



The Ups and Downs of Populations

Based on Oh Deer by Project WILD
By Heather Miller

Focus on Inquiry

The student will collect and analyze data, read, create and interpret graphs, and model population dynamics in a population of 100 deer as they encounter various limiting factors.

Lesson Content Overview

Students will analyze population graphs, collect data to generate their own population graph, and experience limiting factors and their impact on carrying capacity in a small deer population. Students will be able to identify, explain, and evaluate the impact that different limiting factors have on the population of organisms including food, water, shelter, predation, human interference, changes in birth and death rate, changes in immigration and emigration, disease, and reproduction.

Duration 80 minutes	Setting Classroom	Grouping 2-4 students	PTI Inquiry Subskills 1.3, 3.1, 4.2, 4.4, 5.8, 7.3, 7.5
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Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	10 minutes	1.3, 4.2, 4.4, 7.5	Student personal electronic devices (BYOT)	2	Students will analyze 2 different deer population graphs and make hypotheses about what accounts for the differences in the populations. Students will conduct background research on what deer need to survive in the ecosystem.
Explore	20 minutes	3.1	None	3	Students will randomly draw cards to explore how different limiting factors cause changes to their population of deer.
Explain	20 minutes	4.2, 4.4, 5.8, 7.3	None	2	Students will graph their data and respond to follow up questions about their deer population changes.
Expand/Elaborate	20 minutes	4.4, 5.8, 7.3	None	2	Students will choose a different animal and identify the limiting factors in their ecosystem, graphically model the population of their animal and explain the cause of changes in their population.
Evaluate	10 minutes	7.3	None	1	Students will complete a summative assessment on population dynamics.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

NGSS Practice 2: Developing and Using Models

NGSS Practice 3: Planning and Carrying Out Investigations

NGSS Practice 4: Analyzing and Interpreting Data

NGSS Practice 6: Constructing Explanations

NGSS Practice 8: Obtaining, Evaluating and Communicating Information



Next Generation Science Standards – Life Science Content

HS-LS2-1.: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

LS2.A: Interdependent Relationships in Ecosystems

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

**Florida Science Standards – Nature of Science**

SC.7.N.1.1: Define a problem in the 7th grade curriculum and do the following: use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

**Florida Science Standards – Life Science Content**

SC.7.L.17.3: Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.

**Materials and Advance Preparation****Materials List**

Group set:

- Ups & Downs of Populations Cards (1 set per group)
- Ups & Downs of Populations Student Worksheets (1 paper per group or student, as preferred)
- Deer Population A and B Graphs (1 set per group)

Blackline Masters

1. Ups & Downs of Populations Cards – Blackline Master 1
2. Deer Population A and B Graphs – Blackline Master 2
3. Ups & Downs of Populations Student Worksheet – Blackline Master 3
4. Ups & Downs of Populations Assessment – Blackline Master 4
5. Ups & Downs of Populations Answer Keys – Blackline Master 5

Advance Preparation

1. Print enough copies of the Population Cards for each group/pair to have a set of cards.
2. Put cards in an envelope for each group.
3. Print enough copies of the Deer Population Graphs A & B for each group/pair to have a set.
4. Print enough copies of the Student Worksheets for each group/student to have one.

Lesson Information**Learning Objectives**

1. The student will be able to identify, explain, and evaluate the impact that different limiting factors have on the population of organisms including food, water, shelter, predation, human interference, changes in birth and death rate, changes in immigration and emigration, disease, and reproduction.
2. The student will be able to collect and analyze data, read, create and interpret graphs, and model population dynamics in a population of 100 deer as they encounter various limiting factors.

Prior Knowledge Needed by the Students

- Students should have a general understanding of predator-prey relationships and factors that affect living things in their environment.
- Students should have a general understanding of how to read and create line graphs.
- No specific knowledge is required for this activity as students will uncover the concepts throughout the activity.

Background Information

Limiting factors are biotic (living) and abiotic (non-living) things in an ecosystem that prevent a population from growing any larger. For example, 100 deer may live in an ecosystem that has enough water, cover and space to support 200 deer, but if there is only enough food for 100 deer, the population will not grow any larger. In this example, food is the limiting factor.

Food is not the only factor that can limit population growth. For example, sometimes there is enough food in an ecosystem for a large population, but only a small amount of suitable shelter for the organism. Or maybe there is plenty of food, water, shelter and space to support a larger population in an area, but there are so many predators that it limits the amount of that organism.

Limiting factors are very closely tied to carrying capacity. Carrying capacity is the maximum number of a species that can be sustained by a given ecosystem. In the examples above, the carrying capacity of the deer would be 100 since there is only enough of all the resources for 100 deer to feasibly survive. Many animals can increase in numbers very quickly, and may temporarily exceed the carrying capacity of their ecosystem. When there are too many of a species in an ecosystem, this results in stress, starvation, disease, predation and parasites, poor reproductive success and damage to the habitat. For example, multiplying rabbits can very quickly eat all the vegetation in a grassland ecosystem. With the vegetation gone, food becomes the limiting factor and the rabbits may starve or move to another area (immigration). The grassland now has a reduced carrying capacity for rabbits until the vegetation grows back again.

Increasing or decreasing the limiting factors in an ecosystem will result in an increase or decrease in populations. Some of the limiting factors that are explored in this lesson include food, water, shelter, mates, too many males, too many females, drought, fire, hunters, car traffic, immigration, emigration, predators, dangerous organisms, parasites, and disease.

Lesson Procedure

Engage (*Potential student responses can be found in the answer key*)

1. Students are introduced to the lesson's focus question: How is population size affected by different environmental factors?
2. Looking at the patterns in two different graphs, students will predict what they think could account for the differences between the two populations of the deer and write these predictions on their worksheet.
3. With their face partner, students will rally robin (share back and forth) one idea each that they wrote for what is accounting for the differences between the two graphs. They will continue sharing back and forth until the teacher calls time (1-2 minutes).
4. With their shoulder partner, students will research the following questions (BYOD) (5-10 minutes):
 - a. What do deer need to survive?
 - b. What interferes with a deer's survival?
5. Students will then complete the following hypothesis: If a population experiences _____ then it will _____ because _____.
 - a. EX: If a population experiences (an abundance of food, a lack of water, harsh weather, hunting season, etc) then it will (increase, decrease, stay the same) because (deer need to eat a lot of food every day to sustain a healthy weight, deer need water to survive, the severe weather will cause some deer to die from exposure, etc).

