INTRODUCTION

Gorongosa National Park is a 1,570-square-mile protected area in Mozambique. Lion researcher Paola Bouley and her team use motion-detecting trail cameras to learn more about Gorongosa's lions. Lions are not the only animal captured by these cameras. The photos provide valuable information on a variety of different animals, including numbers to help estimate populations, behaviors, and interactions with other animals. The public has identified animals and collected data from the photos on a citizen science website called WildCam Gorongosa (www.wildcamgorongosa.org). The WildCam Lab is a part of WildCam Gorongosa, where you can view trail camera data on a map, filter, and download the data to investigate scientific questions.

The process of science is iterative and adaptable. Scientific inquiry is often initiated by **making observations** about the natural world. Observations can inspire questions about phenomena, to gain understanding about how nature works. For scientists to answer a question, it must be testable, meaning that it could be answered by designing an experiment and/or collecting data. After identifying a **testable question**, the scientist may form a **hypothesis**, which is an explanation for the observed phenomenon based on observations and/or prior scientific knowledge, and **predict** the expected results of the investigation if the hypothesis is supported. The scientist can **test the hypothesis** through experimentation or further observation and then analyze and interpret the collected data.

In this activity, you will learn firsthand what it is like to be an ecologist studying Gorongosa's wildlife. You will use actual trail camera data to generate a testable question, form a hypothesis and prediction, and choose and analyze the appropriate data to answer your question from the WildCam Lab. The results of your investigation may contribute to the conservation effort in Gorongosa National Park.

You can learn more about the trail camera project and help identify animals at WildCam Gorongosa (http://www.wildcamgorongosa.org).

MATERIALS

- Internet access, computers/tablets with spreadsheet software (Excel or Google Sheets)

PROCEDURE

Several online/supplemental resources are used in this activity:

- Gorongosa Interactive Map
- WildCam Lab for data sets
- Tutorial for analyzing data

Follow the instructions and answer the questions in the spaces provided.

PART 1: Making Observations and Asking Questions

A: Launch the Gorongosa Interactive Map (http://www.hhmi.org/biointeractive/gorongosa-national-park-interactive-map) to learn more about the natural features and vegetation types of Gorongosa National Park. In the menu on the left side of the interactive, click on and off the different layers of the map. Clicking features on the map will launch pop-up windows with additional information.

B: Visit WildCam Gorongosa (www.wildcamgorongosa.org) and create an account or sign in with your existing account. Click the "Get Started" button and tour the site to familiarize yourself with WildCam and identify a few animals.

C: Open the Data page of WildCam Lab (https://lab.wildcamgorongosa.org/students/data). A legend in the lower left of the screen explains how the map is color-coded by vegetation type and natural features. The orange dots on the map show the location of cameras. When you click on any of the orange dots, a pop-up window with a random selection of six images is displayed from that camera. Along the top of the pop-up window, information is displayed about the camera location and vegetation type.

Select two orange dots from different vegetation types and document your observations in the table below:

Vegetation Type	Animal observations (types, numbers, behaviors, etc.)	Environmental/landscape observations	Other data

