INTRODUCTION

In this activity, you'll investigate real data from elephants to learn how and why populations may change over time. First, you'll explore the data set and come up with a question that interests you. Then, you'll try to answer your question by creating a plot (graph) with the data. Finally, you'll use the data to investigate specific changes in the elephant populations that could be caused by humans. By doing this activity, you'll learn about forces that can drive changes in all populations. And you'll also practice data exploration and analysis skills that can help you understand all kinds of data.

MATERIALS

- the elephant data set (in *Data Explorer* or as a spreadsheet)
- access to *Data Explorer* or a spreadsheet program

PART 1: Exploring the Data Set

The data you're exploring come from African elephants. Many African elephant populations are shrinking due to hunting, habitat loss, and other threats. These populations are also changing in terms of the **traits**, or characteristics, of their individuals. For example, certain traits have become more common in some populations over time.

These data were collected to investigate possible changes in elephant populations along the Kenya-Tanzania border. The locations of the populations are shown in Figure 1. The data set includes elephants from two different time periods: an older period (1966–1968) and a more recent one (2005–2013).
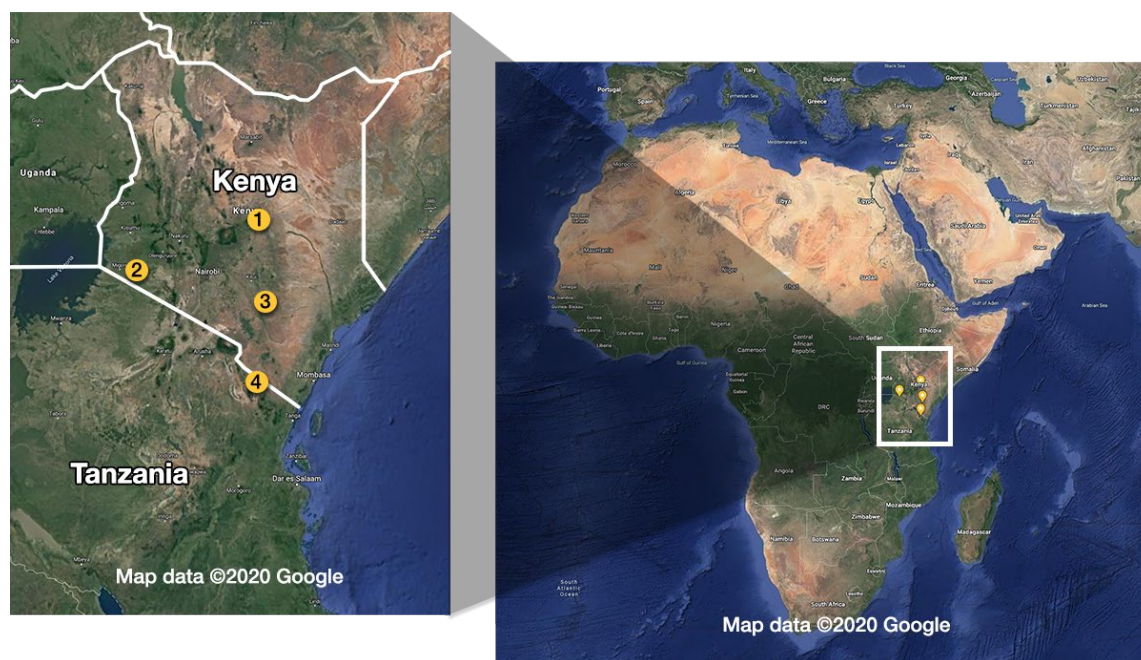

Figure 1. Locations of the elephant populations included in the study (1: Meru National Park, Kenya; 2: Masai Mara National Reserve, Kenya; 3: Tsavo East National Park, Kenya; 4: Mkomazi National Park, Tanzania). Data from the 1966–1968 time period came from locations 3 and 4. Data from the 2005–2013 time period came from locations 1, 2, and 3.

1. Based on the information so far, what kind of data are you expecting to see in this data set? For example, what types of measurements or observations do you think were included?

