Why Did the Bald Eagle Almost Become Extinct?

A Guided Inquiry Activity to Investigate Humans’ Impact on the Environment

by Sarah J. Glassman and Donna R. Sterling

From the moment the teacher poses the question “Why did the bald eagle almost become extinct?,” the quest to find the answer and the cooperative nature of this activity spur motivation, excitement, and curiosity in students. This activity poses a question, provides evidence needed to answer the question, and uses a cooperative learning structure within which students analyze the evidence and create their own questions. During the activity, students see how a single cause can interact with two natural systems, the water cycle and the bald eagle food chain, to affect the bald eagle population size.
Why did the bald eagle almost become extinct?

In 1947, the pesticide DDT was introduced in the United States (Waite 2004). DDT was sprayed on agricultural crops, at which point it entered the water cycle. It was carried by surface-water runoff to rivers and lakes (Figure 6; the figures in this paper are numbered according to the order in which they are passed out in class).

DDT then entered the bald eagle food chain through aquatic producers, which were then eaten by fish, which are the main food source for bald eagles. Once consumed, the concentration of DDT in a single eagle is higher than in a single fish, because the DDT accumulates in the eagle as more fish are eaten (Figure 7). This process of pesticides increasing in concentration as they move through the food chain is known as biomagnification. The high concentration of DDT in bald eagles affected the hardness of the shells surrounding the eggs they laid, which resulted in the female eagles crushing the shells when they sat on them. In 1972, DDT was banned from use in the United States. Since that time, the population of bald eagles has increased (Figure 3). For more background about the effect of DDT on the bald eagle, visit the U.S. Fish & Wildlife website (see Resources).

Class preparation

Before this activity, students should be familiar with the concepts of food chains, food pyramids, and the water cycle as natural systems.

The class should be divided into groups of three or four students. Students who struggle with reading should be paired with students with a higher reading

Activity summary

Students work in groups of three or four students to determine how the bald eagle almost became extinct. Every five minutes, students are given a piece of evidence to analyze (see Figure 1) that will help them answer the question “Why did the bald eagle almost become extinct?” The evidence can be photocopied so that each group gets a paper copy, or it can be presented to the entire class on an overhead presentation system. After receiving their evidence, student groups have a three- to four-minute collaborative period to write a single yes/no question that they would like answered to help them determine why the bald eagle almost became extinct. Because the explanation why the bald eagle almost became extinct is complex with many interrelated aspects, no single question can answer the whole issue. After each collaborative period, each group has an opportunity one after another to ask its question to the teacher while other groups listen. Occasionally a student group can’t agree on a question, so the group loses its turn. After answering each question with a “yes” or “no,” the teacher gives the next piece of evidence to each group and the next collaborative period begins. This process continues through seven pieces of evidence. By the end of the seven collaborative/question periods, most students will have a detailed understanding of why the bald eagle almost became extinct. Either in class or for homework, students should write their own summary paragraph describing why the bald eagle almost became extinct.

FIGURE 1
Summary of the purpose of each piece of evidence

Evidence #1: Picture (Figure 2)
This picture shows a bald eagle eating a fish. Students need to know that fish is the main source of food for the eagle.

Evidence #2: Graph (Figure 3)
This graph shows how the bald eagle population size increased after DDT was banned in the United States.

Evidence #3: Book excerpt (Figure 4)
This excerpt from Silent Spring reveals to students that the bald eagles were laying eggs, but the eggs were not hatching (Carson 1962, p. 120).

Evidence #4: Timeline (Figure 5)
This evidence directly tells students when DDT was introduced and banned in the United States.

Evidence #5: Diagram (Figure 6)
This diagram shows students how chemicals from agricultural land can be carried by surface-water runoff to bodies of water.

Evidence #6: Diagram (Figure 7)
This food pyramid shows students how fish-eating birds are exposed to high concentrations of chemicals that enter the food chain through water and plants.

Evidence #7: Bird-egg model
The model of a bald eagle egg from 1960 shows students what happened to the shells of the eggs.
ability. Each group should have a different student designated as the timekeeper, recorder, and speaker.

