Unit 8 BILL

Activity Log

Worksheets

1. Elephants 1

1 - Elephants 1

Elephant Worksheet 1

Topics

- I can explain how energy flows through an ecosystem (8.2)
- I can explain how elephants serve as keystone species in their ecosystem (8.5)
- I can calculate Simposon's diversity Index to determine the biodiversity of a community (8.6)
- I can investigate elephant poop and the elephants of Zimbabwe

Investigate: Elephant Poop

Your teacher won a grant and was gifted elephant poop from the African savanna and soil from there as well. Your teacher rocks!!

Make 2 observations on the elephant poop.

1. Seeds that are processed often remain intact after expulsion
2. They help plants grow

Compare and contrast the seed found in the elephant poop vs those found in soil.

The ones from the shit tend to grow better because they have more access to nutrients

Pose a question as to how elephants might impact the ecosystem.

How does their shit promote the environment and spread of plants?

Intro to elephants

Watch video https://www.youtube.com/watch?v=Aw6GkiCvcWs

What surprised you the most about elephants?

Elephants drink so much water. Like why?

Pose a question about elephants.

What selective pressures pushed elephants to have that particular body shape.

Energy flow through a community

A food web shows feeding relationships among organisms

- Arrow means “gives its energy to”

Describe the flow of energy starting at primary producer using “gives its energy to” each time

Grass and trees give energy to the primary consumers - elephants and zebras, which get eaten and transfer the energy to hyenas (secondary) and lions (tertiary)

What happens to energy as it moves through a food chain? The 10 Percent Rule

https://www.youtube.com/watch?v=ScizkxMlEOM

Explain why there aren’t 20 trophic levels in a food chain

The amount of energy that gets sent to the next level is significantly less than the previous level, so the more levels, the less energy that level will have

Elephants as keystone species for biodiversity

Define biodiversity

Variety in species and organisms.

Elephants are among the most intelligent of the creatures with whom we share the planet, with complex consciousnesses that are capable of strong emotions. Across Africa they have inspired respect from the people that share the landscape with them, giving them a strong cultural significance. As icons of the continent elephants are tourism magnets, attracting funding that helps protect wilderness areas. They are also keystone species, playing an important role in maintaining the biodiversity of the ecosystems in which they live.

During the dry season, elephants use their tusks to dig for water. This not only allows the elephants to survive in dry environments and when droughts strike, but also provides water for other animals that share harsh habitats.When forest elephants eat, they create gaps in the vegetation. These gaps allow new plants to grow and create pathways for other smaller animals to use. They are also one of the major ways in which trees disperse their seeds; some species rely entirely upon elephants for seed dispersal.

On the savannahs, elephants feeding on tree sprouts and shrubs help to keep the plains open and able to support the plains game that inhabit these ecosystems. Wherever they live, elephants leave dung that is full of seeds from the many plants they eat. When this dung is deposited the seeds are sown and grow into new grasses, bushes and trees, boosting the health of the savannah ecosystem.

How are elephants increasing the biodiversity in their community?

They basically plant and promote plant growth, leading to a boom in primary produces which introduces more energy into the system.

Watch https://www.youtube.com/watch?v=hRGg5it5FMI
Some Animals Are More Equal than Others: Keystone Species and Trophic Cascades

Predict 4 or more events that would happen if elephants were removed from an area

1. Population of plants would decrease
2. Amount of energy in the system would decrease
3. Populations at all levels will decrease due to the lack of energy
4. Biodiversity will decrease due to a "bottleneck event"