For elephants in both time periods, scientists recorded traits such as sex, estimated age, shoulder height, tusk length, and tusk circumference. Figure 2 shows how some of the measurements were taken.
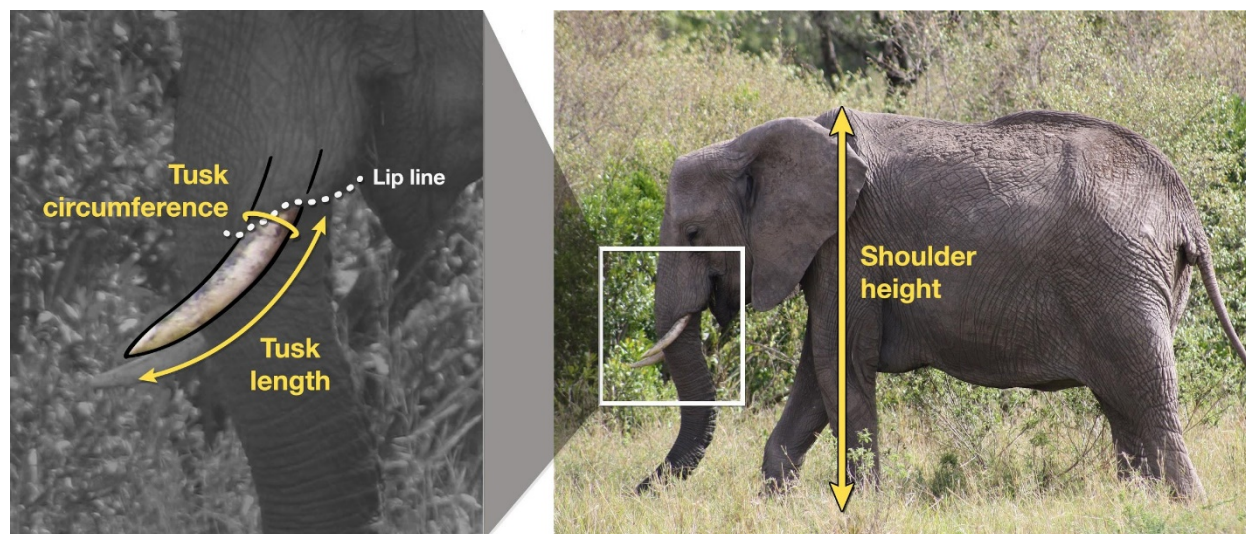

Figure 2. Diagrams showing how an elephant's body and tusk measurements were taken.

Open the elephant data set. In *Data Explorer*, you can do this by clicking "Choose data to explore" on the landing page, selecting the "Elephant populations under poaching" data set, and then clicking the **"Data"** tab at the top. Spend some time getting to know what's in the data set and what the different rows and columns are.

2. Give a reason why collecting these types of data on elephants could be useful. For example, what do you think these data could help us learn or do? If you want, you can pick a specific part of the data to focus on.

3. The data set shows different **variables** (characteristics that differ among individuals) in different columns. There are two types of variables: numerical variables and categorical variables.
    a. How can you tell if a variable is numerical or categorical?

    b. Name one *numerical* variable from this data set.

    c. Name one *categorical* variable from this data set.

4. In many programs, you can "sort" a data set to rearrange it into a certain order. (In *Data Explorer*, for example, you can click on a column name to sort the data by that column.) Sort the data set as needed to answer the following questions.
    a. What is the ID of the elephant with the longest tusks? When was this elephant measured?

b. Find the group of elephants with the top 10 longest tusks. Are there more males or females in this group?

c. What is the age of the youngest elephant, and how many elephants share this age? Why do you think there are no tusk lengths or tusk circumferences listed for these elephants?

d. What are the IDs of the two oldest elephants? Note that no tusk lengths are listed for these elephants. Why might data on these elephants have been included in the data set even though some information is missing?

PART 2: Visualizing the Data

In Part 1, you explored the data by looking at the data table. Another way to explore data is through **visualizing** it, which means visually representing the data in a **plot** (graph). Visualizing data can make it easier to examine trends or relationships between variables.

