Bighorn Sheep and Wolves in Nevada

The Phenomenon

Bighorn sheep are native to Nevada. However, this species disappeared from the area around Pyramid Lake in the early 1900s due to hunting. The Nevada Department of Wildlife (NDOW) and the Pyramid Lake Paiute Tribe decided to reintroduce 21 Bighorn sheep to this area in January of 2020. Take a minute to watch a news report about this project. As you watch the video, write down some things you notice and wonder about.

Things I **noticed**…	Things I **wonder** about…

The Task

The video you watched highlighted how the Nevada Department of Wildlife (NDOW) and the Pyramid Lake Paiute Tribe worked together to capture 21 Bighorn sheep and then release them near Pyramid Lake. They hope this small population of Bighorn sheep will grow to at least 100 individuals by 2025. The NDOW and the Pyramid Lake Paiute Tribe are now working together on a project to reintroduce wolves to the same area. Wolves, however, are known predators of sheep.

Before they can reintroduce the wolves, the NDOW and the Pyramid Lake Paiute Tribe need to determine when the population of sheep will be large enough to support a population of wolves in the same area. They also need to determine how many wolves to release because releasing too many wolves might cause the sheep population to become unstable and die off. On the other hand, releasing too few wolves into the area would decrease the likelihood that the wolves will survive after they are reintroduced. Your goal in this investigation is to figure out how large the population of sheep in the area needs to be before a wolf population can be introduced and to figure out how big

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the initial wolf population can be without causing one or both of the populations to die out. The guiding question of this investigation is:

How many wolves should be released and when should they be released in the Pyramid Lake region to ensure that the wolf and sheep populations will be able to coexist?

Initial Ideas

Before you start this investigation, take a few minutes to think about how the population of Bighorn sheep and a new population of wolves may or may not interact with each other around Pyramid Lake once the wolves are reintroduced. Then draw a model in the space below depicting how you think these two populations will interact with each other and the environment. Be sure to include labels to help explain your thinking.

> Some **ideas** that I have...

Now list some things that you think will be important to learn more about during this investigation in the space below.

> Some **things** that I want to know more about...

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Some Ideas You Can Use: Populations

A population is a group of individuals that belong to the same species and live in the same region. Populations have unique characteristics such a birth rate, a death rate, an age structure, and a sex ratio. The birth rate is the number of births within a population during a period of time while the death rate is the number of deaths during a time period. The age structure refers to the distribution of individuals based on age. The sex ratio is the proportion of males and females in the population. The picture below is called a population pyramid. This population pyramid shows both the age structure and sex ratio of the United States population in 2018.
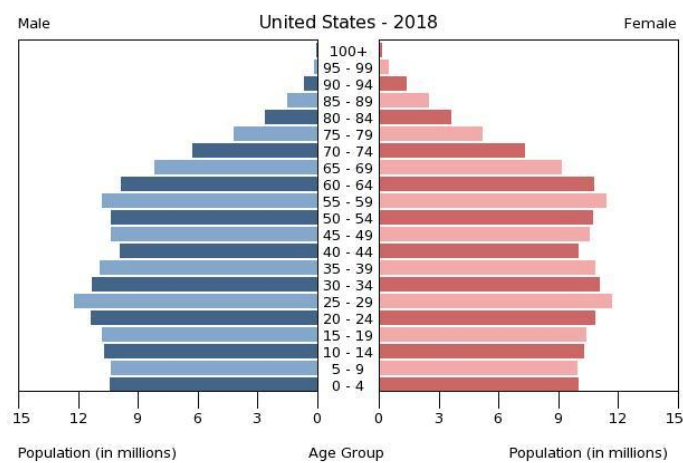
The age structure and sex ratio of a population can change over time because the birth and death rates of different types of individuals vary from year to year. For example, after several years of many births, the age structure of the population might shift, causing the average age of the individuals in population to be younger than it was before. The characteristics of a population can also change as different individuals join (emigrate) or leave (migrate) the population or when some event affects certain individuals more than others (such as a disease that is deadly to older individuals).

