Wildebeest vs. Devil Weed: Who Wins?

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Target Grade: 9th Grade Biology

Time Required: 60 minutes

Standards

Next Generation Science Standards (NGSS):

- HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Common Core State Standards for Mathematics

- MP.4: Model with mathematics. (HS-LS1-4) HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

Lesson Objectives

I can…

- Use manipulatives to collect data and make predictions about a population of wildebeests and the effects of invasive species.
- Analyze and interpret data that was collected by the entire class from the manipulative activity to understand the effects of an invasive species on wildebeests.
- Develop and use a model to support my prediction of the wildebeest's relationship with devil weed and the wildebeest's food source.

Central Focus

This lesson plan is to help students understand the impact of Devil Weed, an invasive species, on the ecosystem in Serengeti National Park. Through watching a video about the Great Wildebeest migration, participating in a lab activity to collect data on Devil Weed, and engaging in class discussion, students will explore the complex interactions between wildebeests, grass/resource, and Devil Weed, and evaluate claims, evidence, and reasoning in ecosystems. The lesson will emphasize the importance of taking multiple samples and averaging data to increase the probability of accurate results and

encourage students to apply what they have learned to future scientific investigations or environmental projects.

Key terms: biology, data collecting, interpretation, invasive species, mitigation, science, graphing

Background Information

Invasive species are non-native organisms that, when introduced into a new environment, can have harmful effects on native species and their habitats. These species often outcompete native organisms for resources, disrupt established ecological relationships, and may even lead to declines in native populations. The impact of invasive species can be far-reaching, affecting not only the natural environment but also economic activities and human well-being.

Through this lesson, students will engage in a hands-on simulation using beans to represent different elements of an ecosystem. This activity is designed to provide a tangible experience of how invasive species, represented by devil weed in the simulation, can influence population trends, specifically focusing on wildebeest populations.

Devil weed, also known as famine weed, is an invasive plant species that threatens the food provision for over 2 million animals across the savannahs and eastern Africa. Devil weed originated in Central and Southern America. It was initially used as plant decorations in tourist lodges. However, overtime, the species began to spread and displaced natural vegetation. This weed is known to contain compounds that are toxic to many herbivorous animals, and it is not considered a desirable food source for most grazers.

Wildebeest, also known as gnus, are large antelopes that are native to the grassy plains of Africa. They are known for their annual migration across the Serengeti ecosystem, which is considered one of the largest and most spectacular wildlife events on the planet.

Wildebeest are not only important because of their size and population, but also because of their unique role in the ecosystem. They are considered a keystone species, which means that they have a disproportionate impact on the ecosystem relative to their abundance.

Wildebeest play an important role in the ecosystem because they are grazers that feed on grasses and other vegetation. By consuming large amounts of vegetation, they help maintain the grasslands and prevent the growth of shrubs and trees. This, in turn, helps support a diverse range of other plant and animal species that rely on the grasslands for food and habitat.

In addition, wildebeest also play a role in nutrient cycling. During their annual migration, large numbers of wildebeest drown in rivers, providing a source of nutrients for other organisms downstream. This helps support fish populations and other aquatic life, which in turn supports a range of other species in the ecosystem.

Overall, wildebeest are a key component of the Serengeti ecosystem, and their presence is critical to maintaining the balance and health of the ecosystem. The loss of wildebeest populations could have a significant impact on the ecosystem and the many species that rely on it for survival.

Key terms to be aware of are the following (defined by the oxford dictionary):

- Invasive species: nonindigenous species that spreads from the point of introduction and becomes abundant. The invasive species label attaches only to populations of species whose impact upon introduction has altered their new environment.
- Overpopulation: occurs when a species' population exceeds the carrying capacity of its ecological niche. It can result from an increase in births, a decline in the mortality rate, an increase in immigration, or an unsustainable biome and depletion of resources.
- Ecosystem: a community of living organisms in conjunction with the nonliving components of their environment, interacting as a system. These biotic and abiotic components are linked together through nutrient cycles and energy flows.
- Keystone species: a species on which other species in an ecosystem largely depend, such that if it were removed the ecosystem would change drastically.
- Population dynamics: study of change in population size and structure over time.

