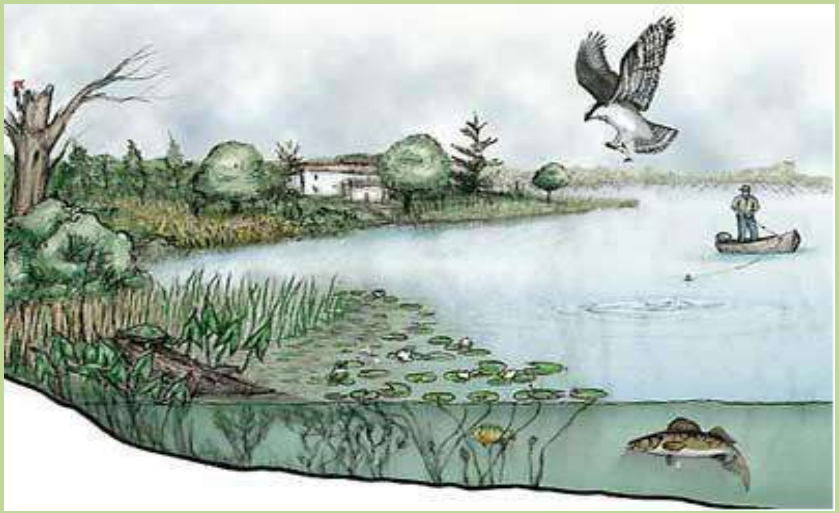
Science Unit 3 Plan
Grade 6
Interdependent Relationships in Ecosystems



Number of Days for Unit: 25 days

Unit 3: Interdependent Relationships in Ecosystems

What happens to ecosystems when the environment changes?

Students build on their understandings of the transfer of matter and energy as they study patterns of interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on a population. They construct explanations for the interactions in ecosystems and the scientific, economic, political, and social justifications used in making decisions about maintaining biodiversity in ecosystems. The crosscutting concept of *stability and change* provide a framework for understanding the disciplinary core ideas.

This unit includes a two-stage engineering design process. Students first evaluate different engineering ideas that have been proposed using a systematic method, such as a tradeoff matrix, to determine which solutions are most promising. They then test different solutions, and combine the best ideas into a new solution that may be better than any of the preliminary ideas. Students demonstrate grade appropriate proficiency in *asking questions*, *designing solutions, engaging in argument from evidence, developing and using models*, and *designing solutions*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on MS-LS2-4, MS-LS2-5, MS-ETS1-1, and MS-ETS1-3.

Student Objectives:

Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations**.** *[Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]* **(MS-LS2-4)**

Evaluate competing design solutions for maintaining biodiversity and ecosystem services. * *[Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]* **(MS-LS2-5)**

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS-ETS1-1)

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

Concepts:

Part A: *How can a single change to an ecosystem disrupt the whole system?*

- Ecosystems are dynamic in nature.
- The characteristics of ecosystems can vary over time.
- Disruptions to any physical or biological component of an ecosystem can lead to shifts in all the ecosystem's populations.
- Small changes in one part of an ecosystem might cause large changes in another part.
- Patterns in data about ecosystems can be recognized and used to make warranted inferences about changes in populations.

Evaluating empirical evidence can be used to support arguments about changes to ecosystems.

Part B: *What limits the number and variety of living things in an ecosystem?*

- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems.
- The completeness, or integrity, of an ecosystem's biodiversity is often used as a measure of its health.
- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines.
- Changes in biodiversity can influence ecosystem services that humans rely on.
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- A solution needs to be tested and then modified on the basis of the test results, in order to improve it.
- Models of all kinds are important for testing solutions.