*****Units are intentionally left off the Deer Population A & B graphs so that students can interpret them in a way that makes sense to them. This could generate good discussion about what would be an appropriate unit to label this axis with. For example, days would not likely be appropriate because populations don't typically change that much from day to day. Years or decades might be a more appropriate time label.*****

Explore

- Students will conduct their own population study with a population size of 100 deer. They will be exposing their deer to factors that they commonly encounter in their natural ecosystems and will be evaluating how it impacts the deer population.

Procedure:

- Draw one card out of the envelope at a time.
- Read what the card says and record the results in your data table.
 - For example, if the card says that aliens have invaded and have killed 10 deer, subtract 10 deer from your population, record the new number of deer in your population, and then carry the new number into the row below for the next turn.

Population	Limiting Factor	Effect on Population	New Population
100	<i>aliens invaded</i>	<i>-10</i>	<i>90</i>
<i>90</i>			

- DO NOT** put the card back in the envelope.
- Draw the next card and continue drawing and recording data until you have drawn 20 cards and completed all 20 trials.
- When you are finished with your trials, put all cards back in the envelope.

Explain

- Some questions you might ask students while they are working include:
 - Which factor(s) has/have had the most dramatic effect on your population so far? *Student responses will vary but may include drought, mating, etc.*
 - What is the highest your population has reached so far? *Student responses will vary*
 - Looking at your data so far, do you think your population is more like graph A or graph B? *Student responses will vary*
 - Have you picked any cards that have surprised you? *Student responses will vary*
- The questions that are included on the student worksheet include: *Possible student responses are included in the answer key.*
 - Give an overall description of your graph/data. Explain what factors accounted for the major increases or decreases in your **population**.
 - Based on the cards that you chose, and using your data table as a reference, what do you think a “**limiting factor**” is?
 - Biotic** factors are the living things in an **ecosystem**. What were some of the **biotic** limiting factors in the deer’s **ecosystem**?
 - Abiotic** factors are the non-living factors in an **ecosystem**. What were some of the **abiotic** limiting factors in the deer’s **ecosystem**?
 - Choose two **limiting factors** that had a **positive** effect on your **population** and explain why they had an impact on your **population**.
 - Choose two **limiting factors** that had a **negative** effect on your **population** and explain why they had an impact on your **population**.
 - Carrying capacity** is the maximum number of organisms that an **ecosystem** can support. Looking at your data table and graph, what would you predict is the **carrying capacity** for your **ecosystem**? Explain your choice.
 - How is your graph similar or different than the graph of another group?

Expand/Elaborate

- Now that students know a little about deer and the limiting factors that affect their population sizes, they will think about one of their favorite animals or plant species and what might affect their population.
- They will create a simulated population study of their animal based on a little research and their knowledge of limiting factors.

3. Students will complete their analysis of the animal's/plant's biotic factors, abiotic factors, factors that will increase the population, and factors that will decrease the population.
4. Lastly, they will interpret a graph that could represent their animal's population and its changes over time.
5. They will explain the graph in terms of what caused the changes in the population fluctuations (increases, decreases, etc).

Evaluate

FORMAL EVALUATION

Students will complete the Ups and Downs of Populations Assessment.

Students can turn in their lab sheet or their Expand/Elaborate activity for Formal Observation and feedback.

INFORMAL or OPTIONAL EVALUATIONS

- 1) Teacher Observation – Teacher should be watching students during the Explore for:
 - a) Students properly acquiring and recording data.
 - b) Student understanding of their data through use of the Explain questions during and after the Explore activity.
 - c) Students properly graphing their data

WRAP UP.

- *Bring the lesson to a conclusion by discussing Explain questions in small groups or as a whole class.*
- *Have students share their Expand/Elaborate assignment in their groups or do a whole class gallery walk.*
- *Watch the Limiting Factors Carrying Capacity Biotic Potential Video (5:40) found at: https://www.youtube.com/watch?time_continue=174&v=JptytfaO_3s or if you cannot access YouTube:*

Supplementary Resources

Teachers

Crash Course. (2012). *Population Ecology: The Texas Mosquito Mystery - Crash Course Ecology #2*. Retrieved from <https://www.youtube.com/watch?v=RBOsqmBQBQk>.

International Hunter Education Association. (2002). *Limiting Factors*. Retrieved from <http://homestudy.ihea.com/wildlife/09limits.htm>.

MrsMetlis. (2013). *Limiting Factors Carrying Capacity Biotic Potential Video*. Retrieved from https://www.youtube.com/watch?time_continue=174&v=JptytfaO_3s

Students

Andrew Raider Studios. (2015) Geography4kids.com: Populations. Retrieved from http://www.geography4kids.com/files/land_population.html

Ecology. (2015). In *Compton's by Britannica*. Retrieved from <http://kids.britannica.com/comptons/article-273221/ecology>

CITATION OF SOURCES.

Colorado Parks and Wildlife. (n.d.) *Oh Deer!* Retrieved from <http://cpw.state.co.us/learn/Pages/ProjectWildOhDeer.aspx>

Crash Course. (2012). *Population Ecology: The Texas Mosquito Mystery - Crash Course Ecology #2*. Retrieved from <https://www.youtube.com/watch?v=RBOsqmBQBQk>.

International Hunter Education Association. (2002). *Limiting Factors*. Retrieved from <http://homestudy.ihea.com/wildlife/09limits.htm>.