> Some things I **know** from what I read…

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Some Ideas You Can Use: Changes in Population Size

There are several factors that affect the size of a population over time. First, population size is affected by the per capita population growth rate. The per capita growth rate is how much the size of a population changes per individual in the population. This growth rate is determined by the population's birth, death, emigration, and migration rates. When the per capita growth rate is positive and does not change for several generations, a population will experience exponential growth. The picture below shows a population of bacteria called *Escherichia coli* (*E. coli*) undergoing exponential growth.

| 120 minutes | 240 minutes | 360 minutes | 480 minutes |
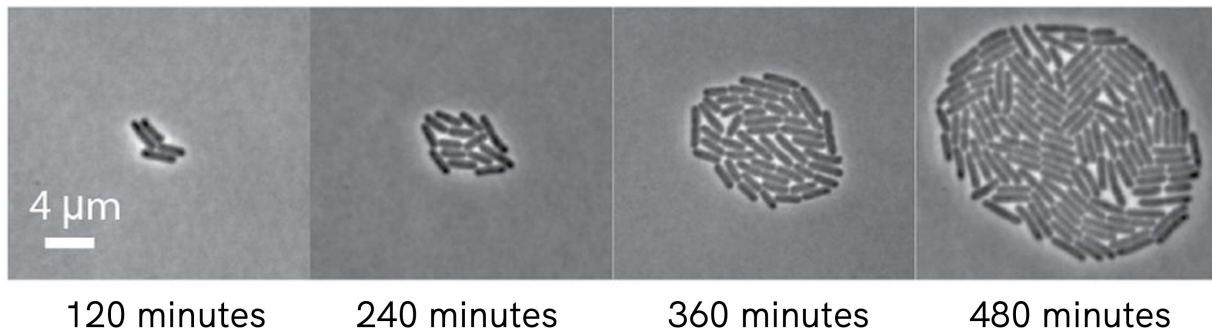
These single-celled organisms reproduce by dividing into two separate cells. As soon as a new cell forms, this cell and the original cell can divide again. A population of *E. coli* cells can therefore grow quickly and reach enormous numbers in a relatively short period of time when it has access to unlimited food, space, and other resources.

Most populations, however, do not have access to the unlimited food, space, and other resources they need to survive. Therefore, another factor that affects the size of a population in a given area is called carrying capacity. The carrying capacity is the maximum population size that an environment can sustain, and carrying capacity is determined by the availability of resources within an environment. These resources include the amount of food to eat or water to drink and sites for breeding and raising offspring. As the number of individuals in a population increases, these individuals must compete with other members of the population (and with individuals from other populations in the area) for the limited available resources. Some individuals, as a result, will not be able to find the resources necessary for their survival. The death rate of the population will therefore increase when competition for resources increases. At this point, the per capita growth rate of the population will decrease.

The picture below shows how the size of a population changes as it reaches the carrying capacity of an environment. The picture also illustrates how a small population of living things will grow exponentially while there is plenty of resources available. The population will then "overshoot" the environment's carrying capacity. Overshoot occurs when the size of the population is greater than the carrying capacity, so some

individuals in the population die off because they cannot find enough resources to survive. At this point, the death rate of the population is greater than the birth rate. Once the population size is less than the carrying capacity, it will start to increase again.