Materials

- Lab guides: Serengeti Plot Sampling Lab (1 per group)
- Containers with manipulated beans (representing other native grass species and devil weed) (1 per group)
    - Two types of dried beans or M&M similar in color.
    - The beans should be manipulated to show a decrease in the grass population over a 20-year span – see the Prelab Set Up

Instruction

Prelab Set Up

- Acquire 3 opaque containers per group of students. On the containers, write each year.
- Identify what color/type of bean or bead will represent devil weed and grass.
- Strategically place the beans in the cups to show a decrease in the grass population over a 20-year span.

Example Cup Set Up:

Year	Devil Weed	Grass	Total Beans
1997	25	75	100
2007	50	50	100
2017	75	25	100

Introduction (10 minutes):

- Show students the flowing video that discusses the Great Wildebeest Migration (1:43): https://www.youtube.com/watch?v=EF9YFyTAJiI
- Discuss with students the following questions:
    - How does the great wildebeest migration contribute to the stability of the ecosystem in Serengeti National Park?
    - What evidence in the video supports the claim that the wildebeest migration is a key factor in maintaining the ecosystem's balance?
    - Do you think that the wildebeest migration is an example of a keystone species? If so, how does this affect the stability of the ecosystem?

Exploration (45 minutes):

- Divide the class into groups of 3-4 students.
- Assign each group a number 1-8 (group 1, group 2, etc.)
- Provide groups with the lab guide and provide them time to read through it.
    - Students will read a brief description of Devil weed grass and its history in the Serengeti as well as the experiment task.
- Before students begin the lab, reiterate the guide by explaining that today they will act as researchers sampling data on an introduced species in the Serengeti, devil weed. Each group will be sampling a different plot of grass over the course of thirty years, collecting data every ten years. The container represents the plot, and the different colored beans represents different plant species.
    - Allow time for students to ask any questions before they begin.
    - It may be helpful to present a photo of what a plot sampling looks like so students can better visualize the experiment in the real world.
- Have students complete the lab up through the reflection section.
- Lead a class discussion about the importance of taking multiple samples and averaging the data during an experiment to increase the probability of accurate results. Below are probing questions you can ask students to guide the conversation into realizing they should combine the class data for analysis to better understand the effect of devil weed.
    - Why is it important to take multiple samples during an experiment instead of just one?
    - What are some factors that could cause variation in your results if you only take one sample?
    - How can taking multiple samples help you reduce the impact of these factors on your results?
    - How do you decide how many samples to take during an experiment? What factors should you consider?
    - What is the purpose of averaging your data after you've taken multiple samples? How does this help you get more accurate results?

- How can we use the understanding of the importance of taking multiple samples and averaging data to better analyze the date in this experiment?

- Create or project the following tables on the board and collect full class data.

Group Number	Devil Weed Population in 1997	Devil Weed Population in 2007	Devil Weed Population in 2017
1			
2			
3			
4			
5			
6			
7			
8			
Average			

Group Number	Other Grass Species Population in 1997	Other Plant Species Population in 2007	Other Plant Species Population in 2017
1			
2			
3			
4			
5			
6			
7			
8			
Average			

- Instruct students to complete the class data analysis section on their lab guide.
- Go over student answers with the class.
  - Use this section to build and define terminology when necessary.
  - If needed, create a graph of the first dataset with the students.
- While discussing with the class, use the following probing questions to check for any misconceptions and build the connection to the effect of devil weed on the wildebeest population.
  - Is there a relationship between wildebeests, grass/resource, and devil weed? If so, what kind?

  - How could devil weed cause the wildebeest population to decrease?
  - What do we call an organism that is causing harm to natural resources in an ecosystem, threatening humans?
  - What do you think will happen to the wildebeest population in the future based on your collected data?
- Instruct students to submit their lab guide.

Closure (5 min):

- Have students discuss the following questions in their group and call on students to share their responses:
  - What did you learn today about the great wildebeest migration and the impact of devil weed on the Serengeti ecosystem?
  - How did taking multiple samples and averaging data help you understand the relationship between wildebeests, grass/resource, and devil weed?
  - How do you know if something is an invasive species?
  - What are other examples of invasive species?

Differentiation

- Allow for extra time for students to complete each activity.
- Place students in heterogeneous groups to encourage diverse learning.
- Provide vocabulary lists and definition in different languages for key lesson vocabulary.
- Allow students to create graphs on different online platforms if drawing by hand is difficult.
- When completing the lab, encourage students to each have a different role (writer, timekeeper, data reservoir, bean counter, etc.).

