

# SciREN Symbiosis Lesson Plan

## Part 1: Lesson Abstract

<b>Lesson plan title:</b>  Friends or enemies: How organisms coexist through symbiotic relationships.	<b>Essential question:</b>  How do organisms interact through mutualism, commensalism, and parasitism? How are these relationships affected by human activity?
<b>Scientist biopic link:</b> <a href="https://youtu.be/ESAHpUy5d-k">https://youtu.be/ESAHpUy5d-k</a>	
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<b>Abstract to Lesson Plan: (Max. 1 paragraph)</b> <i>Summary description of the main activity(ies) of your lesson plan and the main learning goal for each activity. Include aspects of the lesson that are unique and innovative.</i>  <p>In this lesson, students will learn about symbiotic relationships in nature and how human activities can disrupt symbiosis. Symbiosis is an interaction between species that live in close association with each other. There are symbioses that are mutually beneficial (mutualism), beneficial to one partner with no effect on the other (commensalism), and beneficial to one partner but harmful to the other (parasitism). Students will participate in a jigsaw activity in which they will match organismal relationships with its correct type of symbiosis. They will then create hypotheses about how the organisms interact and how the relationship affects each partner. Then, students will learn about how human activities can affect parasitic, mutualistic, and commensal relationships between organisms using sharks, coral, and mosquitoes as examples. Finally, students will complete a worksheet to test their knowledge on the different types of symbiotic relationships.</p> <ol style="list-style-type: none"> <li>1. Introduction: Background information, introduce the terms symbiosis, mutualism, commensalism, and parasitism</li> <li>2. Activity: Identify different types of symbiosis, by matching example animal interactions with the type of symbiosis</li> <li>3. Examples: Learn about three specific examples of symbiosis in coral, sharks, and humans</li> <li>4. Evaluate: Complete a worksheet to apply knowledge on symbiosis to different situations</li> </ol>	

## Part 2: Lesson Plan Information

<b>Class Subject and Grade Level:</b> Biology, 8th grade	<b>Learning Objectives (L.O.):</b>
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<p><b>Class Duration/Logistics:</b> (How long will each part of the lesson be?)</p> <p>60 mins</p> <ol style="list-style-type: none"> <li>Engage (10)</li> <li>Explore (15)</li> <li>Explain (10)</li> <li>Elaborate (15)</li> <li>Evaluate (10)</li> </ol>	<p><b>ASSESSMENT: By the end of the class students will be able to:</b></p> <ol style="list-style-type: none"> <li>Identify different symbiotic relationships including mutualism, parasitism, and commensalism.</li> <li>Explain what organisms gain or lose through symbiotic relationships.</li> <li>Recognize how symbiotic relationships are important for ecosystems and for humanity (ecosystem services).</li> <li>Think critically about how human activities threaten symbioses and why it's important to protect ecosystems.</li> </ol>
<p><b>Class Setting:</b>(e.g. Indoors/Outdoors/Online)</p> <p>Indoors (all activities can be modified for online)</p>	<p><b>Lists of Standards (Common Core, NC Essential Science, Next Gen, etc.):</b></p>
<p><b>Class Size:</b> (Group sizes and number of students activities are designed for)</p> <p>20-30</p>	<p>8th grade NC Essential Science: 8.L.3.2: Summarize the relationships among producers, consumers, and decomposers including the positive and negative consequences of such interactions including: coexistence and cooperation, competition (predator/prey), parasitism, and mutualism.5E/M1, 5D/M4</p>
<p><b>Materials Needed for Teacher:</b> (Including Technology)</p> <p><a href="#">Powerpoint</a> Color printer <a href="#">Symbiosis matching activity</a> and <a href="#">symbiosis matching activity KEY</a> (provided) <a href="#">Symbiosis worksheet</a> and <a href="#">symbiosis worksheet KEY</a> (provided)</p> <p>Matching worksheet can be printed and used throughout the day for different class periods.</p> <p>Optional: Projector for watching video, looking through article together</p>	<p>NC Essential Science: Bio.2.1.3: Explain various ways organisms interact with each other (including predation, competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems.</p> <p>Bio.2.2.1: Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment.</p>
<p><b>Materials Needed for Students:</b> (Including Technology)</p> <p>Symbiosis matching activity Symbiosis worksheet Pencil</p>	<p>Next Gen: MS-LS2-2: <b>Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]</b></p>