Overshoot

Carrying Capacity

Number of Individuals in the Population

Die Off

Exponential Growth

Time
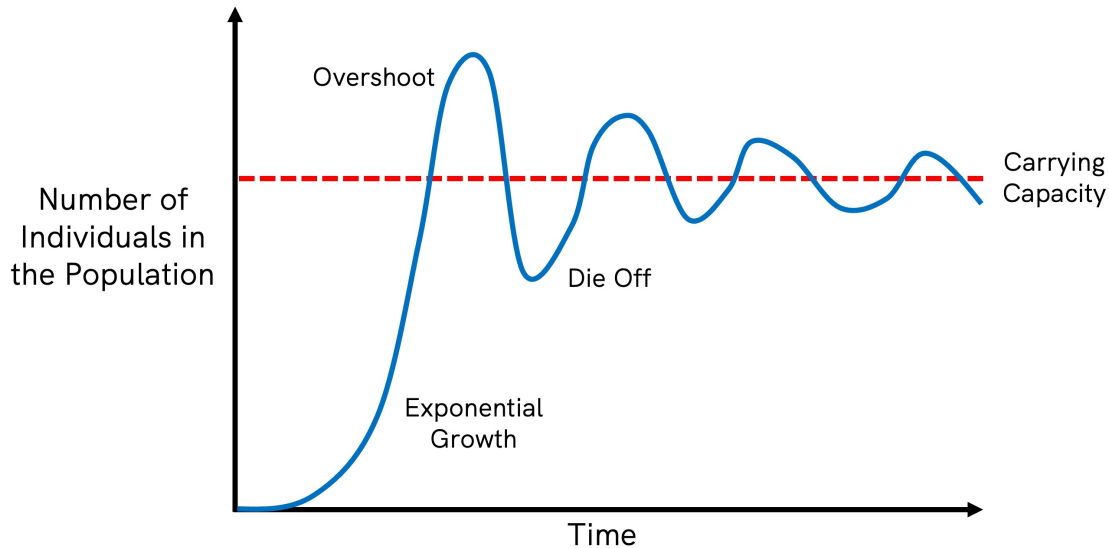
As the birth rate and the death rate of the population change, the number of individuals in the population will fluctuate above and below the carrying capacity. Eventually, the population reaches a stable equilibrium point at or near the environment's carrying capacity. The carrying capacity of an environment, however, is not static. It can decrease due to resource destruction that sprung from disease, a drought or natural disaster, or human activity. On the other hand, the carrying capacity can also increase when there are more resources available than usual.

Some things I **know** from what I read…

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Some Ideas You Can Use: Predator-Prey Population Size Relationships

Predation is an interaction between species in which one species (the predator) uses another species as food (the prey). Predation often leads to an increase in the population size of the predator and a decrease in the population size of the prey. However, if the size of a prey population gets too small, many of the individuals that composing the population of predators may no longer have enough food to eat and will die. As a result, the predator population size and the population size of its prey are linked. The sizes of a predator population and a prey population change in a predictable pattern. This predictable pattern is often described as a *predator-prey population size relationship.* The picture below depicts an example of a predator-prey population size relationship that exists between a population of hares and a population of lynx.
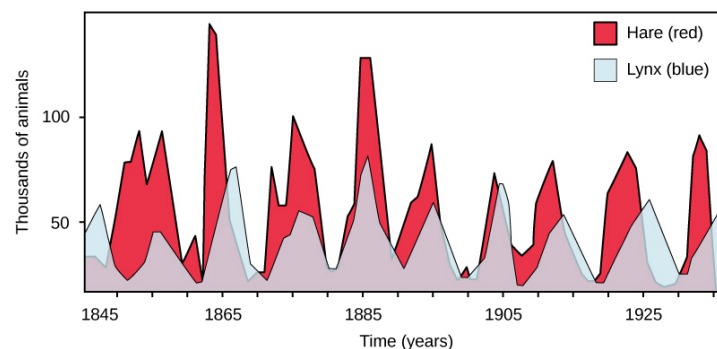
The pattern in the graph above begins with an increase in the size of the hare population. The increase in the size of the hare population then leads to an increase in the size of the lynx population. An increase in the size of the lynx population then results in a decrease in the size of the hare population, which causes a decrease in the lynx population. The whole cycle then starts again. A predator-prey population size relationship that results in both populations surviving over time, despite fluctuations in their respective sizes over several generations, is described as stable. The predator-prey population size relationship between the lynx and hare illustrated in picture above is an example of stable relationship. A predator-prey relationship that results in the disappearance of one or more populations, in contrast, is described as unstable.

