ScienceNews
EDUCATOR GUIDE

April 24, 2021
Elusive Killer
in Eagle Die-Offs ID'd

SOCIETY
FOR SCIENCE

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About this Guide

In this Guide, based on the online *Science News* "[A toxin behind mysterious eagle die-offs may have finally been found](),￼" students will learn about scientists' quest to solve mysterious bird deaths, discuss how invasive species affect ecosystems and research an invasive species in their region.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the online *Science News* article "[A toxin behind mysterious eagle die-offs may have finally been found]()," which explores scientists' quest to ID a suspect in mass bird deaths. A version of the story, "Elusive killer in eagle die-offs ID'd," appears in the April 24, 2021 issue of *Science News*. Related standards include NGSS-DCI: HS-LS2; HS-LS1.

> **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 define invasive species and discuss how certain species affect ecosystems and human society. Then, students will research invasive species in their region and devise an invasiveness rating scale. Related standards include NGSS-DCI: HS-LS2; HS-LS1.

> **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 your students to read the online *Science News* article "A toxin behind mysterious eagle die-offs may have finally been found," which explores scientists' quest to ID a suspect in mass bird deaths, and answer the following questions. A version of the story, "Elusive killer in eagle die-offs ID'd," appears in the April 24, 2021 issue of *Science News*.

1. What types of birds have died in massive numbers around lakes in the southeast United States? When did the die-offs start?

Massive die-offs of bald eagles, mallards and other began in the mid-1990s.

2. What behavioral observations did scientists make about the birds before and after the animals' deaths? How were the observations connected?

Birds lost coordination, struggled to fly and walk, and had seizures. Examinations of dead birds' brains found unnatural holes called vacuoles. Those holes contributed to the observed symptoms.

3. What disease did scientist classify the birds as having?

Scientists classified the affected birds' symptoms as a disease — vacuolar myelinopathy, or VM.

4. What invasive plant did scientists find around lakes where die-offs took place? Based on this observation, what hypothesis did aquatic ecologist Susan Wilde come up with that might explain the die-offs?

Lakes with die-offs all had dense growth of the invasive water plant *Hydrilla verticillate*, which water birds like to eat. Wilde thought that the plant, and the cyanobacteria that sticks to it, may somehow be causing the die-offs.

5. How did Wilde and colleagues test this hypothesis in the lab? Describe each step and the evidence that the researchers gathered from it.

The scientists first collected samples of the weed and looked at it under a microscope. They saw cyanobacteria covered in goo on leaves. An analysis of the cyanobacteria revealed it was a new species. Wilde's team grew the bacteria in the lab and tested it on birds, and observed no effects.

6. Why did Wilde's team take their investigation from the laboratory to the field?

The team thought that maybe something was wrong with their lab setup, so they went straight to the source. The scientists collected wild weeds covered in cyanobacteria from places with confirmed VM outbreaks.

7. What did the researchers find during their fieldwork? Explain how the discovery led to an additional procedural step and evidence.

They detected an unknown compound made by the bacterial colonies. Tests of the compound showed it was rich in the element bromine. When the scientists gave bromine to lab-grown bacteria, the colonies turned toxic.

8. How did the invasive plant play a role in the die-offs? Explain.

The plant builds up concentrations of bromine that are up to 1,000 times greater than in lake water, and likely leaks bromine under certain conditions turning the cyanobacteria on it toxic. Birds that eat the plant get a deadly dose of toxin.

9. Why did birds that didn't eat the plant get vacuolar myelinopathy, or VM?

Predator species like bald eagles and owls ingest the toxin when they feed on affected water birds.

10. What does Wilde's team plan to do next?

The team is investigating how the toxin might affect mammals.

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8. How did the invasive plant play a role in the die-offs? Explain.

9. Why did birds that didn't eat the plant get vacuolar myelinopathy, or VM?

10. What does Wilde's team plan to do next?

Cross-curricular Discussion, Q&A

Directions for teachers:
Ask students to read the online *Science News* article "A toxin behind mysterious eagle die-offs may have finally been found." Discuss the first set of questions as a class. Then ask students to answer the second set of questions with a partner. Finally, students will individually create an invasiveness rating scale and use it to rank invasive species in their region. Emphasize that these are relative scales and can vary regionally.