MrsMetlis. (2013). *Limiting Factors Carrying Capacity Biotic Potential Video*. Retrieved from https://www.youtube.com/watch?time_continue=174&v=JptytfaO_3s

Parker, C. (1999). *Oh Deer!* Retrieved from http://www.beaconlearningcenter.com/documents/313_01.pdf

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Ups and Downs of Populations Cards:

Flame: https://pixabay.com/get/9732887a5bc608483fc8/1441312505/fire-30276_1280.png?direct

Drought: <https://www.flickr.com/photos/oxfameastafrica/5758386784/>

Snake: https://pixabay.com/get/66595badd7fa9a966102/1441312162/rattlesnake-32693_1280.png?direct

Wolf: <http://www.freestockphotos.biz/stockphoto/14950>

Bear: <http://www.freestockphotos.biz/stockphoto/13322>

Buck: : www.public-domain-image.com/free-images/Fart%2Fline-art-illustration-pictures%2Fwhite-tailed-deer-head-illustration%2Fattachment%2Fwhite-tailed-deer-head-illustration&psig=AFQjCNF-0XvP6VQAiiCVaKGn79NibGF_Ig&ust=1441470873659269

Doe: https://pixabay.com/get/a4b6fbfb70b5a7d10c89/1441384611/female-48231_1280.png?direct

Skull: <http://www.sketchport.com/drawing/5684992466223104/ol-alfred>

Shelter: <http://www.freestockphotos.biz/stockphoto/15119>

Water: <http://www.public-domain-image.com/free-images/flora-plants/flowers/water-lily-lotus-flower/aquatic-environments-plants-water-lilies-leaves/attachment/aquatic-environments-plants-water-lilies-leaves>

Food: <http://www.torange.us/Plants/fruit-and-berries/currants-in-isolation-33142.html>

Hunter: https://pixabay.com/get/a0a3a77e989458d58353/1441383050/hunter-160297_1280.png?direct

Biting Fly: https://commons.wikimedia.org/wiki/File:Biting_Midge.png

Car: <http://www.freestockphotos.biz/stockphoto/15049>

Doe & Buck: <http://www.public-domain-image.com/free-images/fauna-animals/deers/mule-deer-in-california/attachment/mule-deer-in-california>

Ups and Downs of Populations Assessment:

Food Web: <https://commons.wikimedia.org/wiki/File:TrophicWeb.jpg>

Four Animal Populations Graph: <https://stangbio.wikispaces.com/Ecology>

All pre-made charts, tables, and graphs created by Heather Miller.

Ups and Downs of Populations Student Worksheet:

All pre-made charts, tables, and graphs created by Heather Miller.

Student graph paper: <http://www.texample.net/tikz/examples/graph-paper/>

Yes, I cited all materials and resources used in this lesson.

Heather Miller

Lesson author signature

Blackline Master 1



Photo Credit:
https://pixabay.com/get/9732887a5bc608483f68/1441312505/fire-30276_1280.png?direct

A fire has engulfed a large section of the forest. 25 deer have died as a result.



Photo Credit: <https://www.flickr.com/photos/osjameastafrica/5758386784/>

It hasn't rained in weeks and your ecosystem is suffering a drought. As a result, half of your current population dies.

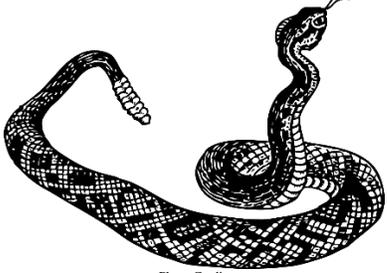


Photo Credit:
https://pixabay.com/get/66595badd7fa9a966102/1441312162/rattlesnake-32693_1280.png?direct

A new family of rattlesnakes are living in your area and have bitten 5 deer in your population. As a result, all 5 deer have died.

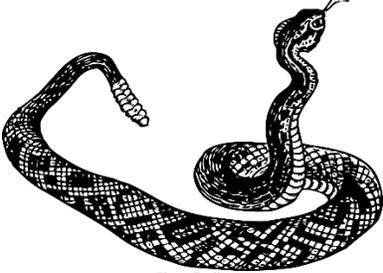


Photo Credit:
https://pixabay.com/get/66595badd7fa9a966102/1441312162/rattlesnake-32693_1280.png?direct

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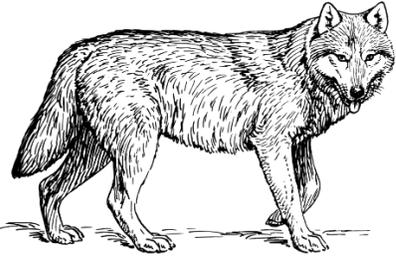


Photo Credit: <http://www.freestockphotos.biz/stockphoto/14950>

You share your habitat with wolves and they are your predator. 5 deer in your population have died to feed the wolves.

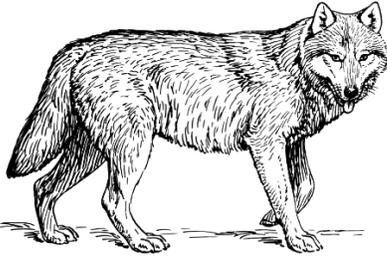


Photo Credit: <http://www.freestockphotos.biz/stockphoto/14950>

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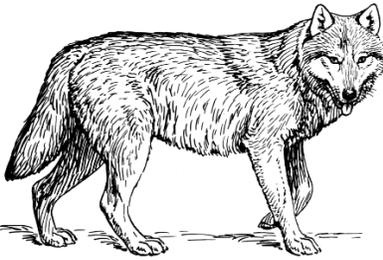


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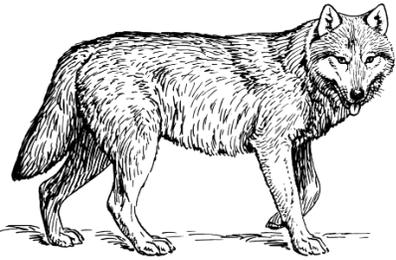


Photo Credit: <http://www.freestockphotos.biz/stockphoto/14950>

You share your habitat with wolves and they are your predator. 5 deer in your population have died to feed the wolves.



Photo Credit: <http://www.freestockphotos.biz/stockphoto/13322>

The local bear family can't find any more fish so they have turned to the deer in your population as a food source. 5 deer in your population have been killed to feed the bears.



Photo Credit: www.public-domain-image.com/%2Ffree-images%2Fart%2Ffine-art-illustration-pictures%2Fwhite-tailed-deer-head-illustration%2Fattachment%2Fwhite-tailed-deer-head-illustration&psig=AFQJCNF-0XvP6VQiiCVaKgn79NibGF_Ig&ust=1441470873659269

There are too many males in your population and not enough females. Decrease your population by 20 deer.

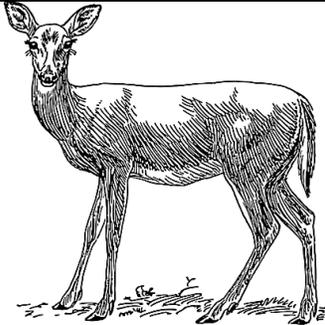


Photo Credit: https://pixabay.com/get/a4b6fbfb70b5a7d10c89/1441384611/female-48231_1280.png?direct

There are too many females in your population and most are of age to reproduce. Increase your population by 20 deer.

