SHEDD AQUARIUM

Providing Forever Homes

LESSON THREE: Rescue and Rehabilitation Penguins

Every year, Shedd animal care specialists travel to South Africa to assist with the rehabilitation and release of abandoned African penguin chicks. Shedd has partnered with the Southern African Foundation for the Conservation of Coastal Birds, or SANCCOB, to give these endangered chicks a chance to survive. Animal care specialists Michael Pratt, Valyn Dall and Maura Redding were among those who did rotations, assisting with handling, feeding and caring for birds that needed help. With the wild African penguin population estimated at less than 2 percent of historic numbers, every chick counts. In this lesson, you will learn why it is so important to protect animals like penguins—not just for their sake, but for the sake of all of the other animals in their ecosystem as well.

LESSON THREE: Rescue and Rehabilitation Penguins

CONNECTION TO UNIT: Why this matters for your students

This is the foundation lesson for both LS2.B and LS2.C. It exposes students to the principles of producers and consumers (decomposers introduced in Lesson 4: Corals) as well as the transfer of energy. But most important, it shows students how interconnected all organisms are and why the natural balance within ecosystems must be protected. Shedd Aquarium partners with a number of organizations and works with learners to share the message on how to help maintain healthy ecosystems.

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 collaborates with SANCCOB to help save and protect wildlife such as penguins.

> be able to define and create a food chain and energy pyramid as a model that shows how energy is transferred in an ecosystem (food webs are introduced in Lesson 4).

> be able to compare and contrast producers and consumers (decomposers are introduced in Lesson 4).

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

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

MATERIALS/SETUP

> Student handout (one per student)

AGENDA

Day 1
Engage (10 min)
Explore (40 min)

Day 2
Explain (50 min)

Day 3
Elaborate (40 min)
Evaluate (10 min)

Option: Lesson can be condensed by assigning portions of lesson for homework.

IMPORTANT VOCABULARY

> Food chain

> Energy pyramid

> Producer

> Consumer

> Energy

> Ecosystem

ENGAGE: Key points previewed

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

In the Engage section of the student handout, students will have pictures of a penguin, sardine and plankton. They will categorize each species as a predator, prey, or both with relation to each other.* They will need to provide the appropriate explanation as to why they used these labels.

**Ideally referencing their definitions of predator/prey from Lesson 1: Otter Habit Design*

These labels should be reviewed as a whole group before moving on to the Explore portion of the lesson

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.

In the Explore section of the student handout, students summarize a scientific article and organize information into the appropriate scientific models: food chain and energy pyramid. During this section, students should use the scientific text to conduct research to paraphrase the definitions of producer, primary consumer and secondary consumer. Students should then use this to create a general food chain and energy pyramid that will be connected to their Engage section in the Explain portion of the lesson.

It is recommended that this section be done mostly independently to give each student the chance to practice his or her science literacy skills. A small-group pullout may be helpful for readers who need assistance. Questions 4 and 5 should be discussion questions that can be reviewed in small groups first, but should be discussed with the whole group.

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.

PART 1:

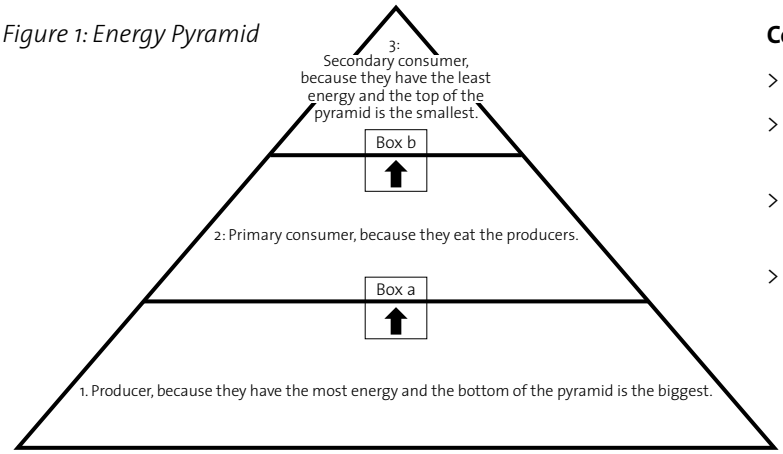
Students independently answer questions 6-8. Think-Pair-Share: Have students discuss each question first in pairs then with the full group.