Assessment

Formative assessment:

- Use each class discussion to check for student's understanding and prior knowledge. Address misconceptions and build vocabulary.
- Walk around the classroom while the students are completing their lab and check for students' progress and understanding.

Summative assessment:

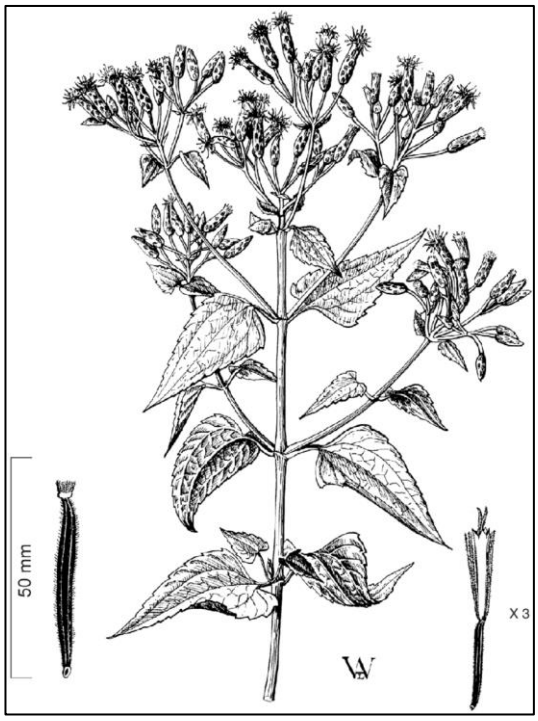
- Have students turn in their lab guides, which can be used to check students' understanding of the given topic.
- Use the closure discussion to check students' understanding, questions, and areas that need more support in future lessons.

Serengeti Plot Sampling Lab

Names: **Date:**

Group Number:

Background Information: Devil weed grass, also known as *Chromolaena odorata*, is a plant species that is native to Central and South America but has been introduced to many other parts of the world, including Africa. It is a fast-growing, perennial shrub that can reach heights of up to six feet. Devil weed grass is known for its ability to colonize disturbed areas quickly, and it has been identified as a threat to natural ecosystems in many parts of the world.



Initially the plant was used as decoration at a tourist lodge in Kenya's Masai-Mara National Reserve. The exact way that devil weed grass was introduced to the Serengeti is not entirely clear, but it is believed to have been brought to the area unintentionally. It is likely that the plant was introduced as a contaminant in imported agricultural products, such as animal feed or seeds. Alternatively, it may have been accidentally introduced by travelers from other parts of Africa where devil weed is already established.

In the Serengeti, devil weed grass is often found growing along roadsides and in areas that have been disturbed by human activity. It is considered a weed by many farmers in the area, as it can quickly take over agricultural fields and reduce crop yields. Additionally, devil weed grass has been identified as a threat to the native plant and animal species in the area, as it can outcompete other plants for resources and disrupt the delicate balance of the ecosystem. Furthermore, this weed is known to contain compounds that are toxic to many herbivorous animals, and it is not considered a desirable food source for most grazers.

Despite these concerns, devil weed grass continues to spread in the Serengeti and other parts of Africa, and efforts to control its spread have been largely unsuccessful. The plant's ability to grow quickly and adapt to changing conditions make it a formidable opponent in the fight to protect native ecosystems.

Field Task: Your research group was tasked with sampling the devil weed population over the course of thirty years. Your container represents 1 plot of land in the Serengeti National Park. Within the container you will have two different beans. One will represent the devil weed grass and the other beans are other species of grass found within your plot. Each container represents data collected from your plot every ten years. Your task is to randomly sample 10 beans each year and determine the change in the devil weed population over time.

Serengeti Plot Sampling Lab

Abstract: In the space below, state the experimental problem and your group's hypothesis.