Use the Venn diagram below to compare differences and similarities between the vegetation types:
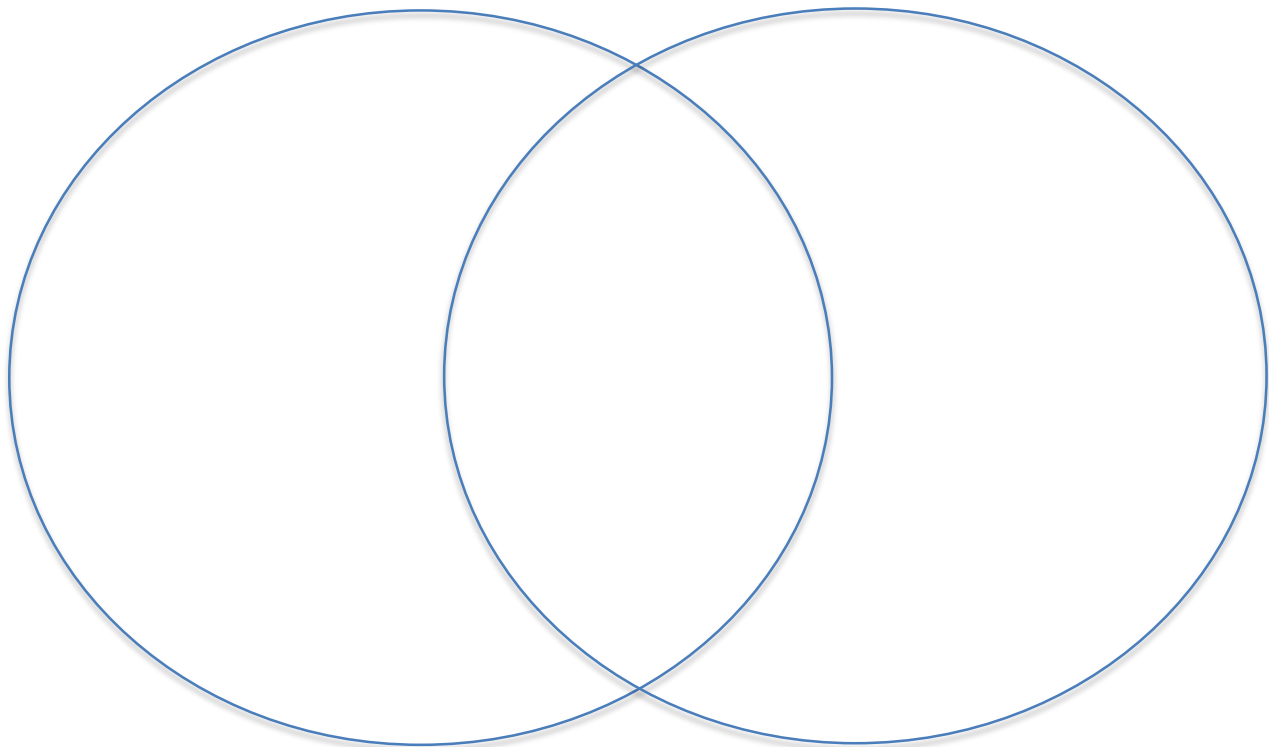
The data on this map can be filtered by preset parameters. Click the "View Filters" button in the upper right portion of the map for a drop-down menu of filters. Choose two filters to activate and then select two new camera locations on the map. Document your observations in the table below:

Selected Filters	Vegetation Type	Animal observations (types, numbers, behaviors, etc.)	Environmental/landscape observations

1. Brainstorm possible research studies or investigations that could be developed using the information (variables) that can be gathered from the trail cameras.

2. Remember that a research question is testable, which we seek to answer through investigating, collecting, and analyzing data. Before coming up with your own testable research question using trail camera data, determine whether the following question is testable using trail camera data:

    During which season is the abundance of animals in the limestone gorge vegetation type highest?

    Explain your answer and include what information (variables) you would need to study this question and whether you could obtain the information from trail camera data alone.

3. A sample spreadsheet from trail camera data below shows the parameters which are collected from the WildCam database for a set of images. Which research questions, identified in question 1 above, are potentially testable using this data? Star or circle each idea that you think you could answer.

image_id	camera	longitude	latitude	date	month	year	season	time_period	veg_type	human_structure	distance_human_m
681504	C15	34.5406	-18.9522	11/17/13	Nov	2013	DryWet Oct-Dec	Day 0623-1709	Floodplain Grassland	Road	4
687882	C08	34.3215	-18.9672	8/10/13	Aug	2013	Dry Jul-Sep	Day 0623-1709	Mixed Savanna and Woodland	Road	3
688612	C21	34.676	-19.0319	9/24/13	Sep	2013	Dry Jul-Sep	Day 0623-1709	Limestone Gorge	Ranger Outpost	6466

water_type	distance_water_m	species	species_count	percentage_resting	percentage_standing	percentage_moving	percentage_eating	percentage_interacting	young_present	horns
River	222	Warthog	1	0	0.2	0.2	0	0	FALSE	
River	3677	Warthog	1	0	0.1	0.1	0	0	FALSE	
River	16	Baboon	1	0.047619048	0.047619048	0.047619048	0.047619048	0	FALSE	

Modify your ideas into questions which could be answered with trail camera data, and write your testable research questions below, underlining the variables you can use from the spreadsheet.