**Remediation: If students are struggling to understand producers at the bottom of the energy pyramid, discuss the sun's relationship to the energy pyramid. Have students draw a sun in the margin with an arrow toward the bottom, aka producers. Discuss why that can occur.*

PART 2:

Students independently answer questions 9-10. Think-Pair-Share: Have students discuss each question first in pairs, then with the full group. Student model exemplar:

Figure 1: Energy Pyramid



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.

EXPLAIN: Key points formalized *continued*

PART 3:
Students independently answer questions 11-14. Think-Pair-Share: Have students discuss each question first in pairs, then with the full group.

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.

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.

Connection back to African penguins case study:
It is important while caring for penguins that scientists care for many other parts of the ecosystem as well. Identification of predator/prey relationships is very important in identifying how energy is moved throughout the environment. We will then see what happens when populations of a single species affect the other organisms. Shedd Aquarium does a lot of work with rescue and rehabilitation of penguins and their environments. Below is a case study of the work that Shedd does in association with SANCCOB (Southern African Foundation for the Conservation of Coastal Birds) in South Africa.

Students will begin to interpret data on how impacting parts of ecosystems affects the whole ecosystem. They will also be asked to explain how producers and consumers are interdependent.

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.

This lesson will take place over multiple days. By the end of the first class, students should be through the Engage and Explore sections; second class the Explain section; and third class, Elaborate and Evaluate sections. Possible ways to assess students along the way:

Day 1: Vocabulary quiz over terms.

Day 2: Give students a sample food chain and have them label the producer, primary consumer and secondary consumer. Then use this to create an energy pyramid.

Day 3: Students can turn in questions 19 and 20 or you have them complete a similar activity.

NOTES/CONSIDERATIONS

Recommended remediation: Give students additional practice problems in the four categories, possibly even as evening homework.

> Identifying producers, primary consumers and secondary consumers

> Creating or interpreting food chains

> Creating or interpreting energy pyramids

> Altering ecosystem dynamics

Some of these topics will be naturally remediated and reinforced in Lesson 4: Corals, but they will be at a higher rigor. That lesson introduces food chains, decomposers and the movement of atoms.

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

Penguins and Their Interactions with the Environment

STUDENT HANDOUT

Name _____ Class period: _____

ENGAGE

Penguins are most commonly associated with the icy climate of the Antarctic, but did you know that penguins can be found on the continent of Africa? Shedd Aquarium performs an annual rescue and rehabilitation trip to help care for these amazing birds and their native environments. We partner in this work with SANCCOB (Southern African Foundation for the Conservation of Coastal Birds). Today we are going to conduct a research project to understand how energy is moved throughout a penguin's ecosystem.

1. How would you define or explain a predator/prey relationship?

2. Below are pictures of three species that exhibit the predator/prey relationship. You must label each species as either predator, prey, or both (only consider how the three species would interact together). You must also write an explanation as to why you have selected that category.

			
Predator, prey, or both			
Explanation of classification			

EXPLORE

Use the article below to find important definitions as well as complete the scientific models. Scientific models can be images or written ways to describe something that happens in science. Scientists use scientific articles to learn and to develop their own models. The information gathered here will be important for the rest of your case study.

African Penguin Case Study: Ecology Information

An ecosystems is a group of organisms (living things such as plants and animals) and nonliving things (like air and water) that coexist or depend on each other for survival. Organisms in an ecosystem can be placed into three main categories: producers, consumers and decomposers. For this case study, we will focus on producers and consumers. Producers are called this because they can PRODUCE, or make, their own food or energy. This energy is made and stored in the process of photosynthesis. These organisms do not have to eat anything; they just need sunlight, air and water. Since producers create their energy, they do not lose any to the environment; thus they have the most energy available to use.

Consumers, on the other hand, cannot make or produce their own food. Therefore, consumers must CONSUME, or eat, their food or energy source. Additionally, consumers that directly eat producers are called primary (first) consumers whereas consumers that eat other consumers are classified as secondary (second) consumers. Each time energy is consumed, some of it is lost to the environment. Therefore, each time an organism eats another organism, there is less energy available. When organisms consume one another they create a food chain. In a food chain, the arrow points in the direction of energy flow: away from the prey and toward the predator.

3. Complete the vocabulary organizer by creating your own definition for each term based on the information provided in the ecology information.

Scientific Vocabulary	Create Your Own Definition
Ecosystem	
Producer	
Consumer	
Food chain	

4. What is the main difference between producers and consumers?

5. How are primary and secondary consumers the same? How are they different?

EXPLAIN

In this portion you will connect the science knowledge you learned with our penguin case study.