NGSS

Performance Expectations:

1. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations (MS-LS2-4)

2. Evaluate competing design solutions for maintaining biodiversity and ecosystem services. * (MS-LS2-5)

3. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS-ETS1-1)
4. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3

Standards 3 & 4 are met when students work on the engineering standard MS-LS2-5

Science and Engineering Practices

Engaging in Argument from Evidence

- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4)
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)

Asking Questions and Defining Problems

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)

Developing and Using Models

- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

Analyzing and Interpreting Data

Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

Disciplinary Core Ideas:

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

LS4.D: Biodiversity and Humans

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5)

ETS1.B: Developing Possible Solutions

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.*(secondary to MS-LS2-5)*

ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)
- Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution

Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)

Cross Cutting Concepts

Stability and Change

- Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable

through measurement and observation. (MS-LS2-3)

Scientific Knowledge is Based on Empirical Evidence

- Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

Science Addresses Questions About the Natural and Material World

- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

Assessments

DE Assessments: Multiple Choice (40) and Constructed Response

District:
Notebook Investigation Entries
Student Observations
Anecdotal Notes
Homework
Readorium
Writing prompts
Summative Assessments: Pre-Assessment, Post Assessment

Discovery Education TechBook Unit Overview

Teachers will begin unit with an anchoring event. The anchoring event is a specific event and students need to explain the event. More information about anchoring events can be found here: goo.gl/ULVptn As students learn about populations they will take their learning and connect it back to their explanation of the anchoring event. groups are an effective method for working with explanatory models. More information about them can be found here: http://ambitiousscienceteaching.org/tools-face-to-face/#Smallgroup

After presenting students with the event, students will explore and learn about populations and over populations. Listed below are high leverage resources teachers can use. Paired with the resources are links to instructional strategies that would be effective for implementation. Teachers are encouraged to have students work in a guided inquiry style lesson, but if student need additional structure the teacher should provide that. Additional detailed instructional ideas can be found at: https://google.discoveryeducation.com/learn/techbook/units/2d17fe2c-67ce-4ea9-b1d2-

b5c4b4106ba8/concepts/968fc1d0-9b4a-4526-800c-8227164e90d0/lesson and https://google.discoveryeducation.com/learn/techbook/units/ac244b56-1ed0-456c-870b-46466a5dea1d/concepts/c029feee-6231-4a8f-8249-a5610d637682/lesson these "model lessons" should not be implemented as is, but can be a valuable resource for teachers looking for strategies and suggestions as they craft their plan. The class should keep a summary table for all learning experiences. More on summary tables with samples can be found at: http://ambitiousscienceteaching.org/tools-face-to-face/#Summtable

Students should document their learning and summarize their learning each day. Every few days, 2 or 3, students should revisit their original explanation and improve their explanation. The explanation should change. Strategies for working on and improving scientific explanations can be found here: http://ambitiousscienceteaching.org/tools-face-to-face/#Sticky

Students should finalize their explanation of the anchoring event. They should use a teacher created rubric to evaluate their explanation and include evidence to support their claim. The rubric listed in the explain tab of Discovery Education is a starting point for the rubric, and could be used, but the teacher may want to add specific details related to populations and the changes in an ecosystem. Student's rough draft and work as they progress is a formative assessment, the final draft explanation should be the summative assessment. Students could submit this as an essay, a digital media project, or some other representation that allows them to communicate their claim, evidence, and reasoning.

What students should understand: (To be shown in their scientific explanation)

All of the organisms of a single species living in a geographical area and can interbreed form a population. Populations are affected by availability of food and water, access to sunlight, shelter, diseases, predators, weather and climate. A habitat has a carrying capacity for a population, which is the number of organisms that the habitat can support. When the availability of resources changes this can cause a population to increase in size, which the local environment may or may not be able to handle. If it cannot that is called overpopulation. Overpopulation leads to a decrease in resources that are available, which impacts other species in the area. Overpopulated species eventually run out of resources and either dies out, or experiences a large population loss. Overpopulation may be controlled artificially. Environmental changes can also cause population loss, possibly extinction, due to changing availability or resources.

After learning about populations and overpopulation through the frame of the anchoring event students will move onto the STEM project, this is the elaborate/extension phase.