**Teacher preparation**

The evidence needs to be prepared to share with the class. The evidence can be photocopied or shown to the class through an overhead presentation system. If photocopied, copies of evidences #1 to #6 (see Figures 2–7) should be made so there is one for each group. Because students do not take these with them, they can be reused for each class period. Laminating them or placing them in clear sheet protectors will allow for easy dissemination and collection throughout the day, as well as continued use year after year.

Evidence #7 is a model bald eagle egg from 1960 created by the teacher by disintegrating the shell off a chicken egg with vinegar to expose the soft membrane below the shell. Three days before the activity, place enough chicken eggs in a bowl so there is one for each group in every class plus an extra one for each class. Pour vinegar over the eggs until they are submerged, cover the bowl in plastic wrap, and store them in the refrigerator for three days. On the day of the activity, rinse each single egg under water before double bagging it in two plastic, resealable bags. If possible, continue to store the bagged eggs in the refrigerator between class periods. (Students will need to wear chemical splash goggles when working with these due to the acid and other substances, and possibly also gloves, even if the eggs are double bagged, in case there is a break or a leak.)

In the book *Silent Spring*, Rachel Carson describes how people throughout the country observed fewer baby bald eagles in the 1950s and late 1940s compared to the 1930s and early 1940s. She describes these two specific examples in her book:

“Observations at Hawk Mountain are in line with findings elsewhere. One such report comes from Elton Fawks, an official of the Natural Resources Council of Illinois. In 1958 Mr. Fawks reported that a recent count of 59 eagles had included only one immature bird. Similar indications of the dying out of the race come from the world’s only sanctuary for eagles alone, Mount Johnson Island in the Susquehanna River...Since 1934 its single eagle nest has been under observation by Professor Herbert H. Beck...Between 1935 and 1947 use of the nest was regular and uniformly successful. Since 1947, although the adults have occupied the nest and there is evidence of egg laying, no young eagles have been produced” (Carson 1962, p. 120).
Finally, write the question “Why did the bald eagle almost become extinct?” in a hidden place, such as a covered chalkboard, that can be revealed after the activity directions are explained.

**Running the activity with students**

Begin class by telling students that they have a special question they need to answer in class that day. Explain that they will be given seven pieces of scientific evidence that will help them answer the question. After being given each piece of evidence, they will have three to four minutes to determine one yes/no question they would like to have answered. During this time, the recorder is responsible for writing the question and the timekeeper is responsible for keeping track of time. At the end of each period, the speaker for each group will ask the group’s question to the teacher before the next piece of evidence is revealed. Explain to students that at the end of class they will be responsible for writing a short paragraph explaining why the bald eagle almost became extinct. Therefore, they should all be taking notes throughout the class that they can refer back to later.

One problem that can occur during the question period is that students will believe they have determined the complete answer to the question when they only know one piece of the puzzle. For instance, students may ask, “Did DDT cause the bald eagle to almost become extinct?” After you tell them, “Yes,” they might believe they have completed their challenge. To avoid this problem, tell students before the activity starts that the entire answer is complicated and they will need all the evidence to understand it. Throughout the activity, you may need to remind students that there is more to the answer than they currently understand. Students will need to see all seven teacher-provided pieces of evidence before they fully understand why the bald eagle almost became extinct.

At this point, reveal the question “Why did the bald eagle almost become extinct?” and pass out evidence #1 (see Figure 2) to each group. Allow students three to four minutes to analyze the evidence and form their questions. Before the question period, explain that you will not repeat the questions that each group asks. Therefore, it is important that everyone is quiet in order to hear the questions being asked. Explain that students will gain as much knowledge by hearing other groups’ questions as they will in learning the answer to their own question. After each question has been asked and answered, pass out evidence #2 (see Figure 3) to each group and begin the collaborative process again.

Before passing out the final piece of evidence, distribute chemical splash goggles. Explain to students that the egg represents a model of a bald eagle egg from 1960. Before giving a single, double-bagged egg to each group, explain to students that they need to carefully pass the egg to each member of the group. If one group accidentally breaks the egg, use it as an example for the entire class to see the fragility of the
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egg. Otherwise, gather the attention of the entire class while you purposely break an egg to make the example.