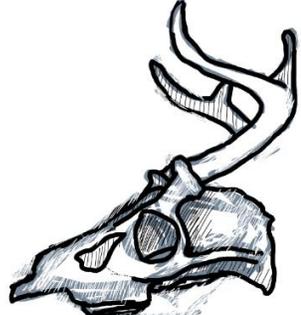


Photo Credit: <http://www.sketchport.com/drawing/5684992466223104/ol-alfred>

It was a harsh winter and all of your infant and elderly deer die. Decrease your population by 20 deer.



Photo Credit: <http://www.freestockphotos.biz/stockphoto/15119>

You've found SHELTER!

Increase your population by 10 deer.



Photo Credit: <http://www.freestockphotos.biz/stockphoto/15119>

You've found SHELTER!

Increase your population by 10 deer.



Photo Credit: <http://www.freestockphotos.biz/stockphoto/15119>

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Increase your population by 10 deer.



Photo Credit: <http://www.freestockphotos.biz/stockphoto/15119>

You've found SHELTER!

Increase your population by 10 deer.



Photo Credit: <http://www.public-domain-image.com/free-images/flora-plants/flowers/water-lily-lotus-flower/aquatic-environments-plants-water-lilies-leaves/attachment/aquatic-environments-plants-water-lilies-leaves>

You've found WATER!

Increase your population by 10 deer.



Photo Credit: <http://www.public-domain-image.com/free-images/flora-plants/flowers/water-lily-lotus-flower/aquatic-environments-plants-water-lilies-leaves/attachment/aquatic-environments-plants-water-lilies-leaves>

You've found WATER!

Increase your population by 10 deer.

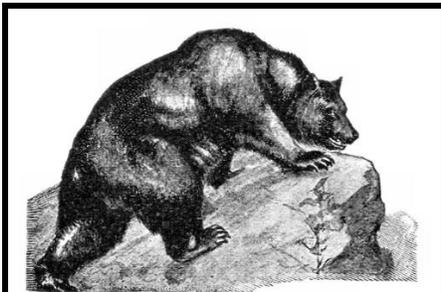


Photo Credit: <http://www.freestockphotos.biz/stockphoto/13322>

The local bear family can't find any more fish so they have turned to the deer in your population as a food source. 5 deer in your population have been killed to feed the bears.



Photo Credit: https://pixabay.com/get/a0a3a77e989458d58353/1441383050/hunter-160297_1280.png?direct

There are hunters in your area. 10 deer in your population have been shot and killed.



Photo Credit: https://pixabay.com/get/a0a3a77e989458d58353/1441383050/hunter-160297_1280.png?direct

There are hunters in your area. 10 deer in your population have been shot and killed.



Photo Credit: https://commons.wikimedia.org/wiki/File:Bitng_Midge.png

The biting fly population is booming this year! As a result, many of the deer in your population have contracted Hemorrhagic Disease and 5 have died.



Photo Credit: https://commons.wikimedia.org/wiki/File:Bitng_Midge.png

The biting fly population is booming this year! As a result, many of the deer in your population have contracted Hemorrhagic Disease and 5 have died.

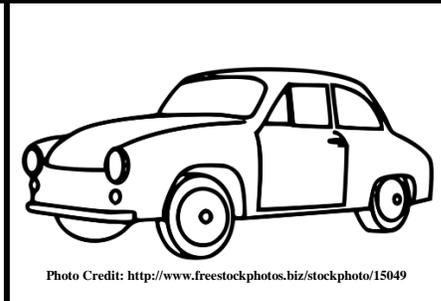


Photo Credit: <http://www.freestockphotos.biz/stockphoto/15049>

There is a highway near your habitat that your population often crosses. Many are hit by cars. Decrease your deer population by 10.



Photo Credit: <http://www.public-domain-image.com/free-images/flora-plants/flowers/water-lily-lotus-flower/aquatic-environments-plants-water-lilies-leaves/attachment/aquatic-environments-plants-water-lilies-leaves>

You've found WATER!
Increase your population by 10 deer.



Photo Credit: <http://www.torange.us/Plants/fruit-and-berries/currants-in-isolation-33142.html>

You've found FOOD!
Increase your population by 10 deer.

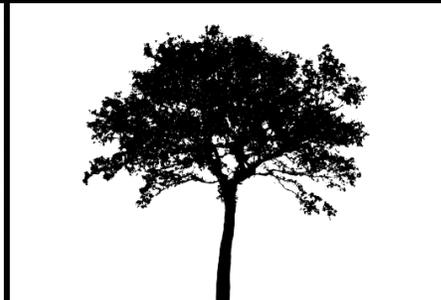


Photo Credit: <http://www.freestockphotos.biz/stockphoto/15119>

You've found SHELTER!
Increase your population by 10 deer.



Photo Credit: <http://www.public-domain-image.com/free-images/flora-plants/flowers/water-lily-lotus-flower/aquatic-environments-plants-water-lilies-leaves/attachment/aquatic-environments-plants-water-lilies-leaves>

**You've found
WATER!**

Increase your population by 10 deer.



Photo Credit: <http://www.public-domain-image.com/free-images/flora-plants/flowers/water-lily-lotus-flower/aquatic-environments-plants-water-lilies-leaves/attachment/aquatic-environments-plants-water-lilies-leaves>

**You've found
WATER!**

Increase your population by 10 deer.



Photo Credit: <http://www.torange.us/Plants/fruit-and-berries/currants-in-isolation-33142.html>

**You've found
FOOD!**

Increase your population by 10 deer.



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**You've found
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Increase your population by 10 deer.



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**You've found
FOOD!**

Increase your population by 10 deer.



Photo Credit: <http://www.torange.us/Plants/fruit-and-berries/currants-in-isolation-33142.html>

**You've found
FOOD!**

Increase your population by 10 deer.



Photo Credit: <http://www.public-domain-image.com/free-images/fauna-animals/deers/mule-deer-in-california/attachment/mule-deer-in-california>

**You've found a
MATE!**

Increase your population by 5 deer.



Photo Credit: <http://www.public-domain-image.com/free-images/fauna-animals/deers/mule-deer-in-california/attachment/mule-deer-in-california>

**You've found a
MATE!**

Increase your population by 5 deer.