To meet the expectation of MS-LS2-5 student need to create and evaluate solutions to protecting an ecosystem. Using the STEM Project Starter #2 as a starting off point, students should be presented with a problem that relates to Orange NJ or NJ

in general. For example, new construction near a river or rebuilding along the shore. Students should create a plan to protect the ecosystem, conduct research in ways to protect it, keeping costs in mind, then create the best solution to the problem. They need to support their solution using evidence from their research and cost analysis, and then examine other solutions from other students, and explain why their solution is better than the others, again using evidence and reasoning. This is a long-term project, students should work in small groups, and this should require them to create visuals and communicate their justifications.

You may want to do the hands-on activity as a class, the goal of the activity is for students to make connections to their project and this is an opportunity to formatively assess students about their understanding of human impact and strategies for minimization.

General Topics

Course:
Ecology
    Unit:
    Populations and Communities
        Concepts:
        Populations
Course:
Ecology
    Unit:
    Genetic Traits & Reproduction
        Concepts:
        Genes
Course:
Ecology
    Unit:
    Environmental Issues
        Concepts:
        Endangered Species
        Preventing Land Use and Environmental Problems
Course:
Ecology
    Unit:
    Engineering to Solve Problems

Concepts:
Agricultural Engineering
Biomedical Engineering

High Leverage Learning Experience

Engage

First Session: Introduction of Anchoring Event/Engage/Opening:

The teacher will provide the students with a relevant experience that relates to the topic of populations. Several suggestions are listed below. For students to create an explanation of the phenomena they will need to learn about several topics over several days. Day one is the presentation of the topic and student's initial explanations. Working in small groups students should create a visual explanation of the anchoring event. (SEP 1, 2, 6, 7, 8)

One potential event is using the story of the Amur leopard as laid on in the engage tab for "Populations" Students are tasked with explaining why the population of the Amur leopard has dropped. Use the video or the techbook page to introduce the event. Students should work in small groups to create an explanatory model based on their prior knowledge.

Another potential anchoring event would be the reintroduction of wolves into Yellowstone and asking students to explain the potential impact on the ecosystem.

As an anchoring event you can also present students with an example of overpopulation such as the one in the Engage tab of "Over populations."

Kudzu vines, Japanese beetles, zebra mussels, other examples of invasive species could also be used as an anchoring event.

Natural events such as fire, flooding, hurricanes, or drought could also be used to create an anchoring event. Presenting students with what was a stable ecosystem or an example of an event and asking students to explain why the ecosystem changed because of that event.

Negative impact of humans could also be an anchoring event. Fertilizers, habitat loss, the construction of a dam, pollution, over hunting, then creating a model of how this event impacts the populations of the ecosystem. This connects with the second standard, but the second standard will be addressed later in the unit.

Whatever you choose for an anchoring event, before beginning the teacher should create a causal story, a story that explains the phenomenon

Anchoring Event Resources:

Amur leopard video: https://google.discoveryeducation.com/player/view/assetGuid/7d0846ff-6510-41e0-82b3-856ceb6bede1

"Populations" Engage: https://google.discoveryeducation.com/learn/techbook/units/2d17fe2c-67ce-4ea9-b1d2-b5c4b4106ba8/concepts/968fc1d0-9b4a-4526-800c-8227164e90d0/tabs/5a1b6f8b-c6bf-4208-87dd-7b3b66692147

"Overpopulations" Engage: https://google.discoveryeducation.com/learn/techbook/units/ac244b56-1ed0-456c-870b-46466a5dea1d/concepts/c029feee-6231-4a8f-8249-a5610d637682/tabs/5a1b6f8b-c6bf-4208-87dd-7b3b66692147

Exploratory Resources:
Populations

Explore
Sessions: Two and Three:

Core Interactive Text. Students should complete a learning task which asks them read the text, respond to embedded questions, interact with the embedded media, and summarize their learning. Instruct students to pay particular attention to, and take notes on, the following: (SEP 6,7)

- vocabulary terms that are defined, including population, species, habitat, niche, and carrying capacity
- how changes in one population of organisms can affect other populations in the ecosystem
- what kinds of things can limit how large a population can become examples and evidence that support claims