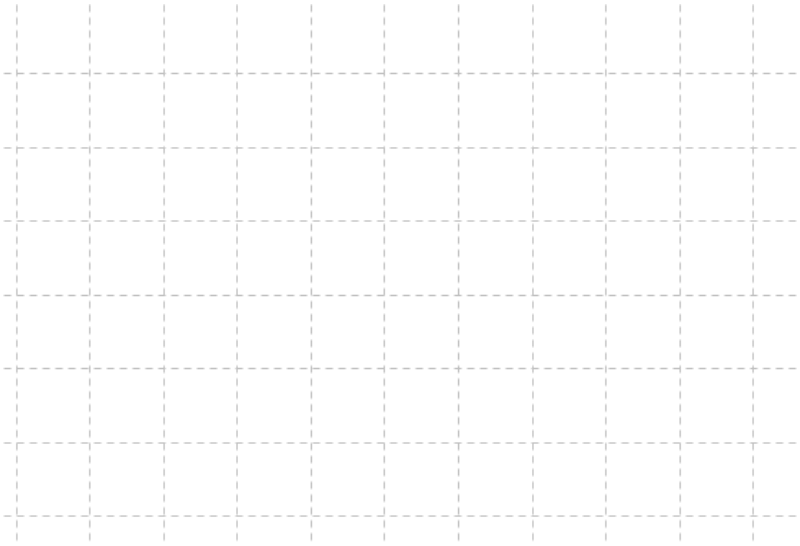
Variables & controls: State the independent variable, dependent variable, and control used in the plot sampling.	
Independent variable	
Dependent variable	
Control	

Procedure: In your own words, write what you did to collect your data.

Data Collection: Record your data in the table below.		
Year	**Total Number of Devil Weed Plants**	**Total Number of Other Species**
1997		
2007		
2017		

Analysis: Graph your data below. Include title, axis labels, and trendline.

Serengeti Plot Sampling Lab



Reflection:

Does your graph support your hypothesis? Why or why not?

What are possible experimental errors that occurred during sampling?

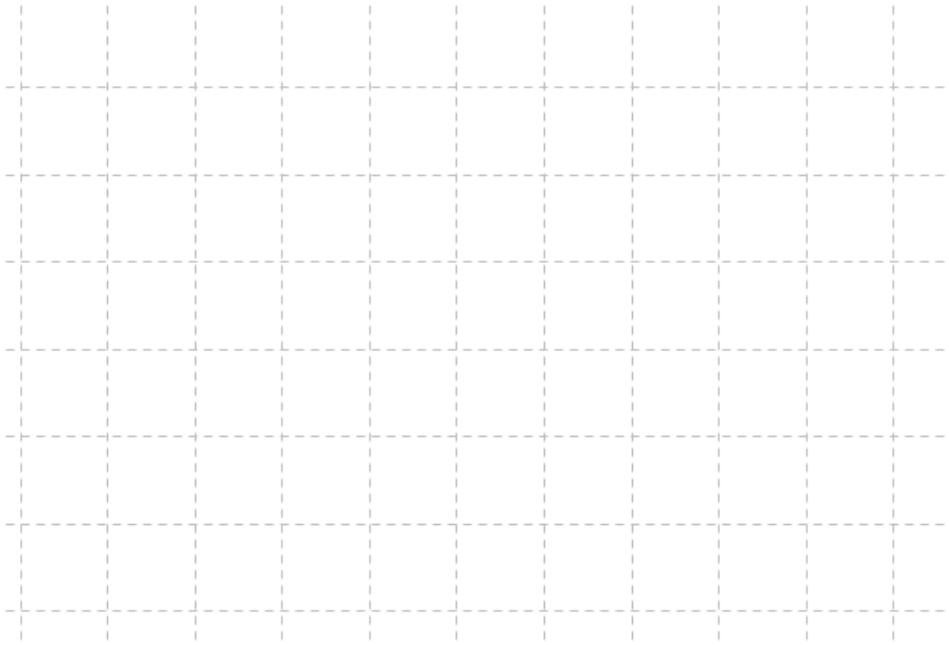
What are ways to get more accurate data when determining population growth over time?

Pause

Serengeti Plot Sampling Lab

Class Data Analysis

Analysis: Create a new graph using the class data. Include title, axis labels, and trendline.



How does your original graph compare to the graph created using the class data?

What are some patterns we see throughout the graph?

Does the new graph support your hypothesis? Why or why not?

Serengeti Plot Sampling Lab

Thinking back to the video about the Great Wildebeest migration, how do you think the introduction of devil weed in the Serengeti will affect the ecosystem? Use the experimental data to support your response.

Create a model to show the to show the relationship between wildebeests, grass/resource, and devil weed.