Photo Credit: <http://www.public-domain-image.com/free-images/fauna-animals/deers/mule-deer-in-california/attachment/mule-deer-in-california>

**You've found a
MATE!**

Increase your population by 5 deer.

Deer Population A

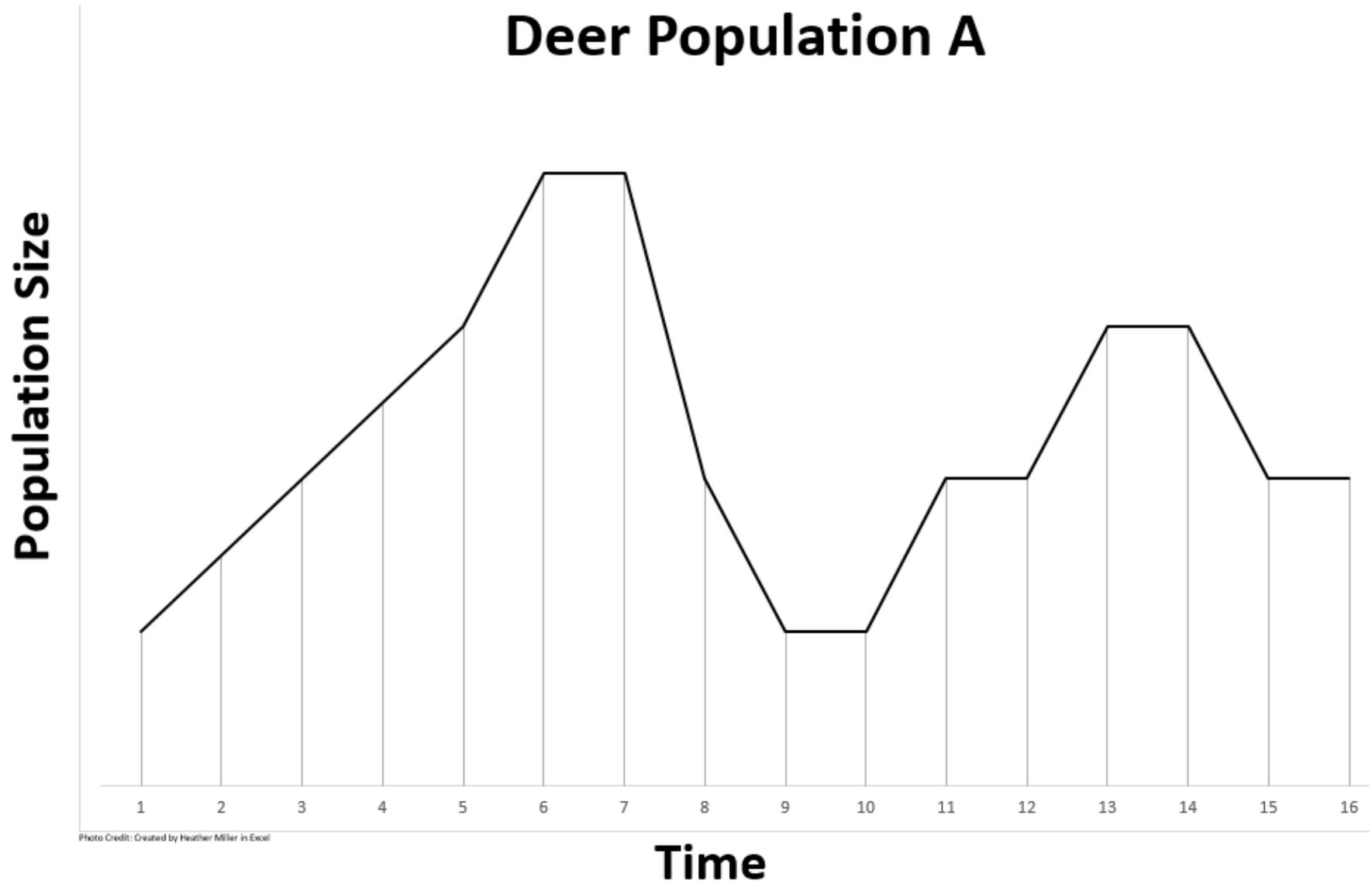


Photo Credit: Created by Heather Miller in Excel

Deer Population B

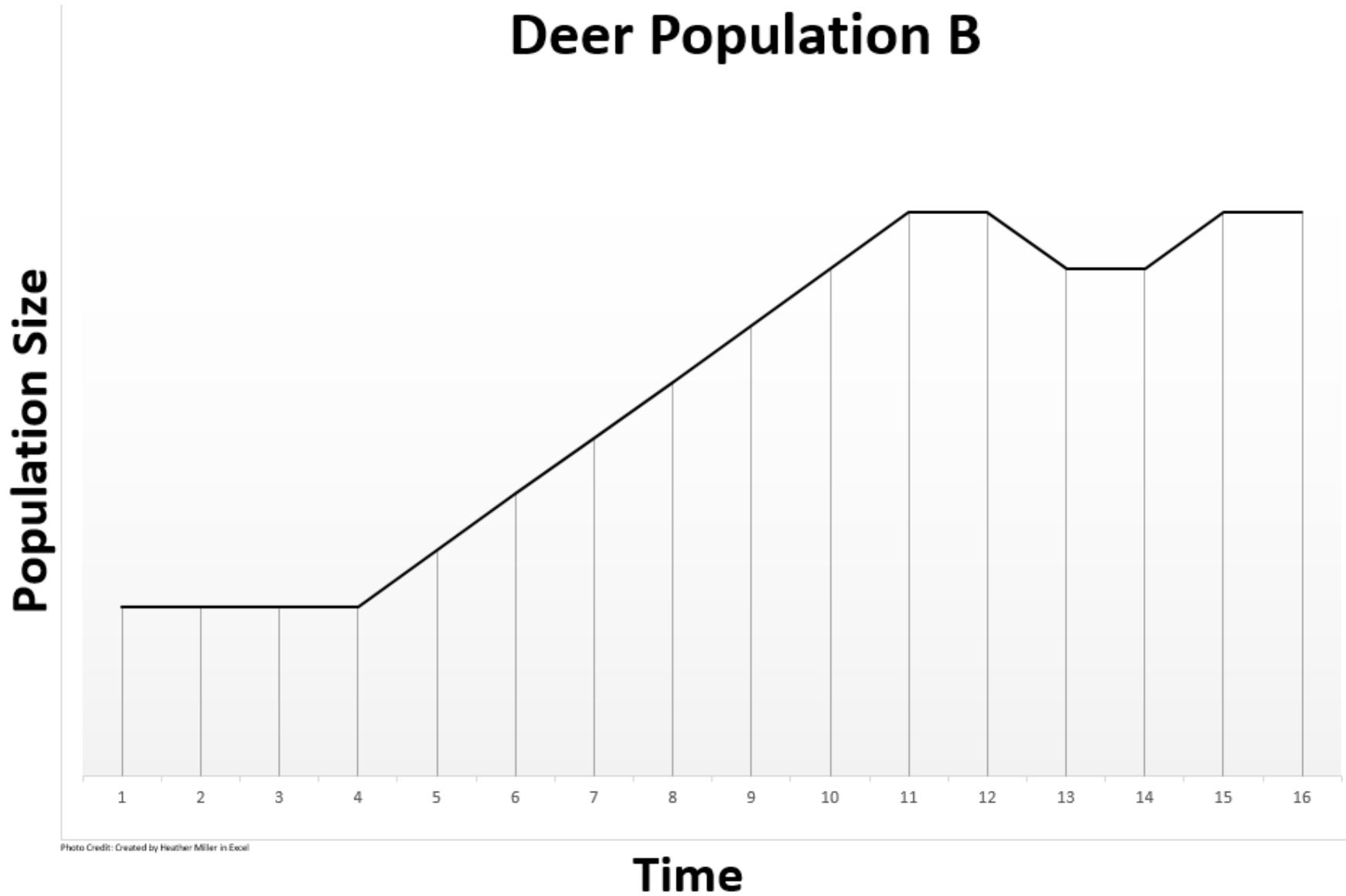


Photo Credit: Created by Heather Miller in Excel

Blackline Master 3

The **U P S** **A N D** **D O W N S** of **Populations**

Engage

Problem: How is population size affected by different environmental factors?

Based on the patterns in the graphs, what do you think could account for the differences between the two populations of the deer?

With your face partner, rally robin (share back and forth) one idea each that you wrote for the question above. Continue sharing back and forth until your teacher calls time.

With your shoulder partner, research the following questions (BYOD):

What do deer need to survive?

What interferes with a deer's survival?