### Part 3: Lesson Activity

#### Engage:

LEARNING OBJECTIVES PREVIEWED - Capture students' attention, activate prior knowledge, and stimulate student thinking so that they are prepared for today's lesson and have sufficient context around which to construct new knowledge.

Prior knowledge:

- General knowledge about different organisms (eg. what is a virus, coral, algae, tick, etc.)
- What an ecosystem is
- What a species interaction is (eg. predator/prey)
- How human interactions can affect the environment (eg. climate warming)

Questions to ask/relation to real life:

- How do we define an ecosystem? Describe an ecosystem (be sure to include location, size, etc.).
- How do humans interact with each other? How do other animals interact with each other? What organisms have you seen interact in the world? What interactions could be happening that we can't see?
- What do we know about bacteria and what are their purposes? (they can help us digest food (relate to mutualistic bacteria & algae))
- What is climate change? How do humans contribute to climate change? What can we do to stop it?

Give students these very basic definitions of symbiosis.

- Mutualism (+/+): A species interaction where both species benefit from the interaction
- Commensalism (+/0): A species interaction where one species benefits from the interaction, and the other is not affected by the interaction
- Parasitism (+/-): A species interaction where one species benefits from the interaction, and the other is negatively affected by the interaction

**WRITE:** Have students write and draw a representation of each definition in their notebook.

## Explore:

LEARNING OBJECTIVES DISCOVERED - Students make observations, record data, design and execute experiments, create graphs, interpret results, organize their findings, and develop hypotheses or conclusions so that they can construct knowledge independently and practice their scientific habits of mind.

### Jigsaw Activity:

In groups of 3, students will be given a stack of photos of different organismal interactions that they must match to "Mutualism", "Commensalism", or "Parasitism" at their table. [See attached activity sheet.](#)

Once they have matched all your cards, one person from each group will take one type of symbiotic relationship (eg. parasitism), and form a group with all the other people with that symbiotic relationship (eg. all students with the parasitism cards are now in one group). At this point, the teacher should sort the photos to make sure that all of the photos are in the correct groups (eg. all parasitism examples are with the parasitism group).

In these large groups, students will be given 5 mins to study the organisms and come up with hypotheses for how each symbiotic relationship works, and how each organism benefits etc. from the

interaction based on the photos. They will then be given 5 mins to use the internet to confirm and/or alter their hypotheses. Teachers should be circling during this time to provide guidance when needed.

After that, students will return to their original groups of 3 and explain to their group how mutualism, commensalism, or parasitism works with at least one concrete example.

Here is the information on the specific symbioses if students have questions/need further clarification:

