SHEDD AQUARIUM

Providing Forever Homes

LESSON FOUR: Coral Rescue and Rehabilitation

Shedd Aquarium rescues animals big and small—sometimes very small! Even corals need rescuing from time to time, and Shedd Aquarium has animal experts who can help. In November 2011, Shedd experts were called upon by the Navy to help rescue 1,500 federally protected coral colonies that were living on a sea wall that had to be rebuilt, which meant that the corals needed to be moved. Shedd experts assisted with the rescue by giving a home to coral specimens that were too small to be relocated to marine sanctuaries. Those corals now live in the Wild Reef exhibit alongside tropical fishes and invertebrates that depend on corals to survive. According to collections manager Mark Schick, "This team effort with the Navy and our conservation partners allowed us to save corals that might have been lost, aid our ongoing research to understand how to protect corals all over the world, and give Shedd guests the opportunity to see corals that are rarely exhibited in public aquariums."

Mark Schick has also used his expertise to help with the SECORE project, which improves coral colonies' rates of reproduction to ensure that reefs can survive long into the future. In this lesson, you will learn about why rescuing corals is so important for the health of the oceans. Every colony counts!

LESSON FOUR: Coral Rescue and Rehabilitation

CONNECTION TO UNIT: Why this matters for your students

This lesson remediates the concepts introduced in Lesson 3: Penguins (producers, consumers, food chains and energy pyramids). This lesson pushes ecological understanding further by adding onto these foundations. Students will gain understanding of decomposers and food chains. They will also determine why balance in an ecosystem is so important.

NGSS DISCIPLINARY CORE IDEAS

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

> Food webs are models that demonstrate how matter and energy are transferred among producers, consumers and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-2)

LS2.C: Ecosystem Dynamics, Functioning and Resilience

> Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological components of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)

> Biodiversity describes the variety of species found within Earth's terrestrial and aquatic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

NGSS SCIENCE AND ENGINEERING PRACTICES

Developing and using models

> Modeling in 6-8 builds on K-5 experiences and progresses to developing, using and revising models to describe, test and predict more abstract phenomena and design systems.

Analyzing and interpreting data

> Analyze and interpret data to provide evidence for phenomena.

Constructing explanations and designing solutions

> Construct an explanation that includes qualitative or quantitative relations between variables that predict phenomena.

Engaging in argument from evidence

> Construct a written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

> Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

KEY POINTS

Students will

> understand why Shedd Aquarium rescues and houses corals.

> be able to define a food web as a model that shows how matter and energy are transferred in an ecosystem.

> be able to define and identify producers, consumers and decomposers.

> be able to explain the interconnected roles played by producers, consumers and decomposers in the cycling of energy and matter.

> be able to begin to identify how alterations of ecosystems affect entire food webs.

> define biodiversity.

> use measurements of biodiversity to measure an ecosystem's health.

MATERIALS/SETUP

> Student handout (one per student)

> INSERT VIDEO CLIP

> Organism playing card set: plankton, coral, raccoon butterflyfish, blacktip reef shark, parrotfish and arrows (students will be in groups of 5 so prep as many group sets as needed)

AGENDA

Day 1

1. Engage (10 min)
2. Explore (20 min)
3. Explain (20 min)

Day 2

4. Elaborate (35 min)
5. Evaluate (15 min)

IMPORTANT VOCABULARY

> Food web

> Producer

> Consumer

> Decomposer

> Ecosystem

> Biodiversity

> Terrestrial vs. oceanic ecosystem

ENGAGE: Key points previewed

Grab students' attention, recall prior knowledge and set framework for today's lesson.

Optional video clip: Play the following video clip before the start of the lesson to hook students with the visually captivating coral reef.

Students will begin to learn about the coral ecosystem by reviewing/applying their previous knowledge (Lesson 3: Penguins). Students will read a short blurb about corals, plankton and fishes found in Shedd Aquarium's Wild Reef exhibit. They will then classify these organisms as plankton/producer, coral/primary consumer and fish/secondary consumer. They will then be asked to add a tertiary consumer to the top of their food chain (shark) and create a hypothesis to the following question: Will a change in water temperature affect a population of sharks? Provide specific evidence (students should support with some mention of energy). By the end of the lesson they will be expected to use energy as well as matter in their explanation.

NOTE: This curriculum does not cover the details of any specific cycles such as carbon or nitrogen.

Considerations for making a food chain:

> All arrows should point away from the producers.

> Arrows show the direction of the movement of energy. They should point away from the prey and toward the predator or consumer.

> The highest-level consumer in the food chain should only have arrows pointing toward and not away from that organism.

Considerations for making an energy pyramid:

> Producers should be on the bottom.

> Primary consumer should be directly above the producer.

> Top consumer should be at the top or peak of the pyramid.

> The width of the pyramid level should be a direct reflection of the energy available to organisms in that trophic level.

