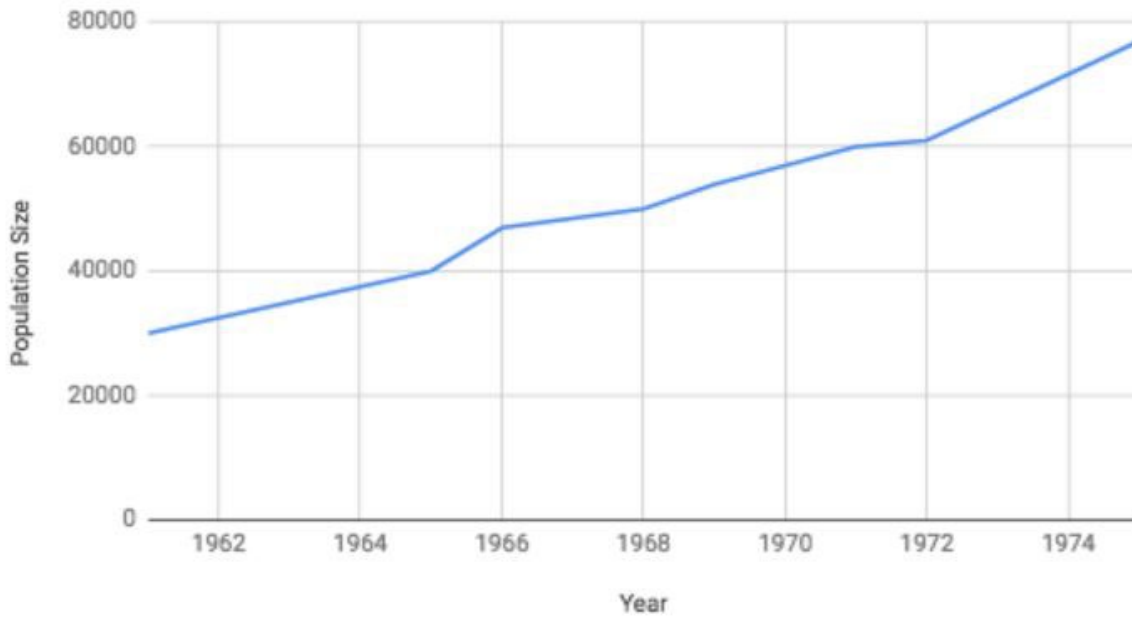# Why does population size change?

Day 1

Examine the graph of the buffalo population below and record some possible reasons to explain why the line shows an increase.

Serengeti Buffalo Population 1960-1975

Reasons:

Examine the two images.

Record what you Notice and Wonder in the chart below.

Notice	Wonder

How Can We Use a Simulation to Investigate Our Questions?

Click here to use the simulation to determine patterns in the buffalo population.

To play the simulation, hit "setup/reset" then "go/pause."

The simulation is already set up for you with these parameters:
- ➢ Initial buffalo population: **10**
- ➢ Grass coverage : **100%**
- ➢ Fences: **ON**
- ➢ Seasonal Rains: **OFF**

1. Hit go/pause button.
2. Watch the blue bar at the top where it says "model speed." When the ticks number is between **1000 and 1500** hit PAUSE.
3. Record the number of buffalo you see in Table 1 below as Trial 1.
4. Hit setup/reset button.
5. Return to Step 1 and repeat all the steps two more times, recording your number of buffalo in Trials 2 and 3.
6. Answer the questions below the table.

Table 1.

Trial	Buffalo Population (at end of simulation)
1	
2	
3	

What patterns did you notice in the data when you compare the trials?

Is there a maximum number of buffalo in the simulation? Use evidence from the simulation to support your claim.

What are some factors that could be limiting the buffalo population?

Environmental Changes and their Effect on Buffalo Populations

Now you will investigate how different environmental changes can affect the buffalo population. Choose one of the following environmental changes to investigate:

- Decrease the grass coverage (food available to the buffalo),

- Increase the precipitation (add seasonal rains) or

- Increase the competition (add wildebeest—they compete with buffalo)

1. In the table below, list the environmental change you selected from the list above.

2. Write a prediction for the change you will investigate using the sentence frame provided.

3. List the variables you will control in your investigation.

4. On the simulation page, make **<u>one</u>** of the following changes which corresponds to the one you chose:
   Grass coverage: decrease the %-grassland-central region from 100% to 70% (in green)

   Precipitation: Click on the button in front of "seasonal-rains" (in green)

   Competition: Click on the button "wildebeests-to-add" and 5 (in green); be sure to change the location you're adding them to "Central Region."