6. The graphic provided is called an energy pyramid. An energy pyramid is a model scientists use to show how much energy is in each level of the ecosystem. Based on the shape of the pyramid, which level (1, 2, or 3) do you think would have the most energy? Why?

7. Based on the shape of the pyramid below, which level do you predict would have the least energy available to it? Why?

8. Using your answers from questions 6 and 7 and the information you have gained about energy in different types of organisms, label levels 1, 2 and 3 on Figure 1 as either a primary consumer, secondary consumer, or producer. Make sure to support your label with an explanation in the pyramid or in the margins.

9. Draw an arrow between the prey and predator to show the flow of energy. Support your answer with a quote from the article ***African Penguin Case Study: Ecology Information***.

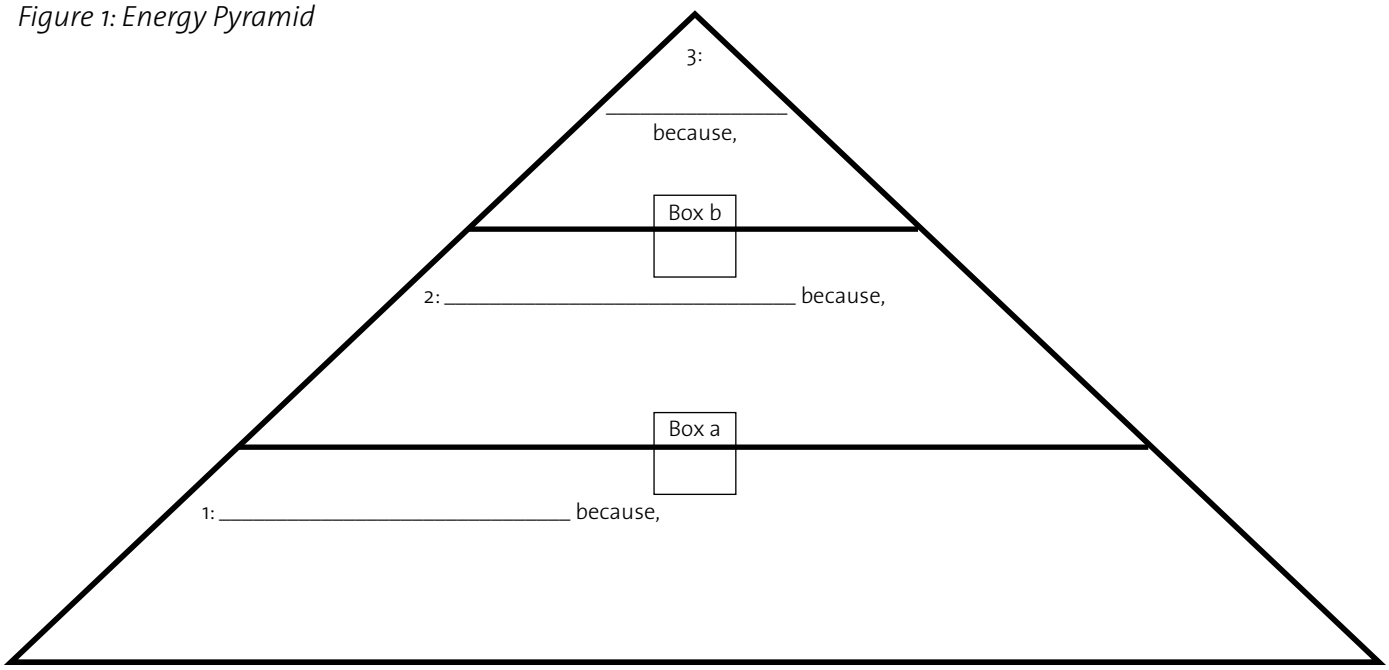
   Prey **Predator** **because according to the text,**

   "_____

   _____"

10. On your energy pyramid below, draw arrows in boxes a and b to show the energy flow between different levels.

Figure 1: Energy Pyramid



Quick check: Fill in the blanks.

11. Grass is a _____ because it can make its own food. Therefore, it would be at the _____ of an energy pyramid.

12. A zebra is a _____ because it eats the grass. Therefore it would be at the _____ of an energy pyramid.

13. A lion is a _____ because it eats the zebra. Therefore it would be at the _____ of the energy pyramid.

14. A. In the space below, draw a food chain for the lion, zebra and grass. You can either draw pictures of the organisms or you can write their names.