PART 2: Hypothesis and Prediction (Expected Results)

Before exploring your own research question, let's walk through making a hypothesis and prediction using the example research question:

> ***During which season is the abundance of animals in the limestone gorge vegetation type highest?***

By turning on layers and clicking through the information in the Gorongosa Interactive Map, you might discover that the limestone gorge has streams that flow year-round and lush, green vegetation, even during the dry season. Vegetation typically dries out and dies in the other vegetation types during the dry season.

> **Example hypothesis:** *In the limestone gorge vegetation type, animals are most abundant in the dry season because they are attracted to the water and green vegetation that are scarce in other areas.*

Before analyzing data, scientists will typically predict the results or observations that would be generated if the hypothesis were supported.

> **Example prediction:** *In the limestone gorge vegetation type, I will find more animals in photos during the dry season than during any other season.*

4. Based on your observations in Part 1, what might be a hypothesis that would explain the relationships between the variables you are going to explore with your research question?

5. Based on the information you've learned and gathered so far, what are your expected results? Explain the source(s) of your information you used to make your prediction.

An independent variable is the variable you are studying the effect of, and the dependent variable is the variable that is affected by (or depends on) the independent variable. For the example question "*During which season is the abundance of animals in the limestone gorge vegetation type highest?*" the independent variable would be the season and the dependent variable would be the number of animals found in the limestone gorge in each of those seasons.

6. Identify the variables for your testable question:

Independent: _____

Dependent: _____

PART 3: Actual Results and Interpreting Data

You will use the *Tutorial on Scientific Inquiry Using WildCam Gorongosa* to practice how to filter and analyze data using the example research question so that you can then apply this analysis to your research question. Before you begin, you will need to download a data set from WildCam Lab and save it to your computer. Go to https://lab.wildcamgorongosa.org/ and enter the site as an Explorer. Click the data tab and download the data per your teacher's instructions. Open the downloaded spreadsheet and follow the directions for making a pivot table and bar graph (Parts B, C, and D of the tutorial).

Next, you will follow these same steps for your testable research question (Part E of the tutorial). Submit your graph per your teacher's instructions.

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PART 4: Analysis and Feedback

Answer the following questions based on the pivot table and graphs you made for your research question:

7. Describe the trends that you see in your graph.

8. Did the data support or disprove your hypothesis? Explain using evidence from the graph.

9. Were your predictions accurate? Explain using evidence from the graph.

10. How would you revise or write a different/new hypothesis based on your analysis of the data?

11. What are the limitations in using trail camera data in answering your research question?

12. Research is often a nonlinear, or iterative, process. Input of additional information, revisions to the investigation, and peer review happen throughout the research. Explain how you might approach the study of this subject differently were you to conduct similar research again.

13. Did the data inspire revised assumptions about Gorongosa and/or the specific animals/places you were exploring? What new questions or ideas do you have?

Optional Extension: Using the techniques you learned and practiced in this activity, choose another area of study to research (*suggestions: choose different parameters, e.g., day/night, time of year/season); select a new question or idea from question 13 above or identified at the end of Part 1).*

Directions: In paragraph form, address (at minimum) the below questions/topics.

- In a few sentences, what was done in today's lab?
- What was your main take-away?
- What are some key concepts from today's lab that you think might be on your quiz next week?
- Applying knowledge: Look at the map of BBC below and the student-collected data from file **"StudentData_Journal1.xlsx"**. Given the data, form a null and alternative hypothesis that you could test. What is/are the independent variable(s)? If these were your data, what would you have done different with the data collection to make the data more useful? *Hint: look at the data headings and what was actually recorded by the students.

Writing should take about half page (more is ok)
Font: Calibri, 11pt font
Single spaced
1" Margins (except for headers)