Some things I **know** from what I read…

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Plan Your Investigation

Prepare a plan for your investigation by filling out the chart below.

> I am trying to answer the following **question**...

> I will use the following **observations or measurements**...

> I will **analyze** these observations or measurements by...

I approve of this investigation plan

_____   _____
Teacher's Signature   Date

Collect Data

Keep a record of what you observe or measure during your investigation in the space below.

My **observations or measurements...**

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Analyze Your Data

You will need to analyze the data you collected before you can develop an answer to the guiding question. To analyze the data you collected, create one or more graphs to demonstrate how the populations of Bighorn sheep and wolves change over time.
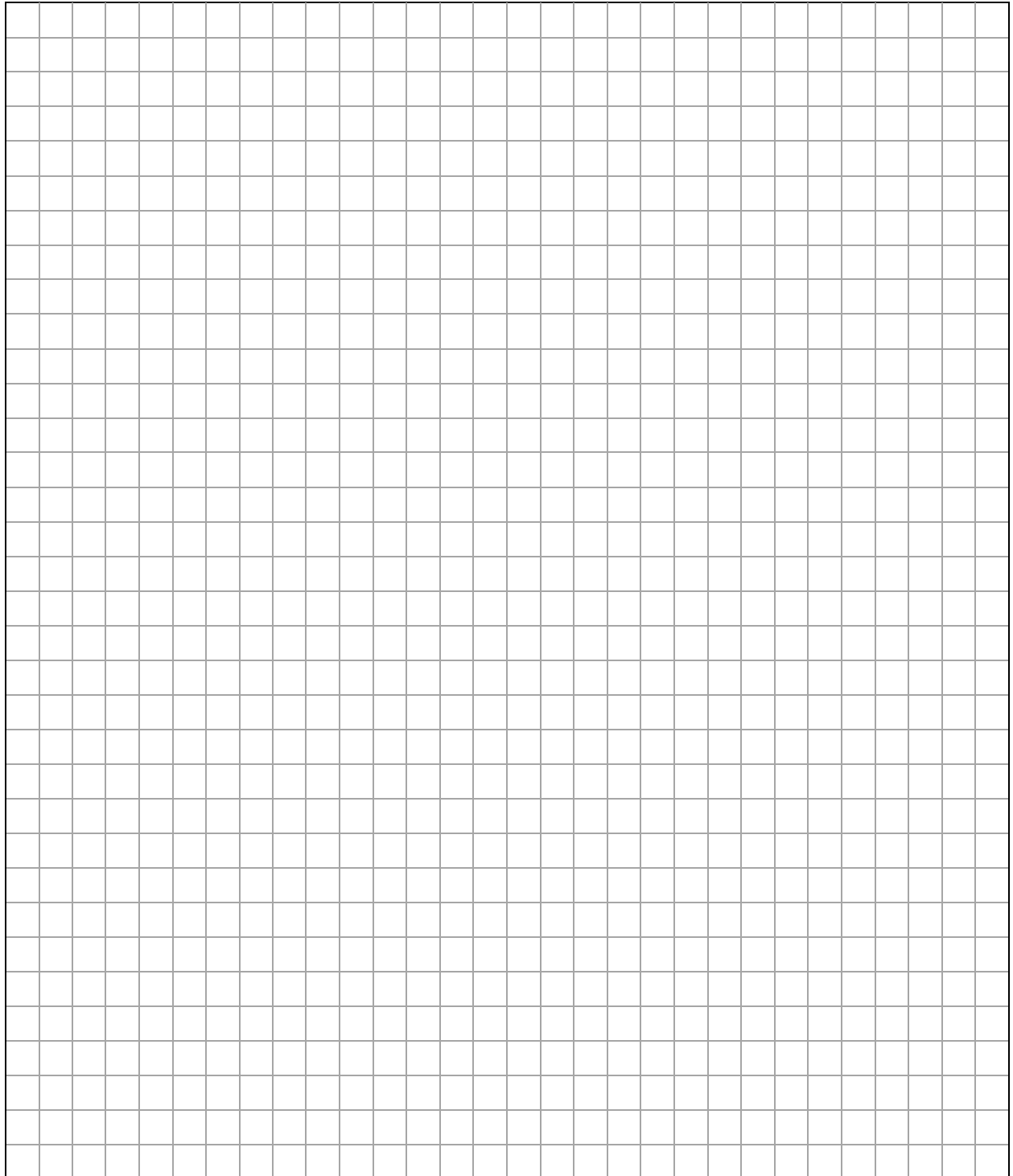
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Draft Argument