Simpson's Diversity Index

Simpson's Diversity Index Formula

$$\text{Diversity Index} = 1 - \Sigma \frac{n}{N}^2$$

$$n = \text{total number of organisms of a particular species}$$

$$N = \text{total number of organisms of all species}$$

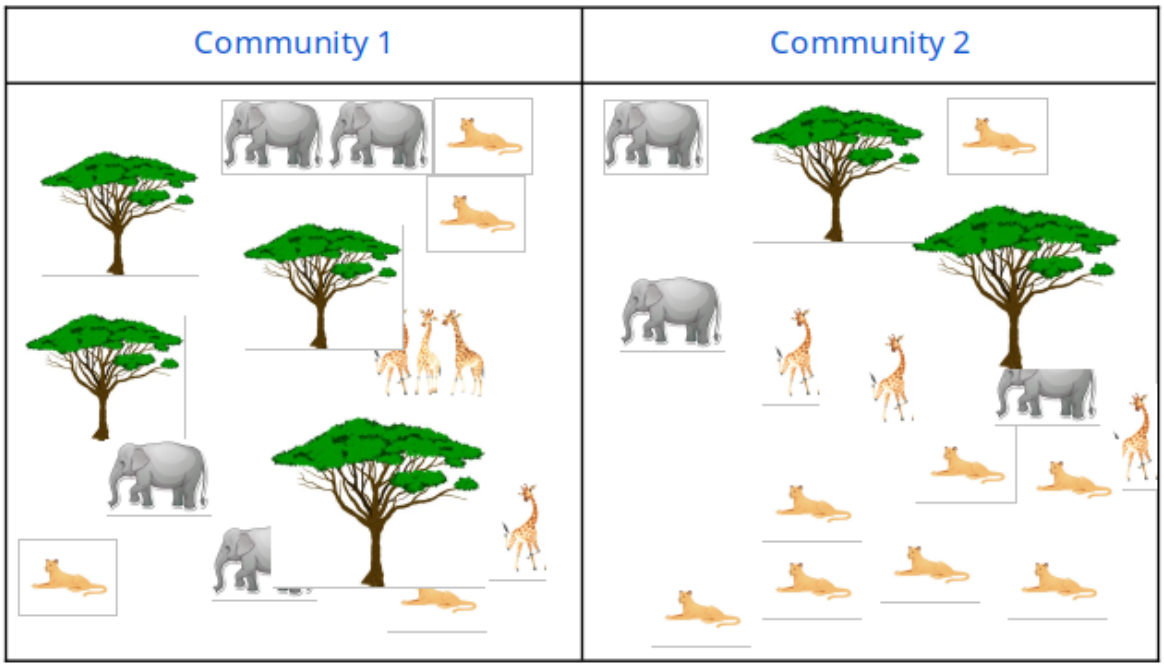
Ecosystems such as old-growth forests and rainforests tend to be quite complex in their biodiversity and are stable. However, not all ecosystems have the same level of biodiversity. Humans have altered many ecosystems to reduce their complexity and diversity by converting previously unused forests into cropland, for example. The conversion of forests into croplands reduces biodiversity by creating monocultures (all the same species), which presents several problems. Nature's tendency to increase biodiversity through succession is something humans battle in an attempt to maintain these monocultures. This is often done with the use of pesticides and herbicides which kill off undesirable species, but that also tend to create other problems when these substances are used to make it easy to harvest a crop for human use.

The Simpson's Diversity Index is used to determine how biodiverse an area is. The formula we will use looks like this:

The index has values from 0 to 1. A large index value indicates a higher degree of biodiversity and a stable ecosystem with many niches and little competition, while a lower

value indicates a lower degree of biodiversity which may indicate an ecosystem with a few dominant species and a greater degree of competition.

Simpsons Biodiversity Practice Problems



Which community is the most diverse?

Community 1 because it is the most balanced.

Justify your guess

It has the most balanced populations of different organisms

Elephants of Zimbabwe

1. Color Zimbabwe on map
2. Read https://qz.com/africa/2005322/zimbabwe-looks-to-elephant-hunting-for-revenue-lost-during-covid/

Describe the state of elephants of Zimbabwe

Zimbabwe is selling rights to hunt elephants in hope that they will have money to protect them??

2. ☑ Elephants 2

2 - Elephants 2

Elephant Worksheet 2

Topics

- I can explain how density-dependent and density independent factors impact elephant populations
- I can collect evidence to support the claim that cooperation increases fitness
- I can compare and contrast types of reproductive strategies
- I can explain the selective pressure that has been placed on a tuskless elephant population

Investigate: Elephant Tusks

-Both male and female elephants have tusks, which start to grow in after baby elephants lose their primary teeth in their first year of life.
-Elephants use their tusks all the time. “Prying bark from trees; digging for water, roots, or minerals; [or] fighting other bull elephants—tusks perform a variety of functions.”

