other wildlife species, algae and plankton, trees and plants)

2. Citizen science is an amazing way for anyone to get involved in scientific research. Search the Minnesota Zoo for projects relevant to this topic, using keywords like “freshwater mussels,” “mussel project,” and “endangered mussels,” to name a few. Find out about a project that you can participate in and get involved.

Lesson resources

America’s Mussels: Silent Sentinels

<https://www.fws.gov/midwest/endangered/clams/mussels.html>

PBS Video

<https://tpt.pbslearningmedia.org/resource/nat16.sci.lisci.mussel/selection-deception-and-reproduction-mimicry-in-freshwater-mussels/#.W0T421VKjIU>

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