Call on students to present their findings to the class, or use one of the high leverage strategies at the bottom as you see appropriate. Use their responses as an opportunity to check for student understanding of populations and limiting factors.
"Populations" https://google.discoveryeducation.com/learn/techbook/units/2d17fe2c-67ce-4ea9-b1d2-b5c4b4106ba8/concepts/968fc1d0-9b4a-4526-800c-8227164e90d0/tabs/759da9a7-2edf-4cde-9515-7081ca990764

This video segment explains some factors that can limit population size, including space, competition, and predator-prey relationships. Show the video segment to students and ask them to add to their answer to the Lesson Question "What

factors in a habitat can limit population size?" Remind them to cite supporting examples and evidence. "Population Limits: https://google.discoveryeducation.com/player/view/assetGuid/ddc30cfb-2d80-4ce5-817e-d6260fd1f6ca (SEP 8)

Assign students to read this reading passage, which describes factors that are affecting penguin populations. "The Heat Is On" https://google.discoveryeducation.com/player/view/assetGuid/1568C2E6-9CBB-40D1-B0D8-46241F2E46E7 (SEP 7, 8)

- As they read, students should take notes on what is happening to the population of emperor penguins in Antarctica and what factors are causing it, citing evidence from the article.
- Tell students that, as they read, they should assess whether the reasoning is sound and the evidence presented is relevant and sufficient to support the claims.
- After they have read the article, assign students to create a graphic organizer that shows the interrelationships among the various factors affecting the penguin population.
- Have a class discussion in which students share the new information that they gained from the article and their graphic organizers. Include a discussion of the evidence presented in the article.

Hands On Activity: Carrying Capacity Game: (SEP 3, 4, 5)
https://google.discoveryeducation.com/player/view/assetGuid/52519ed5-0b15-4030-809d-92df71764285 (Click on the materials button to see the instructions, the student handout may not be necessary for all students. In this Hands-On Activity, students will work in groups to model the carrying capacity of an ecosystem under different environmental conditions.

- Read the Teacher's Guide ahead of time and gather together the required materials.
- Review with students what the carrying capacity of an ecosystem is. Tell students that they are going to complete an investigation which mimics carrying capacity.
- Read the directions to the students and allow them time to carry out the activity, record and interpret their data, and answer the questions.

Exploration: "Populations…Going Up?" (SEP 4, 5, 8)
https://google.discoveryeducation.com/player/view/assetGuid/41a321c7-90c2-4938-b88a-0ec618c20b43 In this Exploration students will investigate how changes in the human birth rate, death rate, and net migration rate could affect the U.S. population over 25 years.

- Read the Teacher's Guide to the Exploration ahead of time for useful information about how to use this Exploration as well as answers to the questions.
- Provide students with copies of the Student's Guide (worksheet) and assign them to complete it as they work

through the Exploration.

- Tell students to make sure that they read the Introduction before starting the activity.
- Assign students to work with a partner to complete the Exploration.
- When students have completed the Exploration, instruct them to write a brief summary explaining how the birth rate, death rate, and migration can affect a population.
- Have a class discussion in which students share their answers and summaries.

Explanatory Model Revision: As a class complete a summary table for the four activities. The Core Interactive Text may need a little more space than the others. In their small groups students should get together and revise their models based on the learning of the last two days. They should refer to the summary table to help them identify key evidence. Information on summary tables and group work can be found in the unit overview. (SEP 2, 6, 7)

Explore : Sessions Four Thru Six

Hands on activity (Common Lab): **Surveying and Comparing Populations.** https://google.discoveryeducation.com/player/view/assetGuid/BCA6FA6D-C158-4F0A-AB67-FD084B6645A3 Teachers guide: https://gtm-media.discoveryeducation.com/videos/DSC/data/G6_TX_Populations_HOL_SurveyingandComparingPopulations.pdf In this Hands-On Lab, students will work in groups to design and carry out an investigation into the populations of organisms in a nearby area and how those populations interact with and depend on one another. IF you cannot take the students outside, then you should find images and examples of organisms from a local habitat, such as a local park, that students can use. Include pictures of the area, water samples, "pond scum" (sample with living organisms), examples of insects (alive or images), you may also want to include an audio recording of the area.