Measure the elephant tusk shown in diagram in cm

10cm

The pulp cavity is connected to the elephant’s face. How much of the tusk is in the elephant’s skull?

Look at a 3D model of an elephant skull. Pose a question about elephant tusks

How did their structure evolve to support strong tusks.

Claim: Cooperative Behavior increases fitness and success of young elephants.

Elephants live in tightly-bonded female-led herds. This is led by the oldest and often largest female in the herd, called a matriarch. Herds usually consist of 8-100 individuals, depending on terrain and family size. When a calf is born, it is raised and protected by the whole matriarchal herd.

Using the graphs, provide at least 2 pieces of evidence to support claim

Those with siblings tend to have larger standard body mass implying better fitness. With a Female as elder, it also increases chances of survival, whilst the opposite decreases.

Elephants are K species. Did you know that they are pregnant for 18-22 months??

How might this slow the conservation effort to save elephants?

Their generation time is much longer, meaning it takes longer to rebound the population

What is the advantage to k-selection? Disadvantage?

Increases survival of offspring, but decreases adaptability.

What is the advantage to r-selection? Disadvantage?

More offspring and increases adaptability, but decreased survival rate.

Optional: Meet the orphan calves
https://elephantswithoutborders.org/elephant-orphanage/meet-the-calves/

Populations of Elephants

What makes a population?

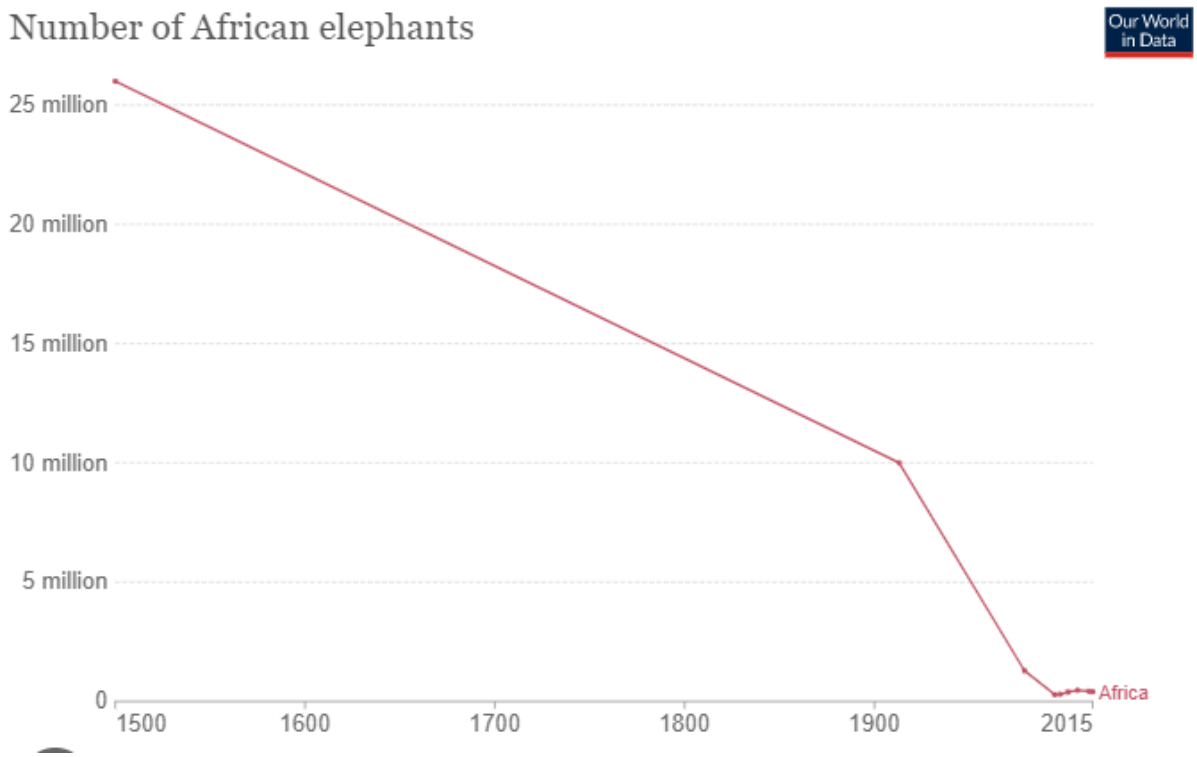
Groups of individuals of the same species that rely on similar resources that occupy the same area

What are density dependent factors that affect elephants?