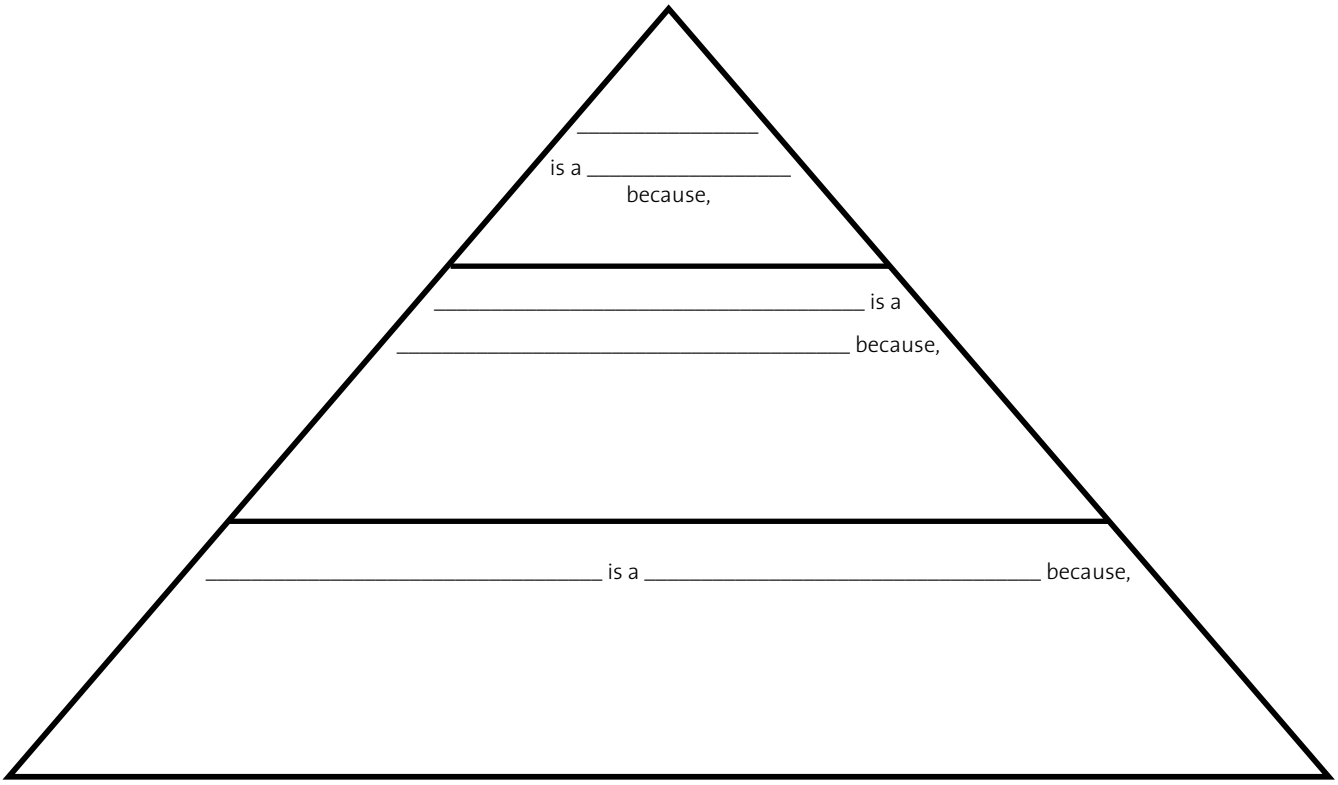
    B. Make sure to label each organism as either a producer, primary consumer, or secondary consumer.

ELABORATE

In this portion we are going to see how changes to ecosystems affect individual populations and ecosystems as a whole.

> Create a food chain using your three species from question 2.
Helpful hint: Make sure to draw your arrows in the correct direction to show the movement of energy.

> Complete the energy pyramid using your same three species. Make sure to classify each species as either a primary consumer, secondary consumer, or producer and explain why.



It is important while caring for penguins that scientists care for many other parts of the ecosystem as well. Identification of predator/prey relationships is important in identifying how energy is moved throughout the environment. We will then see what happens when populations of a single species affect the other organisms. Shedd Aquarium does a lot of work with rescue and rehabilitation of penguins and their environments. Below is a case study of the work that Shedd does in association with SANCCOB in South Africa.

15. Sardines are being overfished off the coasts of South Africa. That means that too many are being taken from the ecosystem. How does this affect African penguins?