- Read the Teacher's Guide ahead of time and gather together all of the required materials.
- Write the word community on the board. Tell students that all of the populations in an area form what is known as a community, and that they will investigate a nearby community of organisms.
- Also review the term habitat with students. Ask them to cite examples of different habitats as a way of checking that they understand the meaning.
- Follow the directions for "Part One: Plan an Investigation." Circulate among the students and assist them with their planning, as needed.
- The next day, take the students to the study area and follow the directions for "Part 2: Conduct a Survey." Allow time for the students to carry out their field study.
- Return to the classroom and follow the directions for "Part 3: Analyze Your Findings."
- Lead a class discussion in which students share their findings, conclusions, and answers to the questions, citing

evidence from the activity to support their claims.
- Encourage student groups to constructively critique each other's work.

Video segment: "The RainForest" (SEP 8)
https://google.discoveryeducation.com/player/view/assetGuid/4f7b1267-cbe5-40ba-8952-a9c4cbace151
- Tell students that, as they watch the video segment, they should look for and write down ways that various populations of organisms in the rain forest depend on each other for survival.
- After the video, conduct a sharing session in which students can present what they saw.
- Assign students to create a concept map in which they show the interrelationships among rain forest populations discussed in the video, including squirrel monkeys, capuchin monkeys, palm nuts, insects, and raptors. If necessary, show the video segment again so that students can look for information that they missed the first time.
- Facilitate a class discussion where students can present their concept maps. Ask them to list and describe factors that limit population sizes in the rain forest.

Explanatory Model Revision: As a class complete a summary table for the four activities. In their small groups students should get together and revise their models based on the learning of the last three days. They should refer to the summary table to help them identify key evidence. Information on summary tables and group work can be found in the unit overview. (SEP 2, 6, 7)

Explore

Sessions Seven thru Ten

Reading Passage: " Spigot Science: Too Many Rabbits, An Ecosystem Gone Crazy"
https://google.discoveryeducation.com/player/view/assetGuid/2C11D79D-3C78-4218-AE32-01734E51D888 (SEP 5, 8)

- Pose the following questions to students to think about: Why might a particular species of organism overpopulate an ecosystem? How can too many of one species affect an ecosystem?
- Call on several students to share their ideas.
- Tell students to think about these questions as they read the reading passage: Too Many Rabbits: An Ecosystem Gone Crazy. This passage discusses the cause and effects of the rabbit overpopulation problem in Australia.
- After they finish reading, ask the questions again and call on several students to share what they learned.
- Assign students to do activity number one in the Activities box on the reading passage. In this activity students calculate how long it would take to get from the 24 introduced rabbits to a million rabbits at the reproduction rate

given in the article.

Hands On Activity "Pop Goes The Population" (SEP 4, 5)
https://google.discoveryeducation.com/player/view/assetGuid/5bf5bbd6-1646-4ea6-a82c-a42c4483ecba

- Read the teacher's guide for the Hands-On Activity "Pop Goes the Population" well ahead of time as advanced preparation is required.
- Tell students that in this Hands-On Activity they will model population changes involving two species of organisms, one of which preys on the other.
- Introduce the activity and follow the directions for working with students as explained in the teacher's guide.
- Facilitate a class discussion in which students share their observations and ideas from the investigation as well as the answers to the analysis questions.

Reading Passage and core interactive text: "It's Crowded In Here" (SEP 2, 8)
https://google.discoveryeducation.com/player/view/assetGuid/51958FA2-5776-44A2-A501-54FC33684400 Students will work to answer three questions: Why does overpopulation occur? What problems does overpopulation cause? How can overpopulation be reduced?

