HOW TO USE THIS RESOURCE

The images for this resource, which show two elephants in Gorongosa National Park, one with tusks and one without tusks, can serve as phenomena to explore the key concepts described below.

The pedagogical practice of using phenomena to provide a context for understanding science concepts and topics is an implementation practice supported by the Next Generation Science Standards (NGSS). Phenomena are observable occurrences that students can use to generate science questions for further investigation or to design solutions to problems that drive learning. In this way, phenomena connect learning with what is happening in the world while providing students with the opportunity to apply knowledge while they are building it.

The "Implementation Suggestions" and "Teaching Tips" sections provide options for incorporating the images into a curriculum or unit of study, and can be modified to use as a standalone activity or to supplement an existing lesson. The student handout includes reproductions of the images and the "Background Information" section.

Additional information related to pedagogy and implementation can be found on this resource's webpage, including suggested audience, estimated time, and curriculum connections.

KEY CONCEPTS

- Traits vary within a population. Many of these variations are inherited, or passed from parents to offspring.
- Certain variations can give individuals a survival and/or reproductive advantage in their current environment. If these variations are inherited, they tend to become more common in a population through the process of natural selection. Such variations are called adaptations.
- Both tusks and tusklessness are examples of adaptations in elephants. In the absence of poaching, tusks provide a survival and reproductive advantage. However, under heavy poaching, tusklessness provides a greater survival advantage.
- Human activities influence the abundance of, and selective pressures on, living organisms.

BACKGROUND INFORMATION

Both male and female African elephants usually have tusks, which are long front teeth that grow outside their mouths. Elephants use their tusks to strip bark off trees for food and to dig holes for water and minerals. Male elephants also use their tusks to fight with other males for females. Males without tusks risk being severely wounded and are less likely to be reproductively successful.

These images were taken by cameras in Gorongosa National Park in Mozambique. They show two different African elephants: an elephant that has tusks and an elephant that does not. This absence of tusks, which is called **tusklessness**, is a natural, but usually rare, trait in African elephants.

Scientists are studying how rates of tusklessness in elephant populations — both in Gorongosa and in other regions of Africa — have changed, and are continuing to change, due to **poaching**: the illegal hunting and killing of elephants in order to harvest their tusks for ivory.

IMPLEMENTATION SUGGESTIONS

The following suggestions outline several options for incorporating the image into a unit of study as a phenomenon:

Engagement, establishing prior knowledge, and providing context:

- Begin the lesson by asking students to independently brainstorm words, phrases, or images they associate with the word "elephant." Students may write down their ideas or draw and label a picture.
    - Students may write down a variety of ideas such as "big," trunk," "ivory," "tusks," "gray," or other descriptors or references to when they have seen elephants in person or in the media.
    - Ask students to turn and talk with a partner, sharing their ideas and discussing any similarities or differences. Any differences they notice may begin to generate questions.
    - For online settings, students could share their ideas using a virtual whiteboarding software, such as Google Jamboard or Miro. You can also use polling software, such as Poll Everywhere, to generate a word cloud.
- Tell students that you will be showing them two images of elephants from Gorongosa National Park, which is in the African country of Mozambique. You may want to show them where Mozambique is on a map, as well as a map of the park, to provide context.
- Show the images and ask students to make observations using the sentence stems "I notice...", "It reminds me of…", and "I wonder…".
- Use a think-pair-share protocol to have students share their observations and questions about the images. Record class observations, noting when students make similar observations and drawing attention to the range of student-generated questions.
    - Students may observe that:
        - The pictures were taken about two weeks apart in 2013.
        - One elephant has tusks and the other does not.
    - Students may ask:
        - Are these the same or different elephants?
        - Are the elephants the same age and/or sex?
        - Are the elephants related? Are they the same species?
        - Why does one elephant have tusks and the other does not? Were the tusks removed from one of the elephants?
- Ask each group to share out three of their questions, prioritizing the ones they think will help them best understand the images. Record the questions, drawing attention to their range as well as to any similarities.
- Have students read the "Background Information" for the image.
- Transition to the "Exploration, investigation, and assessment" section by telling students they will now be exploring some data to help them better understand a key observation that many of them probably had about the images — that one elephant had tusks and one did not — and answer some of their questions.

Exploration/investigation, assessment and extension:

- Exploration/Investigation:
    - Tell students that they will now do an activity to help them understand and explain why some elephants don't have tusks. Introduce them to the activity, "Analyzing Data on Tuskless Elephants," in which they will investigate why so many African elephants are being killed illegally and how that poaching is affecting elephant populations.
        - In the first part of the activity, students analyze data showing that elephants are poached primarily for their tusks. It may be helpful to have students use a technique like the Identify and Interpret strategy to unpack Table 1 in the "Student Handout." This data table includes the number of

elephants with and without tusks illegally killed, and whether their tusks and/or meat were taken by poachers. Students use this data to formulate an initial claim about the main reason why elephants are being illegally killed.

