Science News
EDUCATOR GUIDE

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Whales Eat More Than We Thought

SOCIETY FOR SCIENCE

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About this Guide

In this Guide, based on the online *Science News* article "Baleen whales eat (and poop) a lot more than we realized," students will learn how scientists estimated the food intake of certain whale species and discuss nutrient cycling and conservation of matter within ecosystems.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the online *Science News* article "Baleen whales eat (and poop) a lot more than we realized," which details scientists' efforts to accurately estimate how much certain whale species eat and what that means for ecosystems. A version of the article, "Whales eat more than we thought," appears in the December 4, 2021 issue of *Science News*. Related standards include NGSS-DCI: HS-LS2; HS-PS1.

> **Student Comprehension Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular Discussion Q&A — Students will discuss nutrient cycling and conservation of matter, and how these concepts can be observed in an ecosystem. Related standards include NGSS-DCI: HS-LS2; HS-PS1.

> **Student Discussion Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

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Article-based Comprehension, Q&A

Directions for teachers: Ask students to read the online *Science News* article "Baleen whales eat (and poop) a lot more than we realized," which details scientists' efforts to accurately estimate how much certain whale species eat and what that means for ecosystems, and answer the questions below. A version of the article, "Whales eat more than we thought," appears in the December 4, 2021 issue of *Science News*.

1. What did researchers recently discover about the diets — and bathroom habits — of baleen whales?

Baleen whales eat, on average, about three times as much food as previously thought. More food in means more poop out.

2. How do these habits shape ocean ecosystems? What does the discovery indicate about whales' roles in ocean ecosystems?

Whale poop serves as a source of crucial nutrients for ocean ecosystems. The volume of food that whales eat, and then excrete, suggests that the animals play a larger role in shaping ocean ecosystems than previously thought.

3. How much does a blue whale eat in a day and how much energy does that translate to? What analogy do scientists use to describe their estimate and why might they use an analogy?

A blue whale can eat on average about 16 metric tons of krill in a day, which translates to roughly 10 to 20 million calories. That is equivalent to eating about 30,000 Big Macs in a day. Scientists use the analogy of Big Macs to help readers better understand the magnitude of a blue whale's food intake.

4. What three questions did scientists need to answer in order to estimate whale food intake?

How often do whales feed? How big are the gulps that whales take when feeding? How much food is in each gulp?

5. How did scientists go about answering those questions? What technologies and techniques did scientists use?

Scientists used sensors attached to the backs of 321 whales representing seven species to monitor when whales lunged for prey — a sign of feeding. Aerial drones helped the team estimate gulp size for 105 whales. Sonar mapping provided information about krill density in feeding areas.

6. How do the scientists' methods compare with methods used in previous research?

The scientists' methods relied on newer technologies, which provided a more detailed view than previous methods such as inferring whales' energy needs based on their size and dissections of dead whales.

7. What happened to the world's populations of giant whales over the last century?

Whale hunting decreased populations of certain species by up to 99 percent.

8. What impact did scientists expect the decline of whale populations to have on krill, tiny crustaceans that are a source of food for whales?

Researchers expected that krill populations would grow since there were fewer whales around to eat the krill.

9. What actually happened to krill populations? How does the recent discovery help explain what happened?

Krill in the Antarctic declined by more than 80 percent in areas where whales were heavily hunted. The research revealed that whales eat more than previously thought, which means their poop plays a bigger role than previously realized. Fewer whales means less poop overall, and that means less iron is available for the phytoplankton blooms that krill feed on. Less iron results in shrinking blooms, leading to declines in krill populations.

10. How might the rebounding of whale populations to levels observed in the early 1900s affect the Southern Ocean's ecosystem?

The ecosystem's productivity could increase by 11 percent, the researchers estimate. That boost would translate to 215 million metric tons more carbon stored in the ocean each year.