Develop an argument on a whiteboard. It should include:

1. A *claim*: Your answer to the guiding question.
2. *Evidence*: An analysis of the data and an explanation of what the analysis means.
3. A *justification of the evidence*: Why your group thinks the evidence is important.

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence:

Argumentation Session

Share your argument with your classmates. Be sure to keep track of any ideas that you can use to revise your argument and make it better in the space below.

Some possible ways to **improve** our argument…

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Reflective Discussion

You can keep track of any ideas from the discussion that you think are important or will be useful in the future in the space below.

Some important **ideas**…

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Draft Report

Prepare a *report* to share what you figured out during your investigation.

Introduction

We have been studying _____ in class. Before we started

this investigation, we explored _____

_____

_____

We noticed _____

_____

_____

Our goal for this investigation was to figure out _____

_____

_____

The guiding question was _____

_____

Method

To answer this question, _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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Argument

We figured out _____

_____

_____

_____

The _____ below includes information about _____

_____

_____

_____

This analysis suggests _____

_____

_____

This evidence is based on several important scientific ideas. The first one is _____

_____

_____

_____

_____

_____

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Information and Standards Alignment

Subject
Science

Discipline
Biology

Grade band
9-12

Task
Students figure how large a population of sheep needs to be before a wolf population can be re-introduced into the area and how big the initial wolf population can be without causing one or both of the population to die out.

Core Idea(s)
1. Ecosystem dynamics and function
2. Interdependent relationships in ecosystems

Practices
1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Crosscutting Concepts
1. Patterns
2. Stability and change

Alignment with Academic Standards for Science
Teachers can use this investigation to help students reach any of the performance expectations for science that are listed in the table below.

Source	Code	Performance Expectation
NGSS	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Alabama	Biology 16	Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem
Alaska	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Arizona	HS.L2U1.19	Develop and use models that show how changes in the transfer of matter and energy within an ecosystem and interactions between species may affect organisms and their environment.
Arkansas	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

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California	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Colorado	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Connecticut	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Delaware	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Florida	SC.912.L17.1	Discuss the characteristics of populations, such as number of individuals, age structure, density, and pattern of distribution.
	SC.912.L17.5	Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.
	SC.912.L.17.6	Compare and contrast the relationships among organisms, including predation, parasitism, competition, commensalism, and mutualism.
	SC.912.L.17.13	Discuss the need for adequate monitoring of environmental parameters when making policy decisions.
Georgia	SB5.a	Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems
	SB5.c	Construct an argument to predict the impact of environmental change on the stability of an ecosystem.
Hawaii	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Idaho	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Illinois	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Indiana	B.3.3	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions and identify the impact of changing conditions or introducing non-native species into that ecosystem.
Iowa	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Kansas	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