Competition for land, resources, disease

What are density independent factors that affect elephants?

Natural Disasters



Using info from graph, How have African elephant populations changed over time?

Decreased significantly over time

Elephant species	Population (latest estimate)	Extinction risk	Population trend
African elephant (*Loxodonta africana*)	415,000	*By subspecies below*	*By subspecies below*
African forest elephant (Loxodonta cyclotis)		Critically endangered	Decreasing
African savanna elephant (Loxodonta africana)		Endangered	Decreasing
Asian elephant (*Elephas maximus*)	40,000 – 50,000	Endangered	Decreasing

Using the data table, what species are at risk of extinction today?

African Forest Elephant

Threats elephants face

Read information from the San Diego Zoo website regarding population statistics to see what common threats elephants face: http://ielc.libguides.com/c.php?g=692888&p=4908857

Threat Notes

Watch: How much is your face worth?

What stood out from this PSA?

The tusks are attached to their skull, so to take them then you have to rip off their faces.

Tusklessness population case study

Watch the video clip at http://www.hhmi.org/biointeractive/selection-tuskless-elephants

What is unusual about the elephant populations found in Gorongosa now?

Increased significantly due to artificial selection

How does an elephant use its tusks?

Dig holes, fight, and hunt.

What would probably happen to a male elephant that doesn't have tusks?

Can't fight or hunt.

Therefore, tusklessness in male elephants is a rare trait.

How did the civil war affect elephant populations?

Increased the tusked population

Dr. Poole noticed a high proportion of tuskless elephants after the war. But why did males still have their tusks?

Tuskless elephants could not fight for themselves, so they lost.

What was the selective pressure that increased the numbers of tuskless elephants?

Hunting for ivory

Explain how this selective pressure shifted the population to be more tuskless.

It killed off all the tusked ones so then the allele frequency of the tuskless population increased.

Write an explanation based on natural selection for the high incidence of tusklessness among female elephants in Gorongosa.Highlight vocab: variation, differential reproduction, trait, variation, inherit, DNA

They dont need to fight, so they increased in population due to the hunting, yet tusked males survived because they can basically destroy all the tuskless ones.

Review Questions

In elephants, no tusks (t) is sex-linked recessive tusks (T).

1. If a tuskless female mates with a male with tusks, what % females and males will be tusk-less?
    - 0% tuskless F

- 100% tuskless M

2. In elephants, no tusks (t) is sex-linked recessive tusks (T). If a pure tusked female mates with a male without tusks, what % females and males will be tusk-less?
   - 0% tuskless F
   - 0% tuskless M
3. In elephants, big ears eyes (E) is dominant to small ears(e). If two heterozygous parents mate, what percent will have small ears?
   - 25% small ears
4. In elephants, big ears eyes (E) is dominant to small ears(e). If a homo dominant parent mate with a homo recessive parent, what percent will have small ears?
   - 0% small ears

Elephants of Tanzania

1. Color Tanzania on map
2. Read https://tanzania.wcs.org/Species/Elephant.aspx

> **Describe the state of elephants of Zimbabwe**
>
> Population declines due to poaching for ivory.