- Cleaner wrasse and grouper (Mutualism)
  - Groupers are large fish that are susceptible to bacteria. Cleaner wrasses eat the bacteria out of the grouper's mouth, which provides them with food, and protects the grouper against bacterial infections. This interaction mutually benefits both organisms.
- Sea cucumber and pearl fish (Commensalism)
  - Pearl fish are long thin fish that are very vulnerable to predation. During the day, they hide inside a sea cucumber in order to protect themselves, and then they go out and hunt at night. This does not affect the sea cucumber. This interaction benefits one organism and has no effect on the other.
- Coral and algae (Mutualism)
  - Coral have symbiotic algae that lives inside their tissues. The algae provide coral with energy via photosynthesis, and the coral provides the algae with various nutrients. This interaction mutually benefits both organisms.
- Tick and deer (Parasitism)
  - Ticks latch on to deer (and other organisms) in order to feed, since they need blood to survive. They are able to cling on very tightly, and bury their head inside the skin of their host. Since ticks often carry diseases like lyme disease and rocky mountain spotted fever, they can infect the host with this. This interaction benefits one organism, and actively harms the other.
- Sharks and remora (Commensalism)
  - Remora are fish that have suction-cup like mouths, allowing them to latch on to sharks. The remoras benefit from this by being able to travel far distances, and can eat scraps after the shark feeds. Their presence does not affect the sharks. This interaction benefits one organism and has no effect on the other.
- Whales and barnacles (Commensalism)
  - Barnacles start out as larvae, swimming around, and attach to whales. This benefits them, because it allows them to have constant flow for filter feeding as the whale moves, and brings them to plankton-rich water. Their presence has no effect on the whales. This interaction benefits one organism and has no effect on the other.
- Ants and cordyceps fungus (Parasitism)
  - Fungi in the family *Cordyceps* reproduce via spores, which can settle on ants. The fungus then roots itself in the body of the ant, and turns the ant into a zombie, causing the ant to climb to the top of a plant and grip onto it with its jaw. The fungus then consumes the ant, and sprouts mushrooms through its body. This interaction benefits one organism, and actively harms the other.
- Oaks and cynipid wasps (Parasitism)

- Cynipid wasps lay their eggs on oak trees, and the eggs release a chemical which causes the tissue of the oak leaves to grow a protective case around the egg. This causes the surface area of the leaf to decrease, meaning that the tree cannot photosynthesize as much, and spends more energy creating these protective ‘galls’ around the eggs. This interaction benefits one organism, and actively harms the other.
- Humans and mosquitoes (Parasitism)
  - Mosquitoes need to eat blood to survive, and feed on a variety of animal hosts. Some species have also evolved to live near humans, because they rely on water sources for reproduction. When they bite humans, they cause a reaction, and can often carry diseases such as zika that infect humans. This interaction benefits one organism, and actively harms the other.
- Anemones and clownfish (Mutualism)
  - Anemones have special stinging cells (nematocysts) that help them capture prey such as fish. Clownfish are immune to their stings, and hide among anemones for protection, especially for their young. Clownfish are small and bright, and attract larger species of fish who think they are food. This allows the anemone to catch them and prey on the larger fish, benefitting both species. This interaction mutually benefits both organisms.
- Honeybees and flowers (Mutualism)
  - Honeybees need pollen and nectar from flowers to survive. In getting these resources from flowers, they also become covered in pollen, which they then transfer to other flowers, pollinating them. The flowers need this pollination in order to reproduce. This interaction mutually benefits both organisms.
- Cows and cattle egrets (Commensalism)
  - Cattle egrets follow cows around and eat bugs that like to hang around the cows, or bugs in the ground that the cows kick up. The birds do not bother the cows. This interaction benefits one organism, and has no effect on the other.

## Explain:

LEARNING OBJECTIVES FORMALIZED - Solicit student ideas of what they’ve just done, introduce laws/models/theories/vocabulary, guide students towards generalizations that explain the results of their explorations, and confirm ideas so that students are clear on what is correct, why it’s correct, and what they need to take away.

Go in depth into one example of mutualism, commensalism, and parasitism, and explain how human activity is negatively affecting the symbiosis.