Hypothesis: If a population experiences _____ then it will _____ because _____

Explore

You will be conducting your own population study with a population size of 100 deer. You will be exposing your deer to factors that they commonly encounter in their natural ecosystems and will be evaluating how it impacts their population.

Procedure:

1. Draw one card out of the envelope at a time.
2. Read what the card says and record the results in your data table.
 - For example, if the card says that aliens have invaded and have killed 10 deer, subtract 10 deer from your population, record the new number of deer in your population, and then carry the new number into the row below for the next turn.

Population	Limiting Factor	Effect on Population	New Population
100	<i>aliens invaded</i>	-10	90
90			

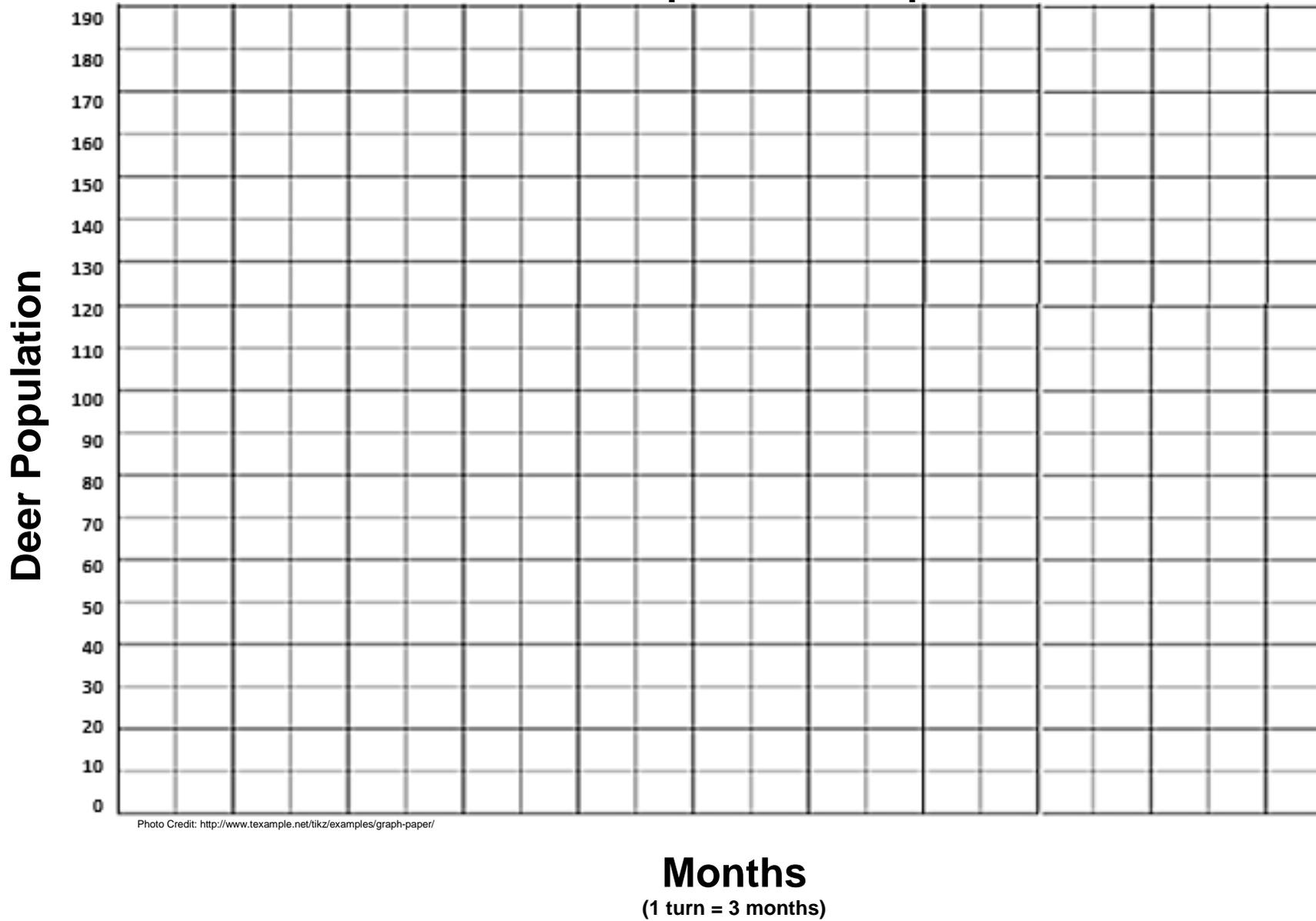
3. **DO NOT** put the card back in the envelope.
4. Draw the next card and continue drawing and recording data until you have drawn 20 cards and completed all 20 trials.
5. When you are finished with your trials, put all cards back in the envelope.