By this point, most students should have a good understanding of the reason why the bald eagle almost became extinct. If there is time left in the period, ask students to write a summary paragraph explaining why the bald eagle almost became extinct. Ask students to include a picture of the bald eagle’s food chain with the paragraph. Otherwise, assign this for homework. It should be due the following day, as students will be more likely to remember details if they write their paragraph soon after the activity is completed.

Assessment

Figure 8 provides a basic guide for assessing student paragraphs. The rubric assesses general understanding of the role of DDT, specific supporting evidence, and advanced understanding of biomagnification.

Follow-up activities

During the following class period, you may choose to have students share their paragraphs with each other.

To extend learning, reassign cooperative groups so that students gain information from students they did not work with during the activity.

It is interesting for students to understand the specific example of how the bald eagle almost became extinct. More importantly, ask students how this story illustrates the crosscutting concepts of change and stability and cause and effect (NRC 2011). The introduction of DDT is a change that ultimately affects the stability of the bald eagle population size. DDT can also be viewed as one example of a human cause that affects the delicate balance between different organisms and their environment. Various follow-up activities can be used to transfer students’ understanding of the bald eagle story to a more generalized understanding of humans’ impact on the environment. For instance, have students choose an endangered species from the Kids’ Planet website (see Resources) and determine why the species is endangered. Students will learn that in addition to the bald eagle, numerous other species are endangered due to human activities, such as hunting, deforestation, habitat fragmentation, and pollution.

For an extension, a number of related topics can be discussed. Students can investigate how the Environmental Protection Agency (EPA) regulates pesticides. Information about pesticide regulations can be found on the EPA’s website (see Resources). The controversy of using DDT in developing countries to decrease the incidence of malaria can also be discussed. See Resources for articles about DDT and malaria.

To help students better understand the bald eagle food chain as a natural system, have them draw the bald eagle’s healthy food chain before DDT was introduced. Students can explain how DDT acted as a mechanism to disrupt this natural system. Have students describe other ways this natural system could be affected that would lead to the same kind of problem.

Summary

This cooperative learning activity provides an exciting way for students to learn the specific story of how the bald eagle almost became extinct. In order to attain a detailed understanding of this story, students review the concepts of food chains, water cycles, and how chemicals can affect an organism’s physiology. The bald eagle’s specific story illustrates the delicate balance between organisms and their environment and the impact humans have on this balance. Finally, the process students use during this activity requires
Why Did the Bald Eagle Almost Become Extinct?

Assessment rubric

<table>
<thead>
<tr>
<th>Basic understanding</th>
<th>Yes</th>
<th>Partial</th>
<th>No</th>
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</thead>
<tbody>
<tr>
<td>• DDT caused the bald eagle to almost become extinct.</td>
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<tr>
<td>• Bald eagles eat fish.</td>
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<tr>
<td>• DDT was in the fish that bald eagles ate.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional details</th>
<th>Yes</th>
<th>Partial</th>
<th>No</th>
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</thead>
<tbody>
<tr>
<td>• DDT was a pesticide sprayed on crops.</td>
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<tr>
<td>• DDT was in the fish because fish ate smaller fish, which ate producers.</td>
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<tr>
<td>• Surface-water runoff carried DDT from crops to rivers and lakes.</td>
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<tr>
<td>• DDT caused the eagles to make soft shells.</td>
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<tr>
<td>• When the eagles sat on the eggs, the eggs broke.</td>
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<tr>
<td>• Accurate food chain included showing producers/aquatic plants, fish, and eagles.</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Advanced understanding</th>
<th>Yes</th>
<th>Partial</th>
<th>No</th>
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</thead>
<tbody>
<tr>
<td>• DDT had a bigger impact on the bald eagle compared to other organisms because the bald eagle is at the top of the food chain. Through the process of biomagnification, the concentration of DDT is magnified as it moves through the food chain. This is because the same amount of DDT is spread across a smaller number of eagles compared to a larger number of fish and producers.</td>
<td></td>
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References


Resources

Environmental Protection Agency: Pesticides—www.epa.gov/pesticides/regulating

Kids’ Planet: Especies fact sheets—www.kidsplanet.org/factsheets/map.html
Scientific American: Should DDT be used to combat malaria?—www.scientificamerican.com/article.cfm?id=ddt-use-to-combat-malaria
U.S. Fish & Wildlife Service—www.fws.gov/midwest/eagle/recovery/biologue.html

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