Here are some examples of rating scales:
Invasiveness Rankings, New York Invasive Species Information
California Invasive Plant Inventory, California Invasive Plant Council

You can also point students to the online *Science News* article "These are the 5 costliest invasive species, causing billions in damages," which discusses how much invasive species have cost the global economy over the last 50 years and ranks the costliest species.

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.

Defining invasiveness
1. What is an invasive species? Are all non-native species considered invasive? Explain.

An invasive species is a species that is not native to an ecosystem and causes harm to the ecosystem. Not all nonnative species cause harm. Nonnative species are not considered to be invasive until they are shown to cause harm.

2. How can invasive species enter an ecosystem? Give examples to explain your answer and state whether the species was intentionally or accidentally brought to the ecosystem.

Invasive species can be introduced into ecosystems accidentally or on purpose. An example of an accidental introduction is from ballast water in cargo ships. Intentional introduction can happen as a form of pest control or when an animal becomes popular as a pet.

3. Brainstorm ways an invasive species can impact an ecosystem. Consider impacts on the physical environment and living organisms, as well as possible effects on human health, economics and disruption of resources or processes.

Answers will vary, but should include effects on native species, endangered species, humans (economy, health, etc.), the physical environment, etc. For example, an invasive plant species could affect human health by causing lake water to become toxic, thereby limiting humans' ability to eat fish from that lake or to swim in it.

A cascade of harm

1. What nonnative species is described in the *Science News* article?

The nonnative species is the water plant Hydrilla verticillata.

2. Why is this nonnative species considered invasive? What impacts did it have on the ecosystem's physical environment and the animals that live there?

The plant concentrates bromine in its tissues and leaks the element, causing the cyanobacteria that lives on it to become toxic. Birds that ate the weed developed a disease, called vacuolar myelinopathy, in which small holes developed in their brains.

3. Explain the cascade of ecosystem events that the invasive species triggered, starting with the introduction of the nonnative species to the ecosystem. Try to list them in chronological order as much as possible.

Hydrilla verticillata *are introduced to ecosystem and build up high levels of bromine-rich compounds. Cyanobacteria grow on the* Hydrilla. *Low-oxygen water trapped at bottom of lake causes* Hydrilla *to leak bromine-rich compounds into the water. Cyanobacteria use those bromine-rich compounds to create toxins. Water birds eat* Hydrilla *with toxic cyanobacteria and are poisoned. Secondary predators eat poisoned water birds and are also poisoned.*

Ranking invasiveness

1. What are some invasive species in your local area? Choose one to focus on, and write down the impacts it has on its ecosystem. The [USDA National Invasive Species Information Center](#) lets you look for invasive species in your region.

Student answers will vary.

2. Once a species has been identified as invasive, think through characteristics that the species has that may affect its ability to damage the ecosystem. For example, some characteristics could be rate of spread or reproduction, difficulty to control and longevity. Discuss how damaging the species could be to the ecosystem based on these characteristics.

Student answers will vary, but should gauge the threat level of the invasive species based on its characteristics in each of the areas. For example, a species that has a fast rate of reproduction may be more damaging than one that has a slower rate of reproduction.

3. Based on the class brainstorm and other group discussions, create three or four main categories for impacts that invasive species have on ecosystems. Define a scale for ranking the species' level of impact in each category you create. Then, rank your chosen invasive species for each category and come up with an overall rating of the threat the invasive species poses to the ecosystem.

Student answers will vary, but should use categories such as impact to native species, humans and general environment to gauge impact. They should combine that with characteristics like rate of spread, difficulty to control, etc. to create a rating of an invasive species on a scale from highly damaging to not as big of a threat.

4. If time allows, compare your rating scale with another group's. How were your scales similar and different? Rank each other's invasive species using your rating scale. Does it work for another species, or do you need to adjust your rating scale?

Student answers will vary, but they should highlight the relative nature of each scale.

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2. How can invasive species enter an ecosystem? Give examples to explain your answer and state whether the species was intentionally or accidentally brought to the ecosystem.

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