3. ☑ Elephants 3

3 - Elephants 3

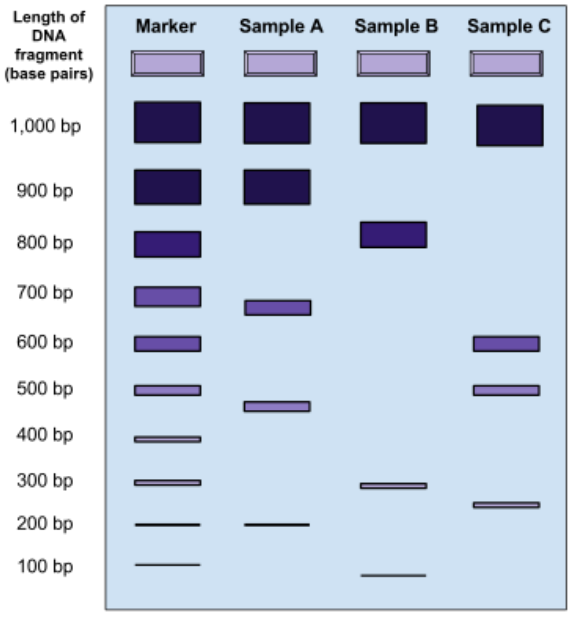
Elephant Worksheet 3

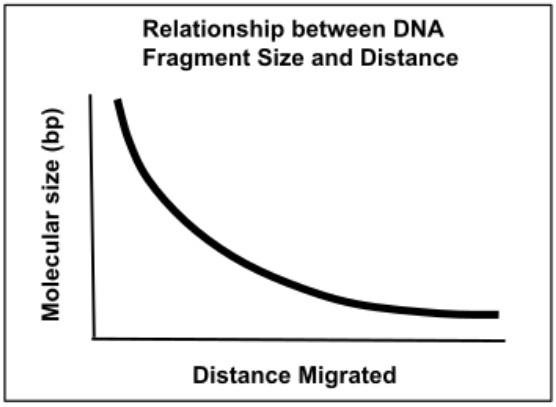
Topics

- I can compare organism relationships

Investigate: Gel electrophoresis

Gel 1



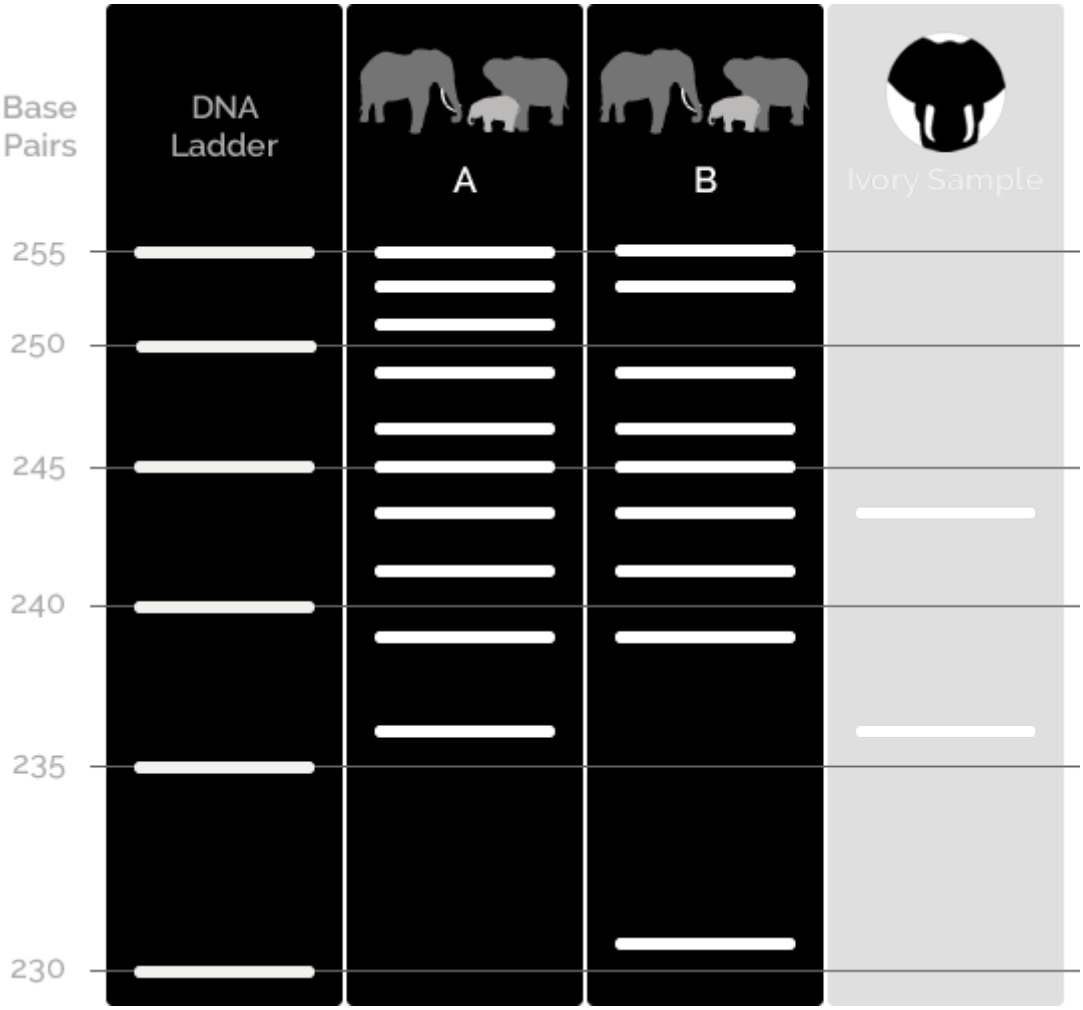


Count the bands on sample A, B and C in gel 1

Sample A ⇒ 5
Sample B ⇒ 4
Sample C ⇒ 4

The fragments that traveled the furthest are **smaller**

Gel 2



Where in Africa Did the Tusks Come From?

The tusks were shipped from a port in Tanzania. Did they come from elephants in that country, or were they transported there from other parts of Africa? You will use data from a reference map of genetic profiles of elephant populations that was built using DNA isolated from dung!

Compare the ivory sample to pop A or pop B. Is the ivory sample more like population A or population B?

A

What's your evidence?

The bands from the electrophoresis line up better

The left lane shows a DNA ladder and lanes A–D show the alleles for Marker X present in each elephant population. Remember that each population profile consists of the alleles from several individual dung samples.

A researcher collected DNA from five dung samples in an elephant population. She amplified the sequence corresponding to the STR locus called "Marker X" and determined each allele's size using gel electrophoresis. The data are shown in the table. Samples that have an identical fragment for both alleles are homozygous for Marker X. If the alleles are different, the individual is heterozygous.

Which of the lanes shown at left corresponds to the Marker X profile for this population?

Lane 1 and 5

Elephants and Other Species

Relationshp	Description	Is this a ++ += +0	Species Examples
Mutualism	Both benefit	++	1, 4
Commensalism	One benefits	+0	2
Paracitism	One benefits, one suffers	+-	3

Example 1

Oxpeckers and cattle egrets are two species of birds that land on elephants and spend their days eating lice, ticks, and other parties out of the elephants' skin and hair. The elephants benefit by having dangerous critters removed from their bodies, and the oxpeckers get a snack and a free ride.

Example 2

The dung beetle retrieves its nourishment from the elephant’s dung, while on the other hand, the elephants are totally indifferent to what happens to its waste.

Example 3

The elephant-specific intestinal fluke Protofasciola robusta, likely to be an ancestral species within the Fasciolidae (Lotfy et al., 2008), has been associated with intestinal tissue damage, hemorrhage and death in free-ranging African elephants