Deer Population Data Table

(each turn represents population changes over a 3 month period)

Turn	Population	Limiting Factor	Effect on Population	New Population
1	100 Deer			
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Deer Population Graph



Explain

Use your data and your graph to help you answer the following questions.

1. Give an overall description of your graph/data. Explain what factors accounted for the major increases or decreases in your population.
2. Based on the cards that you chose, and using your data table as a reference, what do you think a “**limiting factor**” is?
3. **Biotic** factors are all of the living things in an **ecosystem**. What were some of the **biotic** limiting factors in the deer’s ecosystem?
4. **Abiotic** factors are all of the non-living things in an **ecosystem**. What were some of the **abiotic** limiting factors in the deer’s ecosystem?
5. Choose two **limiting factors** that had a **positive** effect on your population and explain why they had an impact on your population.
6. Choose two **limiting factors** that had a **negative** effect on your population and explain why they had an impact on your population.
7. **Carrying capacity** is the maximum number of organisms that an ecosystem can support. Looking at your data table and graph, what would you predict is the **carrying capacity** for your ecosystem? Explain your choice.
8. How is your graph similar or different than the graph of another group?

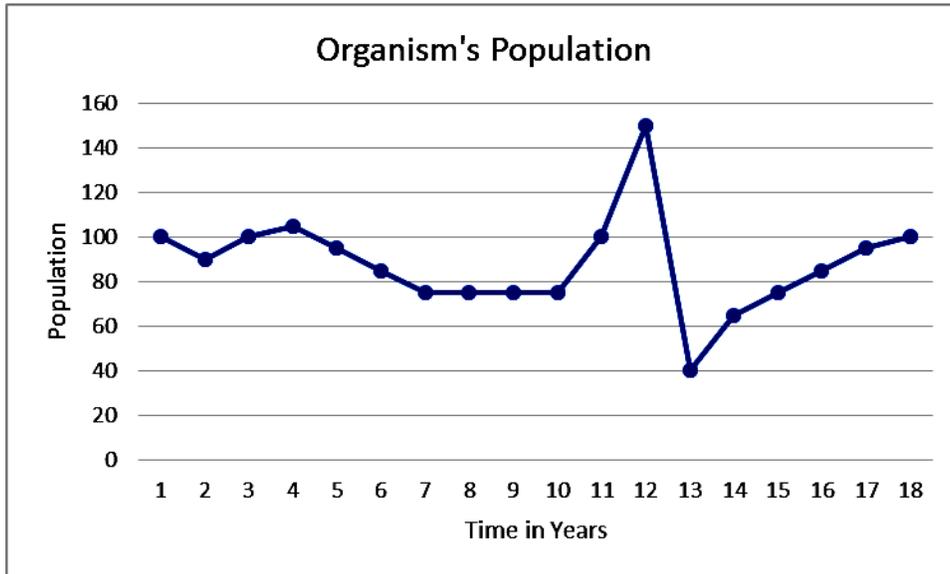
Expand/Elaborate

Now that you know a little about deer and the limiting factors that affect their population sizes, think about one of your favorite animal or plant species and what might affect their population. You will be creating a simulated population study of your animal based on a little research and your knowledge of limiting factors.

Animal: _____

Biotic Factors	
Abiotic Factors	
Factors that will increase the population:	
Factors that will decrease the population:	

The graph below represents your organism's population and its changes over time. Explain the graph in terms of what caused the changes in the population fluctuations (increases, decreases, etc) for your specific organism.



Graph created by Heather Miller

Explanation of the graph:

The **U P S** **A N D** **D O W N S** of **Populations**
Assessment

1. Aphids are a small insect that feed on plant material. Aphids are a popular food source for Ladybug Beetles. **How would Ladybug Beetles be affected by a drought?** (SC.7.L.17.3)
 - a. The Ladybug population would not be affected by the drought.
 - b. The Ladybug population would increase because there would be less plants.
 - c. The Ladybug population would decrease because there would be less aphids.
 - d. The Ladybug population would decrease because there would be more aphids.

2. The graph shown represents the population of two different species of organisms, A and B. **What is a valid prediction based on this graph?** (SC.7.L.17.3) (PTI 4,4. 5.8)

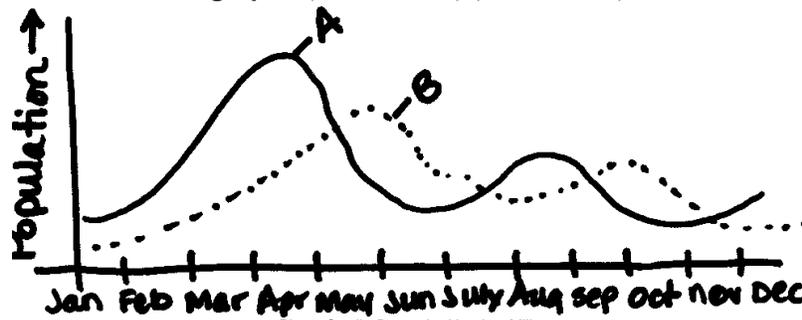


Photo Credit: Drawn by Heather Miller

- a. Species A will eliminate species B after 1 year.
 - b. Species A will not be present in the winter months.
 - c. Species B will increase each autumn due to a decrease in temperature.
 - d. Species B will decrease after a decrease in the population size of species A.
3. The food web below shows the relationship between different factors in a forest ecosystem. (SC.7.L.17.3) (PTI 5.8)