Quickly review before moving on to Explore section.

Optional: Take a vote—will a change in water temperature affect the shark population? This could be visually posted in the room while you perform the case study.

EXPLORE: Key points discovered

Students conduct a mini investigation to challenge or confirm initial model. They should make observations, collect/record data and interpret their results.

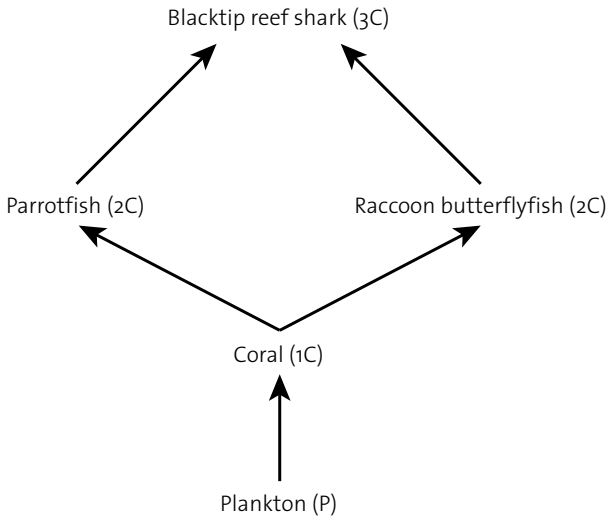
Students should be placed into groups of five. Each student will be given an organism playing card. Students should share the information on their organism cards with the group.

Students should then make a Wild Reef food web together on a desk or table using the playing cards and arrows. You can optionally make the activity a race among groups, with the winning group getting the chance to present its Wild Reef food web or another incentive.

Next, review the food webs as a whole group or check in with groups individually, but make sure that all groups have a correct food web before they continue. Students will then begin to alter their food webs to remove coral from the ecosystem and see the impact that this has on the ecosystem as a whole. Students will compare their food webs to food chains.

EXPLORE: Key points discovered *continued*

Student exemplar:



EXPLAIN: Key points formalized

Students are guided toward creating explanations of their results. Here is where they really connect their investigation back to the content. Key vocabulary, scientific principles and theories are introduced. Additional sense-making activities may be used or can be follow-up questions/discussion.

Students will read a short "sense-making" article to help support the data they collected during the Explore section. Students should be pulling out the following key points from the text and reflection on the activity:

> Define a decomposer and compare it to the roles of producers and consumers.

> Determine that both energy and matter are moved within an ecosystem between living and nonliving things.

Explain that biodiversity is a measurement of the how many different types of organisms live in an ecosystem and that scientists use the amount of biodiversity to measure that ecosystem's health.

ELABORATE: Key points used

Students continue to complete practice problems of skills and/or apply new knowledge to the situation or new scenario. Teacher checks student comprehension and push extension of content.

Students will answer in-depth questions that begin to organize information gained during the lesson to revisit their initial hypothesis/claim from the Engage section. Students will

> be able to explain the interconnected roles that producers, consumers and decomposers play in the cycling of energy and matter.

> begin to identify how alterations of ecosystems affect entire food webs.

> use measurements of biodiversity to measure an ecosystem's health.

Students will also be required to interpret pie charts during this section to prove mastery on understanding the importance of biodiversity. If the class does not have prior knowledge, a mini lesson could be done to provide context. Pie charts are discussed in Lesson 2: Otter Enrichment Design Challenge.

EVALUATE: Key points assessed

In this section, both students and teacher check students' acquisition of knowledge. Students should gain a clear understanding of what they have learned. As the teacher, you can use this information to begin to formulate the next day's lesson.

Students should have a well-crafted conclusion statement to the initial scientific question: If coral populations are decreased by a change in temperature, how do you think a change in temperature would affect the population of sharks? Have students explain their answers.

Students are provided a checklist to use to help them plan their responses and also make sure they have all pieces.
Student exemplar:

A change in temperature would decrease a shark population because sharks are part of a coral reef ecosystem. Sharks get energy and matter by eating fishes that eat corals. If a population of corals decreases, then so will sharks. Healthy ecosystems have a lot of biodiversity so that all roles are filled. So the more types of organisms, the better for the others.

NOTES/CONSIDERATIONS

This lesson is made to be a follow-up to Lesson 3: Penguins. It assumes a lot of prior knowledge for that lesson and might be difficult to execute in isolation from that activity. This lesson assumes students know the following vocabulary or points:

> Producers, primary consumers, secondary consumers, food chain, energy pyramid and ecosystem

> Energy is passed between organisms in ecosystems. Scientists use food chains and energy pyramids to model how energy is moved.

Support for struggling writers or lower grade levels: Writing a strong conclusion can be extremely difficult for many students. Students can be supported with the use of sentence stems or a writing guide. The student exemplar can be used as a grading guide, but it can also be adapted to make sentence stems. The writing checklist on the student handout can be used to create a writing guide to offer support.