Example 4

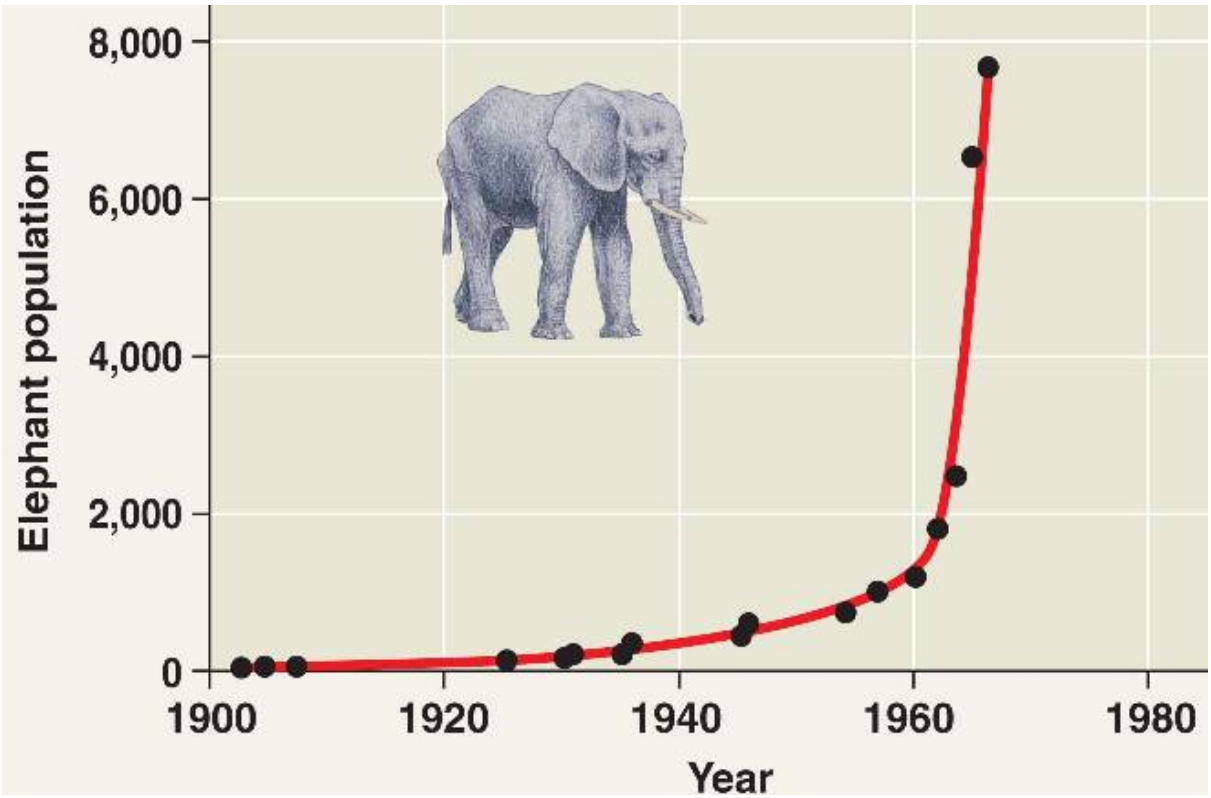
In Eritrea, a country in the Horn of Africa, olive baboons and elephants have formed a symbiotic relationship. The baboons drink from water holes dug by the elephants, and the elephants rely on baboons sitting in the treetops to alert them to danger.

Look at the African continent, make observations on the elephant populations?

Decreasing a lot over time.

Pose a question about populations in different countries

What differences allow certain elephants to survive better in the face of poaching