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Student Comprehension Worksheet

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Cross-curricular Discussion, Q&A

Directions for teachers:
Ask students to read the online *Science News* article "Baleen whales eat (and poop) a lot more than we realized" and answer the following questions with a partner. A version of the article, "Whales eat more than we thought," appears in the December 4, 2021 issue of *Science News.*

Want to make it a virtual lesson? Post the online *Science News* article to your virtual classroom. Discuss the article and questions with your class on your virtual platform.

Conserving cycles
1. What cycles through an ecosystem and how does it cycle? Explain and give a specific example from the article.

Matter, including nutrients, cycles through ecosystems via processes that include physical and chemical changes. For example, plants and animals consume and then excrete elements found in other organisms and in the physical environment, making those elements available for yet other plants and animals. Those elements combine in different ways into different molecules as they move through. Iron is an example of a cycling nutrient in the article. Whales eat iron-rich krill and excrete the iron. Phytoplankton blooms rely on that iron and in turn feed krill.

2. How does the law of conservation of mass support cyclical processes? How can a cyclical process in an ecosystem be disrupted? Give an example from the article.

The law of conservation of matter states that in a closed system, the mass of the system must remain constant over time. Instead of matter being created or destroyed, it changes forms. That changing of forms allows the same matter to be used by different organisms, so it cycles through the ecosystem. Such cycles can be disrupted if the size of a plant or animal population changes or if a natural disaster impacts the physical environment, for example. Sometimes a cycle is disrupted by humans. For example, humans hunting whales have decreased the size of whale populations. That decline appears to have altered how iron cycles through ecosystems.

3. What role does energy play in ecosystem cycling?

The cycling of matter is supported by the flow of energy. Energy enters most ecosystems from the sun. Photosynthesizing plants use carbon dioxide, water and energy from the sun to create sugars within the plants, thus transforming the sun's energy into chemical energy. This process supports primary consumers, who serve as food and energy sources for secondary consumers, and so on. All physical and chemical changes of matter in a food web, for example, involve energy transformations. Some changes rely on energy, while

others release it. As energy flows, some energy is lost from the system in the form of heat, which is why an outside energy source, such as the sun, is needed to sustain an ecosystem.

A whale of an ecosystem

1. What does it mean to talk about an organism's "role" in an ecosystem? What does the term "role" in this context mean? Give an example from the article.

An organism's role in an ecosystem refers to how it impacts the cycles that exist within the ecosystem. Some examples include producer, consumer, decomposer, parasite, predator, prey and so on. One role that whales play in a marine ecosystem is to keep iron moving through the system. This makes them a nutrient cycler.

2. When ecosystems experience a dramatic change, it can be challenging to determine why. Explain the unexpected impact of whaling on the nutrient cycle as described in the article.

Scientists initially expected that the decrease in the whale population from whaling would lead to an increase in krill because there are fewer whales to eat the krill. Instead, krill populations decreased. Whale poop provides essential nutrients, including iron, for phytoplankton. Krill eat that phytoplankton. By removing iron, phytoplankton numbers dropped, and thus krill numbers dropped too.

3. The article describes how whales' food consumption was quantified. How can putting specific numbers to animal behavior help scientists understand an animal's role in the ecosystem?

Quantifying the amount of krill consumed by whales allowed scientists to determine how big a role whales play in the cycling of iron in the ecosystem. This helped scientists gain a better understanding of the degree to which the whales' disappearance affected various aspects of the ecosystem.

4. Given the complexity of ecosystems, how can scientists determine if one trend or event causes another trend or event?

In a complex ecosystem, there are many possible factors that may contribute to an observed change. In order to prove that one trend or event causes another trend or event, scientists need to identify and explore other contributing factors in order to isolate the variables of interest. Often scientists rely on lab experiments to control for confounding factors — variables that have the potential to distort the relationship between the study's variables of interest. Confounding factors can mask a causal relationship between a study's variables of interest or falsely suggest that a causal relationship exists. Controlling for confounding factors helps scientists gain evidence for causal relationships.

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3. What role does energy play in ecosystem cycling?

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