- Review the three questions with students.
- Instruct students to create a note taking sheet by writing the three questions on a blank piece of paper, leaving enough space between the questions to take notes.
- Assign students to read the reading passage It's Crowded in Here and take notes that will help them to answer the Lesson Questions.
- When students have finished reading, facilitate a class discussion about the reading passage. Ask students to share what they learned while reading that helps to answer the Lesson Questions.
- Have the students read the Core Interactive Text, https://google.discoveryeducation.com/learn/techbook/units/ac244b56-1ed0-456c-870b-46466a5dea1d/concepts/c029feee-6231-4a8f-8249-a5610d637682/tabs/759da9a7-2edf-4cde-9515-7081ca990764 and add to their chart.

Video segments: "Population Size" and "Keystone Species" (SEP 6, 7, 8)
https://google.discoveryeducation.com/player/view/assetGuid/9af733ab-cde5-47ec-b91b-64454b938f59 and
https://google.discoveryeducation.com/player/view/assetGuid/d5efe201-082b-4fd3-aa76-9f964275b67d

- Have students watch the video segments Population Size and A Keystone Species. Instruct them to write down information from the video segments that would help them answer the questions "What problems does overpopulation cause?" and "How can overpopulation be reduced?"

- After watching the video segments, facilitate a class discussion in which groups share what they have learned from the videos. Tell students that they may add information to their note sheets during the discussion.
- Assign students to work in pairs to create a flow chart that shows how reducing the number of predators in a species can lead to overpopulation in prey species. Instruct them to include in their flow chart how overpopulation of a single organism can affect the rest of the habitat.
- Call on several students to present their flow charts to the class, explaining each step. As a class, constructively critique each one and use the collective experience to develop consensus on a class flow chart.

Additional Resource Exploration: (SEP 3, 6, 7, 8)

As time allows, have the students explore these additional resources. These could be used outside of class as homework, or in class to collect additional evidence. Students need structure for viewing/reading beyond "find evidence." One potential idea is for students to create an inquiry chart, http://www.readingrockets.org/strategies/inquiry_chart and as they read/watch the resources below they are collecting evidence around questions they still have related to their model.

- "The Importance of Keystone Species" Reading passage about the removal of wolves from Yellowstone, the impact, and the reintroduction. Pairs well with the video below. https://google.discoveryeducation.com/player/view/assetGuid/ebb8d5fa-ecb4-4042-aff9-0cf2a2f84d52
- "Wild Thing" https://google.discoveryeducation.com/player/view/assetGuid/7b0a8a68-1a5f-4772-a555-cf5bfaddaf07
- "The Heat Is On" https://google.discoveryeducation.com/player/view/assetGuid/1568c2e6-9cbb-40d1-b0d8-46241f2e46e7
- "Classifying Life in a Hydrothermal Vent" https://google.discoveryeducation.com/player/view/assetGuid/c5d1b258-2cac-4b11-883d-915a0f89efd1
- "How wolves change rivers." This video explains how the reintroduction of the wolf had a dramatic impact on the ecosystem of Yellowstone. https://youtu.be/ysa5OBhXz-Q
- "A Keystone Species" https://google.discoveryeducation.com/player/view/assetGuid/d5efe201-082b-4fd3-aa76-9f964275b67d
- "Predator-Prey Relationships" https://google.discoveryeducation.com/player/view/assetGuid/da39a625-a613-4b83-943b-6c966e7f29cd
- 100 Greatest Discoveries: Ecology" https://google.discoveryeducation.com/player/view/assetGuid/165b4c57-122c-4428-ad69-5dccce29f25c
- "Deer Damage" https://google.discoveryeducation.com/player/view/assetGuid/552f6b9c-4e5d-4d38-939b-70c5077aef00

- "Boom and Bust, Lemming Populations" https://google.discoveryeducation.com/player/view/assetGuid/d1aca98e-2a86-41bf-a20b-b9f9cc063b32
- High Society: Termite Metropolis" https://google.discoveryeducation.com/player/view/assetGuid/f97acc9c-cd82-4955-b1e1-3e5a558c46c2