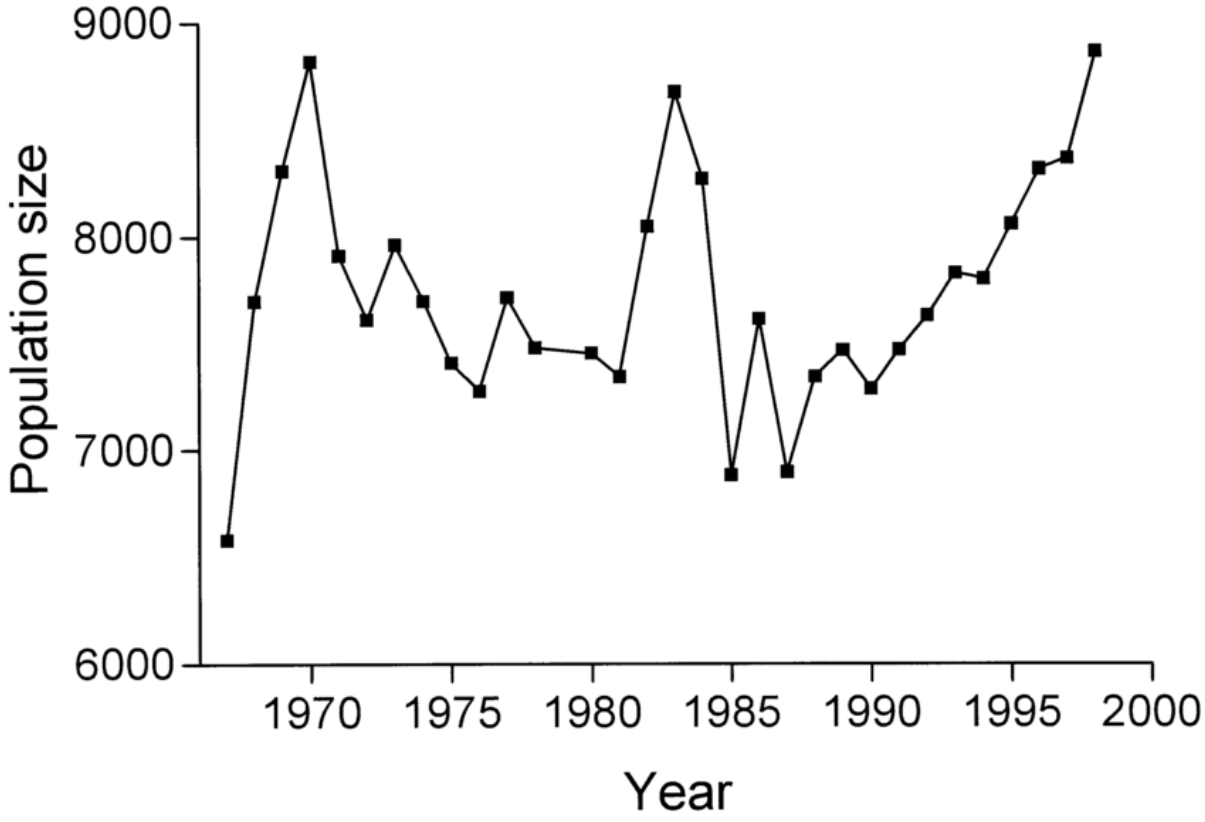


What is the rate of growth in this population between 1950 and 1960?

50 elephants / year

Is this logistic or exponential growth?

Exponential



What is the rate of growth in this population between 1975 and 2000?

70 elephants / year

Is this logistic or exponential growth?

Logistic

Population formulas review questions

Appendix B: AP Biology Equations and Formulas

Rate and Growth	
Rate dY/dt	dY= amount of change t = time
Population Growth dN/dt=B-D *at this moment - absolute number*	B = birth rate D = death rate
Exponential Growth $\frac{dN}{dt} = r_{max}N$ *dynamic - will change the following year as the population changes*	N = population size K = carrying capacity
Logistic Growth $\frac{dN}{dt} = r_{max}N\left(\frac{K-N}{K}\right)$ *when exponential growth is slowed down as it reaches the carrying capacity*	r_{max} = maximum per capita growth rate of population

1. A pop of 23,473 elephants has 2,342 births and 473 deaths. What is the growth rate for this population?
   - 1869
2. One thousand two hundred and seventy deer are living on an island that is eight hundred and thirty square kilometers in size. What is the population density of the deer per square kilometer?
   - 1.53
3. In 2002, 16.47 million babies were born in China. What was the birth rate (as a percentage and per 1000)?
   - 1.29%
4. There are 252 elephants in a population. There is no net immigration or emigration. If 47 elephants die and 32 elephants are born in one month, what is the population size at the end of the month? Round to the nearest whole number.
   - 237
5. In a population of 600 squirrels, the per capita birth rate in a particular period is 0.06 and the per capita death rate is 0.12. What is the per capita growth rate of the population? Round to the nearest hundredth.
   - -0.06
6. If rmax = 1.0 and carrying capacity (K) = 1,500, calculate the population growth rate, where population size (N) = 1,600. What is happening to this population?
   - population is in decline, since above carrying capacity

Review Questions

A lion kills and eats an elephant. Cellular respiration begins. Describe the steps of cellular respiration.

1. How is ATP made in glycolysis, Krebs, and ETC?
    - In cytoplasm
    - In mitochondria
    - Through differential presures
2. How do elephants react to being chased?
    - Secrete hormones like adrenaline that promote the production of energy
3. What molecules amplify the signal?
    - cAMP, kinases

Elephant population of South Africa

1. Color South Africa on map
2. Double Scan and read and describe

Describe the elephant population of South Africa

People interrupted elephants' cycle, which prevented them from migrating, which led them to be too large for the area, putting them above the carrying capacity and decreasing their population.