16. African penguins can also be prey to sharks. Based on your answer above, if African penguins are affected by overfishing, what will happen to the shark population as well?

17. Scientists use both food chains and energy pyramids to show how energy moves between organisms in an ecosystem, but how are they different?

18. A scientist says that removing or reducing the size of a single population of organisms can affect the entire ecosystem. Do you agree or disagree with the scientist? Why or why not?

EVALUATE

19. Create your own example! Use the models below to create your own example ecosystem.

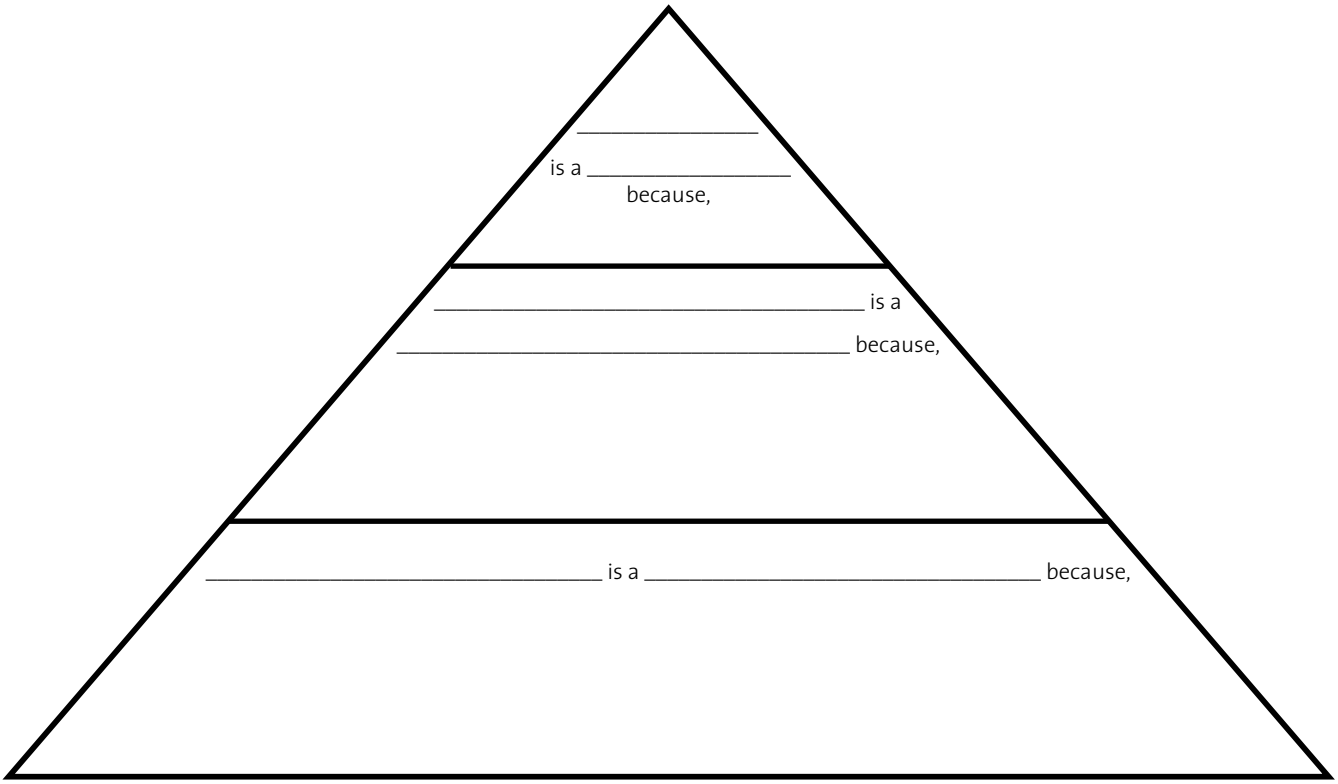
Producer: _____

Primary consumer: _____

Secondary consumer: _____

> Create a food chain using your three species from question 1.
Helpful hint: Make sure to draw your arrows in the correct direction to show the movement of energy.

> Complete the energy pyramid using your same three species. Make sure to classify each species as either a primary consumer, secondary consumer, or producer and explain why.



20. Shedd Aquarium has a long history of responding to animals in urgent need. Through our formal partnership with SANCCOB, we have committed to send Shedd's Animal Response Team every year to help the African penguins, a species closely related to the Magellanic penguins at Shedd. Why is it important to you to protect our world's ecosystems?