5. Come up with a research question that is interesting to you *and* could be answered by visualizing these data.

6. Write a hypothesis (your expected answer or result) for your research question.

7. Plan a plot (graph) that could help you test your hypothesis. Feel free to explore several types of plots before choosing the one best suited to your purpose.
   a. Which variables from the data set will your plot show? Are they categorical or numerical variables?

   b. What type of plot are you going to make? Why did you choose that plot type? (*Hint*: Think about the types of variables you chose. Some plots may be better for showing certain types of variables than others.)

   c. What will be on the *x*-axis?

   d. What will be on the *y*-axis?

8. Create your plot in *Data Explorer* (under the **"Visualize"** tab at the top) or another program, as directed by your instructor. Make sure to include the plot when submitting this handout.
9. Summarize what you observe from your plot, including any patterns or trends. Does the plot support the hypothesis you made earlier? Why or why not?

PART 3: Investigating the Impacts of Poaching

Many interesting research questions can be investigated with this data set. One question explored by the scientists who collected the data involves the impacts of **poaching**: the illegal hunting of wild animals by humans.

In the late 1970s and early 1980s, these elephant populations experienced heavy poaching. Poachers (humans who poach) killed many elephants in order to take their tusks for **ivory**: a hard, valuable material used in jewelry, ornaments, and more. Larger tusks have more ivory, so poachers targeted elephants with larger tusks more often.

The poaching of elephants and other animals has reduced many wild populations. Poaching can also cause other long-lasting changes that affect the types of traits in a population. In the late 1800s and early 1900s, for example, foxes in Canada were heavily hunted for their fur. The hunters considered silver fur more valuable than red fur. So, silver foxes were more likely to be killed than red foxes were (Figure 3). Over time, the red fur trait became much more common. Even decades later, foxes with silver fur are still rare in this population.

Figure 3. Examples of foxes with red fur (left) and silver fur (right).

10. Based on what you learned about the fox population, which traits do you think were affected by poaching in the elephant populations? How might the elephant populations have changed over time as a result?

To investigate the impacts of poaching, scientists compared the traits of elephants from 1966–1968 (*before* heavy poaching) to those of elephants from 2005–2013 (*after* heavy poaching). One trait they looked at was tusk length, which is a measure of tusk size.

11. Would you expect the elephants from the two different time periods to have different tusk lengths? Why or why not?

To see whether the data supports your expectations, you will now visualize the data by creating a plot.

12. Plan a plot that will compare the *mean* tusk length for elephants from 1966–1968 (before poaching) to that of elephants from 2005–2013 (after poaching).
    a. What type of plot are you going to make? (*Hint*: What type of plot can you use to compare mean values?)

    b.   What will be on the *x*-axis?

    c.   What will be on the *y*-axis?

13. Create your plot in *Data Explorer* (under the **"Visualize"** tab at the top) or another program, as directed by your instructor. <u>Make sure to include the plot when submitting this handout</u>.

14. Summarize what you observed from this plot, including any patterns or trends. How do these results compare with your expectations in Question 11?

PART 4: Elephant Evolution

Many elephant traits, including tusk length, are likely to be at least partially **inherited** (passed from parents to offspring). Changes in these traits within the elephant populations may indicate changes in the frequency of related genes, which is known as **evolution**. Evolution can be driven by many forces in the environment, including human activities such as poaching.

15. Consider the following conditions required for evolution. Describe how you think each condition applies to the elephant populations under poaching. Provide evidence based on the data set, your plots, and/or information you learned in this activity.

Condition	Description	Evidence in the elephant population
Variation	There is variation in the trait of interest (e.g., tusk size) in the population.	
Inheritance	The trait of interest is at least partially inherited.	
Differential survival and reproduction	Individuals with a certain version of the trait are more likely to survive and reproduce than individuals with a different version of the trait.	
Adaptation	The version of the trait that helps individuals survive and reproduce becomes more common in the population over multiple generations. (The average generation time for African elephants is 25 years.)	

16. Poaching has decreased a lot since the 1980s. Why might poaching still affect mean tusk length in 2005–2013? (*Hint*: The average generation time for African elephants is 25 years.)

17. If there is no more poaching in the future, how might the mean tusk length in 100 years differ from the mean tusk length in 2005–2013? (*Hint*: African elephants use their tusks to strip bark off trees for food and to dig up water from the ground. Larger tusks are useful for these tasks.)

18. In addition to changes in tusk length, how else might elephant populations change due to poaching?