- Commensalism: sharks and remora
  - Remora rely on sharks for food and protection. Sharks are messy eaters, so remora eat the scraps that the shark leaves behind. Also, remora attach to sharks so that other predatory fish will not eat them. However, humans kill ~100 million sharks/year through illegal fishing, longlines, and shark finning. With decreasing shark populations, remora will not be able to survive either. We need sharks as apex predators to keep fish populations in check.
- Coral and algae

- Corals and algae exchange nutrients that each partner needs to grow and thrive. Warmer temperatures due to human-driven climate change are causing corals to become stressed and actually expel their algal symbionts. This causes the corals to die because they need the algae to survive (they don't get enough nutrients on their own). Coral reefs are home to 25% of all marine life in the ocean, so if corals die, these organisms die too.
- Humans and mosquitoes
  - Mosquitoes drink human blood for nutrients, but leave humans with itchy welts and can even transmit diseases such as malaria. Warmer temperatures due to human-driven climate change will lead to mosquito persistence for longer periods of time throughout the year, increased transmission of mosquito-borne disease, and wider geographic range of mosquitoes. Essentially, there will be more mosquitoes to bite more humans and transmit mosquito-borne pathogens.

### **Elaborate:**

LEARNING OBJECTIVES USED - Students practice applying ideas to new domains in an increasingly independent way and practice problems for skill objectives so that they reinforce their knowledge, check their understanding while the teacher is present, and can extend ideas beyond just the problem or application in the example.

Ask Students: have you heard of any other symbioses in nature? What type? Write it down in your notebook. Now create your own example of symbiosis using your imagination and two fictional organisms. Make sure to describe: what type of symbiosis it is, what two fictional organisms are involved, what characteristics each organism has that makes it well suited for this symbiosis.

Level down: Sentence starters/fill in the blanks

Organism 1 has \_\_\_\_\_ which makes it very good at \_\_\_\_\_

Organism 2 has \_\_\_\_\_ which makes it very good at \_\_\_\_\_

These two organisms have a \_\_\_\_\_ (mutualistic/commensalistic/parasitic) relationship

Level up: Discuss with students - are there different types of mutualisms? What do you think the difference between an obligate and facultative symbiosis is? (Obligate = at least one of the organisms needs the symbiosis in order to survive eg. ticks, coral and algae, and Facultative = the symbiosis is not necessary for the survival of either of the organisms, or the symbiosis only exists when the two organisms are present together eg. honeybees and plants can be pollinated by other organisms or get their food from other sources)

### **Evaluate:**

LEARNING OBJECTIVES ASSESSED - Assess students' current mastery of knowledge, skills, and concepts, and determine students' self-assessed level of comfort and confidence with the objective so that the teacher knows where to remediate or reinforce ideas the next day, and the extent to which each individual has mastered the lesson.

Students can define and give examples of mutualism, commensalism, and parasitism

Students can explain the tradeoffs between the different types of symbioses

Students will use the worksheet attached to evaluate their understanding of mutualism/commensalism/parasitism.

[Symbiosis worksheet](#)

## Part 4: Differentiation Strategies

<p><b>Modifications for Online/Hybrid Classroom:</b> <i>(Are there ways to run this activity online?)</i></p> <p>This activity can be turned into a matching activity online by using software such as google classroom chalkboards, and putting students into breakout rooms during the activity.</p>	<p><b>Differentiation Strategies:</b> <i>(Are there ways to make the activity more or less challenging?)</i></p> <p>Less challenging: Have students work through fewer symbiosis examples, or work through the examples together as a class with the instructor guiding. For any writing activities, you can include sentence starters or a word bank to help</p> <p>More challenging: Understanding obligate vs. facultative symbioses. Label each example in the activity with facultative vs obligate. Think about how there can be symbioses between multiple organisms (3+), eg. coral, bacteria, algae.</p>
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## Part 5: Electronic Resources

<p><b>List Electronic Resources for Activity</b> <i>(List any images, powerpoint slides, worksheets, appendices, or extra reading that should be included with this activity)</i></p> <p>Powerpoint: <a href="#">Powerpoint</a></p> <p>Optional: video (<a href="https://www.youtube.com/watch?v=zTGcS7vJqbs">https://www.youtube.com/watch?v=zTGcS7vJqbs</a>)</p> <p>Add extra reading (<a href="https://education.nationalgeographic.org/resource/symbiosis-art-living-together">https://education.nationalgeographic.org/resource/symbiosis-art-living-together</a>)</p>
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