There are pie charts for students to use in the Elaboration section. The fill option is both color and patterned to accommodate a lack of color printing.

We would love to learn from you!

Please take a moment to share your thoughts about the NextGen Animal Responders curriculum. You can complete our brief survey—and boost Shedd learning—at **http://bit.ly/NextGenSurvey**.

SHEDD AQUARIUM

Exhibit Explorer: Wild Reef, the Story of the Amazing Coral Ecosystem

STUDENT HANDOUT

Name _____ Class period: _____

Have you ever been to the Wild Reef exhibit at Shedd Aquarium? This exhibit allows you to explore the beautiful Philippines and their amazing coral ecosystem. Did you know that corals are animals? It might seem weird because they do not move once they are adults, but they eat photosynthetic plankton! Corals both provide homes to and are a source of food for many fishes and other species in the ocean.

ENGAGE

In the space below each picture, label each organism in the coral ecosystem as a producer, primary consumer, or secondary consumer. Make sure to support your label with scientific evidence.

Organism			
Producer, primary, or secondary consumer			
Scientific evidence	I picked this label because	I picked this label because	I picked this label because

In the space below, draw a food chain and an energy pyramid for the three organisms above.

1. A tertiary consumer is an organism that eats a secondary consumer. Very important tertiary consumers in coral reef ecosystems are sharks. Place your shark on your food chain. Why did you place your shark in that position?

2. Create a hypothesis: Corals are extremely sensitive to water temperature changes. There is a temperature range they need to survive and thrive. Corals cannot survive if they do not have the right temperature. Based on this information and your food chain above, how do you think a change in water temperature would affect the population of sharks? Why?

EXPLORE

Food chains are a great way to show how energy is moved directly between a line of prey to predators. But in ecosystems most organisms usually have more than one predator. This can make things more complicated. Scientists make food webs, which are multiple food chains that weave together. Complete the following steps to show how energy is moved in the large and diverse ecosystem of the Philippines coral reef.

a) Each person should receive one organism playing card: coral, plankton, blacktip reef shark, parrotfish, or raccoon butterflyfish. The arrows and labels should be placed to the side for now.

b) Each person should take a turn sharing the information on his or her card with the group.

c) On your desk or table, use your organism playing cards and arrows to create a coral reef food web.

d) Now label each organism as either a producer, primary consumer, secondary consumer, or tertiary consumer.

e) Your teacher must approve your food web before you move on.

f) Draw your food web in the space below. Make sure you label each organism with the following code: (P) producer, (1C) primary consumer, (2C) secondary consumer, or (3C) tertiary consumer. DO NOT PUT AWAY YOUR GROUP FOOD WEB.

3. How was your food web similar to your food chain?

4. How was your food web different from your food chain?

5. Remembering that everything that has an arrow between it is directly connected and therefore dependent on each other, conduct a quick experiment. Corals cannot survive when there are extreme temperature changes. If the temperature of the water is increased, the coral population will decrease. Complete the following steps:

   a) Remove your coral playing card.

   b) Since any organism that has an arrow connecting it gets energy by consuming coral, remove that consumer and the arrows as well.

   c) In addition, any organism that eats the consumers in Step b no longer has energy. Remove that consumer and the arrows as well.

6. After the coral was removed from the ecosystem, did you have to remove any other organisms? Why?

EXPLAIN

You conducted an experiment to test your original hypothesis. Good scientists collect as much data as they can. A lot of this information has been collected by scientists that came before us. Use the article below to collect evidence to support and explain the data you collected during your food web alteration.

Saving coral isn't just about coral. Corals provide food and shelter for thousands of fish and invertebrate species in the Caribbean alone. As a leader in conservation and research, Shedd Aquarium is determined to help restore these crucial populations. Coral reefs make up less than 1% of the ocean, but support 25% of all ocean life! Coral reefs provide homes, hideouts, food and nurseries to many species of animals. The Coral Triangle in the Philippines is considered to be one of the most biodiverse places on Earth! Biodiversity is the variety of species that live and depend on each other within an ecosystem. "Bio" means life and "diversity" means different. Scientists use biodiversity to measure the health of an ecosystem. The more biodiversity, the healthier the ecosystem.

A healthy ecosystem needs three types of organisms: producers, consumers and decomposers. Decomposers recycle nutrients from dead plant or animal matter back to the environment. They are important to move both energy and matter throughout ecosystems. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

7. What is biodiversity?

8. How do scientists use information about biodiversity?

9. Connect your prior knowledge about producers and consumers to your new information about decomposers to fill in the table below:

	PRODUCER	CONSUMER	DECOMPOSER
Definition: Role it plays in an ecosystem.			