- In the next part of the activity, students learn about the work of Joyce Poole, a scientist studying elephants in Gorongosa National Park, by watching the short Scientists at Work video *Selection for Tuskless Elephants*. The "Student Handout" for this activity includes pause points and associated discussion questions for the video. These questions help students analyze data showing how heavy poaching has led to a significant increase in the frequency of tuskless elephants.
- In the extension at the end of the activity, students can explore an additional data set showing the prevalence of tuskless male and female elephants in populations experiencing varying amounts of human activity. They then complete a Claim-Evidence-Reasoning (CER) chart to support the following claim: "In general, the prevalence of female tuskless elephants is highest in areas with heavy poaching." This CER can serve as a formative assessment of students' understanding of tusklessness.

- Assessment**:**
  - Ask students to write a paragraph explaining why there are so many tuskless female elephants in Gorongosa National Park.
    - Consider using part of the complementary activity "Developing an Explanation for Tuskless Elephants" to help students organize their evidence and connect their explanations to their understanding of adaptation and natural selection — in particular, the "Scientific Explanation of Evolution by Natural Selection" chart from Task II in the "Student Handout."
    - The "Scientific Explanation" chart identifies the four main conditions for natural selection and provides space for students to gather evidence related to tusklessness for each of those conditions. Students can fill in the chart based on what they learned from the "Analyzing Data on Tuskless Elephants" activity, then use the chart to write a detailed explanation for the relatively high frequency of tuskless females in Gorongosa.
  - Depending on the course level and goals, it may be helpful to have students engage with another set of resources related to human impacts on the frequency of traits within populations. Students can compare selection for tusklessness to selection in these other cases. Some examples are as follows:
    - The short film *Popped Secret: The Mysterious Origin of Corn* explores the domestication of corn from its wild ancestor, teosinte, by indigenous peoples in what is now Mexico. After students view the film and complete the related activity, have them complete the "Scientific Explanation" chart explaining how selection by humans led to the traits seen in modern corn.
    - For upper-level biology classes, it may be appropriate to substitute the activity "Mapping Genes to Traits in Dogs Using SNPs," which accompanies the lecture "Dog Genomics and Dogs as Model Organisms." Have students complete the "Scientific Explanation" chart explaining how selection by humans led to the traits seen in modern dogs.
    - Both the corn and dog activities provide examples of artificial selection: the selective *breeding* of desirable traits (such as more kernels in corn or desired coat colors in dogs) by humans, which *increases* the frequency of these traits. Students may struggle with the distinction between artificial selection and the type of selection that led to elephant tusklessness: selective *poaching* of individuals with desirable traits (such as large tusks in elephants) by humans, which *decreases* the frequency of these traits (sometimes called "unnatural selection").
      - It may be helpful to have students complete a chart or other graphic organizer comparing unnatural and artificial selection using tusklessness and corn/dogs as examples.

- Extension:
  - Have students engage with the *CSI Wildlife* Click & Learn to explore how scientists use genetics to identify the regions where most elephant poaching occurs, in order to better protect the elephants in those areas. This Click & Learn has three accompanying worksheets.
    - The first worksheet, "Student Worksheet One (Analyzing Genetic Evidence)," walks students through all sections of the Click & Learn, except for the "Frequency Primer" section.
    - The second worksheet, "Student Worksheet Two (Using Genetics to Hunt Elephant Poachers)," provides additional data sets that students use to solve several new cases and asks students to apply claim-evidence-reasoning to support their thinking.
    - The third worksheet, "Student Supplement (Frequency Primer)," scaffolds the "Frequency Primer" section in the Click & Learn and provides additional practice with probability calculations. It may be helpful for students who are new to frequency and probability calculations.
  - Have students engage with the Data Point activity "Using Genetic Evidence to Identify Ivory Poaching Hotspots" to analyze scientific figures and learn more about how scientists are using genetic evidence to identify areas with heavy poaching. This Data Point includes a series of maps showing the locations where African elephants were likely poached, based on genetic evidence from ivory seizures conducted between 2006 and 2014. The associated discussion questions ask students to identify patterns on the maps and to formulate strategies to combat poaching.

TEACHING TIPS

- Present students with the images first, before they read the background information.
- Background information may be edited to support student proficiency, course sequence, etc.
- The images may be projected in lieu of handouts.
- Printed images can be laminated for use in multiple classes.
- Pair or group students to work through one or more of the implementation suggestions.

CREDITS

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