5. Run your simulation <u>three times</u> like you did before and record your data each time as Trial1, 2, and then 3.

List your environmental change:	
Write your prediction by filling in this sentence frame: *When the _____ increases/ decreases (choose one), the buffalo population will increase/ decrease (choose one).*	
List the variables you will control: (factors you keep the same)	

Trial	Buffalo Population
1	
2	
3	

How did this environmental change affect the maximum number in the buffalo population?

Cause and Effect Relationships in Ecosystems

Based on your data, what cause (environmental change) and effect (buffalo population) relationships do you see in the buffalo population?

Which cause (environmental change) might explain the original graph from Lesson 9? Provide evidence to support your claim.

What conclusions can be made about how changes in an environment can impact the population of specific organisms?

Resources:
NSTA Daily Do: https://www.smore.com/f6d3s
Simulation: Novak, M. and Penuel, W. (2017). Serengetti Consumers model.
Related models: Wolf Sheep Predation and Rabbits Weeds Grass are other examples of interacting predator/prey populations with different rules.

PowerPoint:
https://docs.google.com/presentation/d/1GFsYd47mtPnZKrEwB4F2hMh0Ql2FTtg71GKLBSevBAE/edit#slide=id.p

Causes of air pollution

Why don't we see emissions like this too often anymore?

This photo of a power plant was taken before emission control equipment was added. Emissions are down since laws have been enacted to protect the air.

Causes of Air Pollution

Most air pollutants come from burning <u>fossil</u> fuels or plant material. Some are the result of <u>evaporation</u> from human-made materials. Nearly half (49%) of <u>air pollution</u> comes from transportation, 28% from factories and power plants, and the remaining pollution from a variety of other sources.

1. Based on the passage above, use your own words to define "emissions."

2. How do you think emissions have changed over the past month while much of the world is staying in their homes? Support your claim using evidence from the passage.

Fossil Fuels

Fossil fuels are burned in most motor vehicles and power plants. These non-<u>renewable resources</u> are the power for nearly all manufacturing and other industries. Pure coal and petroleum can burn cleanly and emit only carbon dioxide and <u>water</u>, but most of the time these <u>fossil</u> fuels do not burn completely and the incomplete chemical reactions produce pollutants. Few sources of these fossil fuels are pure, so other pollutants are usually released. These pollutants include carbon monoxide, nitrogen dioxide, sulfur dioxide, and hydrocarbons.

3. What is the common name of the fossil fuel we put into our cars? What does it mean for this fossil fuel to be non-renewable?

In large car-dependent cities such as Los Angeles and Mexico City, 80% to 85% of <u>air pollution</u> is from motor vehicles (like the photo to the left). *Ozone, carbon monoxide, and nitrous oxides come from vehicle exhaust.*

Auto exhaust like this means that the fuel is not burning efficiently.

A few pollutants come primarily from power plants or industrial plants that burn coal or oil. Sulfur dioxide (SO_2) is a major component of industrial air pollution that is released whenever coal and petroleum are burned. SO_2 mixes with H_2O in the air to produce sulfuric <u>acid</u> (H_2SO_4).

Mercury is released when coal and some types of wastes are burned. Mercury is emitted as a <u>gas</u>, but as it cools, it becomes a droplet. Mercury droplets eventually fall to the ground. If they fall into sediments, <u>bacteria</u> convert them to the most dangerous form of mercury: methyl mercury. Highly toxic, methyl mercury is one of the metal's organic forms.

4. Go back and circle or highlight all the **pollutants** explained in this section on fossil fuels. Now list them below:

   -
   -
   -
   -

   -
   -
   -

5. Which of these substances have you heard of before? Explain any association you have to any of these substances.

Resources:

https://www.ck12.org/earth-science/causes-of-air-pollution/lesson/Causes-Of-Air-Pollution-HS-ES/?referrer=concept_details

Causes of air pollution continued

Biomass Burning

Fossil fuels are ancient plants and animals that have been converted into usable hydrocarbons. Burning plant and animal material directly also produces pollutants. Biomass is the total amount of living material found in an environment. The biomass of a rainforest is the amount of living material found in that rainforest.