10. Compare and contrast: How is a decomposer similar to and different from a consumer?

11. A fellow scientist claims that only energy is shared among organisms. Do you agree or disagree? Provide a specific example from the text on the previous page.

I _____ because _____

_____

ELABORATE

Complete the following questions.

12. Your partner has written the following claim: "Decomposers and producers have the same role in an ecosystem because they both are usually not animals." Do you agree or disagree with your partner? Provide scientific evidence to support your answer.

13. Do nonliving factors and dead organisms play an important role in ecosystems? Why?

14. There are two main types of ecosystems: terrestrial and aquatic. Aquatic ecosystems are in water whereas terrestrial ecosystems are on land.

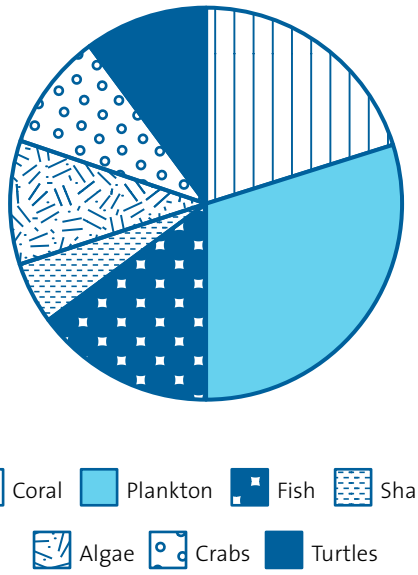
    A. What type of ecosystem is a coral reef? Why?

    B. Can you think of an example of a terrestrial ecosystem? Explain how it fits the definition.

The data below is of two hypothetical aquatic ecosystems, meaning that it was not collected from any real ecosystem. It is for you to use to answer the questions following the data.

ECOSYSTEM 1

Ecosystem Population Sizes



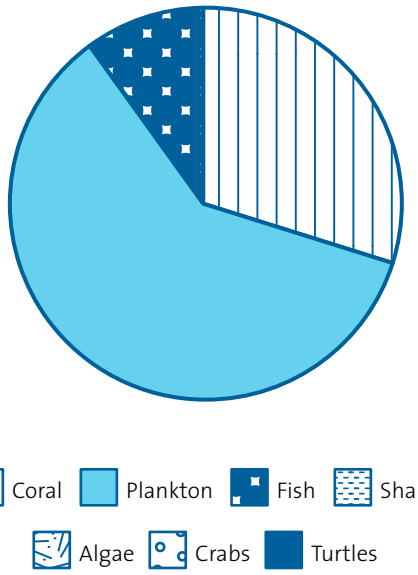
a. How many types of species are present in this ecosystem?

b. Which species makes up the largest percentage of this ecosystem? Why?

c. Is this species a producer, consumer, or decomposer? Why?

ECOSYSTEM 2

Ecosystem Population Sizes



d. How many types of species are present in this ecosystem?

e. Crabs are a decomposers. Are they present in Ecosystem 2? How will this affect the entire ecosystem?

15. Based on the data above, which ecosystem is healthier? Make sure to provide specific quantitative information to support your claim (remember that quantitative information is expressed in numbers rather than words).

EVALUATE

Original scientific question: If coral populations are decreased by a change in temperature, how do you think a change in temperature would affect the population of sharks? Explain your answer.

16. Look back to your original hypothesis. Was your hypothesis supported? Why or why not?

17. Create a scientific conclusion: In the space below, create a final conclusion statement to answer your scientific question. Use the checklist to make sure you have fully supported your statement and include all pieces needed to write a strong scientific conclusion.

- ☐ My conclusion statement directly answers my scientific question.
- ☐ I have provided evidence to support my claim by showing how the movement of **energy** is important to ecosystems.
- ☐ I have provided evidence to support my claim by showing how the movement of **matter** is important to ecosystems.
- ☐ I have used biodiversity to create a scientific reason as to why my conclusion statement is true.

WILD REEF ORGANISM PLAYING CARDS

SPECIES: Plankton

ENERGY SOURCE: Creates its own energy by the process of photosynthesis.

PREY OF many different organisms, but is the main food source of corals.

SPECIES: Coral

ENERGY SOURCE: Does not create its own energy, eats plankton.

PREY OF many different organisms, but is the main food source of raccoon butterflyfish and parrotfish.

SPECIES: Raccoon butterflyfish

ENERGY SOURCE: Does not create its own energy, eats coral.

PREY OF many different organisms, but is frequently consumed by the blacktip reef shark.

SPECIES: Parrotfish

ENERGY SOURCE: Does not create its own energy, eats coral.

PREY OF many different organisms, but is frequently consumed by blacktop reef sharks.

SPECIES: Blacktip reef shark

ENERGY SOURCE: Does not create its own energy, eats many species but frequently consumes different types of fishes.

PREY OF very few species and is usually considered a top-level consumer.