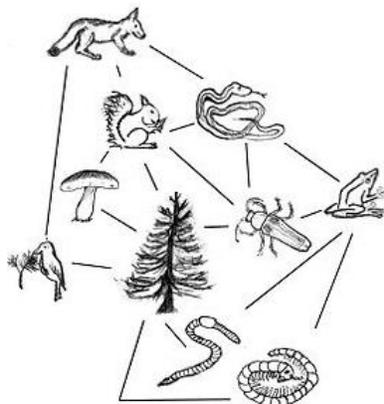


Photo Credit: <https://commons.wikimedia.org/wiki/File:TrophicWeb.jpg>

- Identify an abiotic factor that could decrease the snake population.**
- a. disease in the trees
 - b. a decrease in air and soil quality
 - c. an increase in the fox population
 - d. a decrease in the number of frogs

4. Goatfish are fish that move in schools and feed on plankton and plant matter. Natural predators of the goatfish include sea trout, sharks, pelicans and dolphins. The graph below shows how the number of goatfish in an area has changed over time. (SC.7.L.17.3) (PTI 4.4, 5.8)

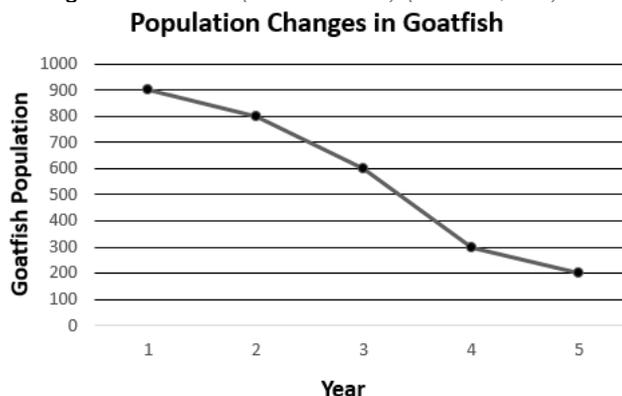


Photo Credit: Created by Heather Miller in Excel

Based on the data, one student concludes that a new predator was introduced into the area during this time period. **Which of the following is a likely alternate explanation for the change in the goatfish population?**

- goatfish prey increased in the area
 - aquatic plants in the area decreased
 - the temperature of the area increased
 - goatfish parasites decreased in the area
5. Squirrels eat acorns. Good acorn production happens when there are good growing conditions for the oak trees that make acorns. Often, there are many acorns produced one year but very few acorns the next year. **What is the most likely impact on the squirrel population in years when fewer acorns are produced?** (SC.7.L.17.3)
- Nest size will increase.
 - Competition will increase.
 - Predation risks will increase.
 - Reproduction rates will increase.
6. Like the success of animals, the success of plants is limited based on the resources available to each individual. In the tropical rainforest, plants are especially limited by the space they have available to grow and reproduce. **Which of these statements describes a way that limited space will impact the success of a plant in the rainforest?** (SC.7.L.17.3)
- A plant without enough space will face increased predation from herbivores
 - A plant without enough space will not have as many parasites and diseases.
 - A plant without enough space will be more likely to be impacted by air quality.
 - A plant without enough space will not be able to capture enough light to grow.

Blackline Master 5: Answer Keys

Engage:

- Based on the patterns in the graphs... *Student responses will vary.*
- What do deer need to survive? *Student responses will vary but could include food, water, shelter, space, and mates.*
- What interferes with a deer's survival? *Student responses will vary but could include disease, hunters, lack of food, water, shelter, space, and mates.*
- Hypothesis: If a population experiences *(a hardship, lack of food, lack of water, too many predators, an abundance of food, a stable ecosystem, etc)* then it will *(increase, decrease, stay the same, etc)* because *(organisms need food to survive, organisms need to mate to carry on the population, etc.)*

*****Units are intentionally left off the Deer Population A & B graphs so that students can interpret them in a way that makes sense to them. This could generate good discussion about what would be an appropriate unit to label this axis with. For example, days would not likely be appropriate because populations don't typically change that much from day to day. Years or decades might be a more appropriate time label.*****

Explore:

- *Student data & graphs will vary.*

Explain:

1. Give an overall description of your graph/data. Explain what factors accounted for the major increases or decreases in your population. *Student responses will vary based on their graphs. Students should be able to identify what caused the increases and decreases in their population of deer.*
2. Based on the cards that you chose, and using your data table as a reference, what do you think a "limiting factor" is? *Student response should indicate that a limiting factor is anything in an organisms' environment that can have a positive or negative impact on their population size.*
3. What were some of the **biotic** limiting factors in the deer's ecosystem? *Food, hunters, bears, wolves, mates, biting flies, disease (if not viral), shelter (if trees and brush), snakes, and bears. Students may have additional responses that are correct as long as they are LIVING things.*
4. What were some of the **abiotic** limiting factors in the deer's ecosystem? *Water, air, cars, fire, drought, guns, and seasons. Students may have additional responses that are correct as long as they are NON-LIVING things.*
5. Choose two **limiting factors** that had a **positive** effect on your population and explain why they had an impact on your population. *Food, water, shelter, mates, too many females all had a positive impact on the population. These allowed the deer to be healthy and reproduce which increased their numbers.*
6. Choose two **limiting factors** that had a **negative** effect on your population and explain why they had an impact on your population. *Drought, fire, snake bites, predators, disease, too many males, hunters, bad weather, and car traffic all had a negative impact on the population. These factors caused death or heightened competition which led to a decrease in numbers.*
7. **Carrying capacity** is the maximum number of organisms that an ecosystem can support. Looking at your data table and graph, what would you predict is the **carrying capacity** for your ecosystem? Explain your choice. *Student responses will vary depending on their graphs*

and data. The carrying capacity should be represented somewhere around their maximum population. Once deer reach a certain population size, the resources in their ecosystem become stretched too thin amongst the deer and deer begin dying or are not born.

8. How is your graph similar or different than the graph of another group? *Student responses will vary depending on their graph and the graph they choose for comparison.*

Extend/Elaborate:

Student animals, biotic factors, abiotic factors, factors that will increase or decrease the population, and explanations will vary depending on their chosen organism. Generally speaking, their graph explanation should state something along the lines of the population starting off relatively stable and then there was a huge jump in numbers. This could be due to available resources that year like excessive food, water, shelter, or mates. The following year the population crashed likely due to unavailability of those same or other resources. In the end, the population appears to return to the stable population which we can assume is near its carrying capacity.

Evaluate:

1. C 2. D 3. B 4. B 5. B 6. D