The primary way biomass is burned is for **slash-and-burn agriculture** (**Figure** below). The rainforest is slashed down and then the waste is burned to clear the land for farming. Biomass from other biomes, such as the savannah, is also burned to clear farmland.

The pollutants are much the same as from burning fossil fuels: CO_2, carbon monoxide, methane, particulates, nitrous oxide, hydrocarbons, and organic and elemental carbon. Burning forests increases greenhouse gases in the atmosphere by releasing the CO_2 stored in the biomass and also by removing the forest so that it cannot store CO_2 in the future. As with all forms of air pollution, the smoke from biomass burning often spreads far and pollutants can plague neighboring states or countries.

A forest that has been slash-and-burned to make new farmland.

Particulates result when anything is burned. About 40% of the particulates that enter the atmosphere above the United States are from industry and about 17% are from vehicles. Particulates also occur naturally from volcanic eruptions or windblown dust. Like other pollutants, they travel all around the world on atmospheric currents.

1.   What is slash-and-burn agriculture and what is a main cause for it?

2.   What pollutants does slash-and-burn agriculture release?

Evaporation

Volatile organic compounds (VOCs) enter the atmosphere by evaporation. VOCs evaporate from human-made substances, such as paint thinners, dry cleaning solvents, petroleum, wood preservatives, and other liquids. Naturally occurring VOCs evaporate off of pine and citrus trees. The atmosphere contains tens of thousands of different VOCs, nearly 100 of which are monitored. The most common is methane, a greenhouse gas (**Figure** below). Methane occurs naturally, but human agriculture is increasing the amount of methane in the atmosphere.
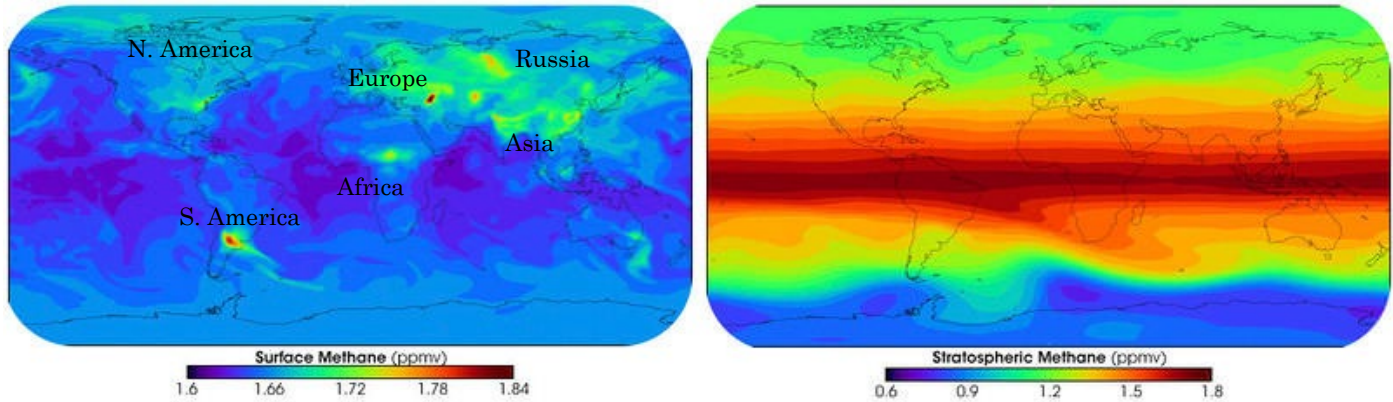
Methane forms when organic material decomposes in an oxygen-poor environment. In the left image, surface methane production is shown. Stratospheric methane concentrations in the right image show that methane is carried up into the stratosphere by the upward flow of air in the tropics.

3. The images above show methane, a greenhouse gas, over different parts of the world. Where are some locations that produce higher amounts of methane? (Use left image).

4. What scientific principle explains why air is moving upward in the tropics – an area of warmer temperatures (and carrying pollutants with it)? (See right image).

5. Define volatile organic compounds and give some examples from both man made items as well as some that occur in nature.

6. Two compounds have been mentioned in lessons 13 and 14 that both occur in the atmosphere naturally but are considered pollutants when in excess, due to human activities. They both are referred to as "greenhouse gasses" because they contribute to the retention of heat in Earth's atmosphere. What are these two gases?

Resources
https://www.ck12.org/earth-science/causes-of-air-pollution/lesson/Causes-Of-Air-Pollution-HS-ES/?referrer=concept_details