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Kentucky	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Louisiana	HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity, biodiversity and populations of ecosystems at different scales.
Maine	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Maryland	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Massachusetts	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Michigan	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Minnesota	9L2.2.1.1	Use a computational model to support or revise an evidence-based explanation for factors that have ecological and economic impacts on different sized ecosystems including factors cause by the practices of various human groups.
Mississippi	BIO.5.5	Evaluate symbiotic relationships (e.g., mutualism, parasitism, and commensalism) and other coevolutionary (e.g., predator-prey, cooperation, competition, and mimicry) relationships within specific environments.
	BIO.5.6	Analyze and interpret population data, both density-dependent and density-independent, to define limiting factors. Use graphical representations (growth curves) to illustrate the carrying capacity within ecosystems.
Missouri	9-12.LS2.A.1	Explain how various biotic and abiotic factors affect the carrying capacity and biodiversity of an ecosystem using mathematical and/or computational representations
	9-12.LS2.C.1	Evaluate the claims, evidence, and reasoning that the interactions in ecosystems maintain relatively consistent populations of species while conditions remain stable, but changing conditions may result in new ecosystem dynamics
Montana	LS2.A	Use mathematical or computational representations to support arguments about environmental factors that affect carrying capacity, biodiversity, and populations in ecosystems.
Nebraska	SC.HS.7.2.B	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales
Nevada	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

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New Hampshire	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
New Jersey	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
New York	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
North Carolina	Bio.2.1.3	Explain various ways organisms interact with each other (including predation, competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems.
	Bio.2.1.4	Explain why ecosystems can be relatively stable over hundreds or thousands of years, even though populations may fluctuate.
	Bio.2.2.1	Infer how human activities may impact the environment.
North Dakota	HS-LS2-2	Use evidence from mathematical representations to explain factors that affect population dynamics and biodiversity.
Ohio	B.DI.2	Devise a study to investigate ecosystems in equilibrium and an ecosystem in disequilibrium. Predict how predator/prey populations cycles will change in there are changes in the number of either species. Explain how humans can impact predator/prey relationships. Compare equilibrium and disequilibrium. Give examples of each in real populations.
Oklahoma	B.LS2.2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Oregon	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Pennsylvania	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Rhode Island	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
South Carolina	H.B.6.A.2	Use mathematical and computational thinking to support claims that limiting factors affect the number of individuals that an ecosystem can support.
South Dakota	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Tennessee	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Texas	Biology 12.A	Interpret relationships, including predation, parasitism, commensalism, mutualism, and competition, among organisms.

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	Biology 12.E	Describe how environmental change can impact ecosystem stability.
Utah	BIO.1.1	Plan and carry out an investigation to analyze and interpret data to determine how biotic and abiotic factors can affect the stability and change of a population.
	BIO.1.4	Develop an argument from evidence for how ecosystems maintain relatively consistent numbers and types of organisms in stable conditions.
Vermont	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Virginia	BIO.8.a	Investigate and understand dynamic equilibria within populations, communities, and ecosystems. Key concepts include interactions within and among populations including carrying capacities, limiting factors, and growth curves.
Washington	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
West Virginia	S.10.LS.11	use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Wisconsin	HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
Wyoming	SES-HS-LS2-1	Describe how the population of a species changes in relation to the availability of resources.
	SES-HS-LS2-2	Identify factors that affect biodiversity in different environments.

Alignment with Common Core State Standards for English Language Arts

Teachers can use this investigation to help students reach any of the performance expectations for reading, writing, or speaking and listening that are listed in the table below.

Strand	Code	Standard
Reading	RH.9-10.1	Cite specific textual evidence to support analysis of primary and secondary sources, attending to such features as the date and origin of the information.
	RST.9-10.2	Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
	RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*.

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	RST.9-10.5	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
	RST.9-10.6	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
	RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words
	RST.9-10.8	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words
	RST.9-10.9	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts
	RST.9-10.10	read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently
Writing	WHST.9-10.1.A	Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence
	WHST.9-10.1.B	Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns
	WHST.9-10.1.C	Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims
	WHST.9-10.1.D	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing
	WHST.9-10.1.E	Provide a concluding statement or section that follows from or supports the argument presented.
	WHST.9-10.2.A	Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension
	WHST.9-10.2.B	Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

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	WHST.9-10.2.C	Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts
	WHST.9-10.2.D	Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers
	WHST.9-10.2.E	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing
	WHST.9-10.2.F	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing
	WHST.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience
	WHST.9-10.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience
	WHST.9-10.6	Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically
	WHST.9-10.2.9	Draw evidence from informational texts to support analysis, reflection, and research
	WHST.9-10.2.10	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences
Speaking and Listening	SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
	SL.9-10.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
	SL.9-10.1.B	Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed.
	SL.9-10.1.C	Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

	SL.9-10.1.D	Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
	SL.9-10.3	Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.
	SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
	SL.9-10.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
	SL.9-10.3	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Alignment with Texas Essential Knowledge and Skills for English Language Arts and Reading

Teachers can use this investigation to help students reach any of the performance expectations for English 1 that are listed in the table below.

Strand	TEKS	Standard
Oral Language	1.A	Engage in meaningful and respectful discourse by listening actively, responding appropriately, and adjusting communication to audiences and purposes.
	1.C	Give a presentation using informal, formal, and technical language effectively to meet the needs of audience, purpose, and occasion, employing eye contact, speaking rate such as pauses for effect, volume, enunciation, purposeful gestures, and conventions of language to communicate ideas effectively.
	1.D	Participate collaboratively, building on the ideas of others, contributing relevant information, developing a plan for consensus building, and setting ground rules for decision making.
Vocabulary	2.A	Use print or digital resources such as glossaries or technical dictionaries to clarify and validate understanding of the precise and appropriate meaning of technical or discipline-based vocabulary.
Comprehension	4	Use metacognitive skills to both develop and deepen comprehension of increasingly complex texts.
Response Skills	5.E	Interact with sources in meaningful ways such as notetaking, annotating, freewriting, or illustrating.
	5.G	Discuss and write about the explicit or implicit meanings of text.
	5.H	Respond orally or in writing with appropriate register, vocabulary, tone, and voice.

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	5.I	Reflect on and adjust responses when valid evidence warrants.
Multiple Genres	7.D	Analyze characteristics and structural elements of informational texts.
	7.E	Analyze characteristics and structural elements of argumentative texts.
Composition	9.A	Plan a piece of writing appropriate for various purposes and audiences by generating ideas through a range of strategies such as brainstorming, journaling, reading, or discussing.
	9.B	Develop drafts into a focused, structured, and coherent piece of writing in timed and open-ended situations.
	9.C	Revise drafts to improve clarity, development, organization, style, diction, and sentence effectiveness.
	10.B	Compose informational texts such as explanatory essays, reports, and personal essays using genre characteristics and craft.
	10.C	Compose argumentative texts using genre characteristics and craft.

Alignment with English Language Proficiency Standards

Teachers can use this investigation to help emerging multilingual students reach the performance expectations for English language proficiency listed in the table below.

Modality	Code	Standard
Receptive	ELP 1	Construct meaning from oral presentations and literary and informational text through grade-appropriate listening, reading, and viewing.
	ELP 8	Determine the meaning of words and phrases in oral presentations and literary and informational text.
Productive	ELP 3	Speak and write about grade-appropriate complex literary and informational texts and topics.
	ELP 4	Construct grade-appropriate oral and written claims and support them with reasoning and evidence.
	ELP 7	Adapt language choices to purpose, task, and audience when speaking and writing.
	ELP 9	Create clear and coherent grade-appropriate speech and text.
	ELP 10	Make accurate use of standard English to communicate in grade-appropriate speech and writing.
Interactive	ELP 2	Participate in grade-appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.
	ELP 5	Conduct research and evaluate and communicate findings to answer questions or solve problems.
	ELP 6	Analyze and critique the arguments of others orally and in writing.