Explain

Session Eleven

As a class create a must haves list for the scientific explanation. Students should decide what important concepts from the last two weeks need to be included in the explanatory model. After the class has created their list, students should begin to finalize the list using the must haves list and teacher rubric as a guide. They could create a final model digitally, it could be a presentation, it could be an essay, or some other medium. In addition to explaining the anchoring event, students should prepare to argue why their explanation is the best, and defend their choices of evidence and reasoning included. The teacher may want to provide students with a list of sentence stems to assist in their writing. (SEP 2, 4, 6, 7, 8) http://ambitiousscienceteaching.org/wp-content/uploads/2014/10/D3-sentence-starters-Claim-Evidence-sound-unit-3rd.pdf

Session Twelve

Students finalize their explanatory model and prepare to present. Based on timing students may begin to present, or students may be going back over resources to finalize their model. (SEP 2, 4, 6, 7, 8)

Evaluate

Sessions Thirteen and Fourteen

Students present their models to the class. Students ask questions and provided feedback to student models. This could be done as individual groups presenting their findings in short presentations, a gallery walk, one stay rest stray, or some other sharing out strategy. Students should also use this opportunity to review the information presented and prepare themselves for the summative assessment the next day. The process of writing the explanation and discussing them is the process for reviewing the content. This allows the students to think deeply about the content vs. a study guide which causes students to only superficially review the information. (SEP 2, 4, 6, 7, 8)

Session Fifteen

Summative assessment.

After the assessment, if time allows you can present the students with the project below. This is a two-week project. Students will work in small groups and defined roles to complete the project.

STEM Connection

Sessions Sixteen Thru Twenty-Five (2 weeks)

In this **STEM project**, students complete a summative assessment by applying what they've learned about environmental problems and solutions to the place where they live. Students will complete this activity in small groups. Allow students to present their maps and discuss their improvements after they are finished. STEM Project Starter "Build A Better City" (SEP 1, 3, 4, 6, 7, 8)

https://google.discoveryeducation.com/learn/techbook/units/ac244b56-1ed0-456c-870b-46466a5dea1d/concepts/b94bb204-9bf3-4a36-b115-b24d82dec387/tabs/054d49d8-d8f5-4203-b276-19e25b56cc5f/pages/C44AAB3A-57F2-4432-8379-26D4082531E4

When presenting this to students, the goal is to keep the focus on environmental issues and how humans can maintain biodiversity. In the rubric the teacher creates for the students be sure that this is evident. That is, it needs to be part of the grade.
Best practices for small group work show that there needs to be individual as well as group responsibility. Each student should have a clear role with responsibilities. Student roles for this project could be related to different roles in government and planning, city planner, city manager, civil engineer, councilmember, city service contractor are examples.

Students should have objectives on a timeline which will allow them to be successful. Strategies for planning a timeline for students can be found at http://pages.uoregon.edu/moursund/PBL/part_6.htm S

Student milestones for this project:

1. Identify environmental problems in our community at all three levels. Review research materials to help identify problems.
2. Brainstorm potential solutions.
3. Research potential solutions.

4. Decide on ten actionable solutions.
5. Create an awareness document for each level, (home, block, city) to share with the public how people can improve the city.
    a. This could be brochures or posters, board builder, flyers, newspaper/blog stories, Facebook stories, YouTube videos, other social media
6. Share your work.

The teacher should use the milestones above to formulate a project timeline based on the needs of the students. Students should their projects finished by day 22 or 23 so they can receive feedback to revisit and improve their project.

Resources for student research:
Share with students to use for their research as they create their plan:

CIT, which includes text, interactive, and videos: https://google.discoveryeducation.com/learn/techbook/units/ac244b56-1ed0-456c-870b-46466a5dea1d/concepts/b94bb204-9bf3-4a36-b115-b24d82dec387/tabs/759da9a7-2edf-4cde-9515-7081ca990764

"Water Pollution and Waste": https://google.discoveryeducation.com/player/view/assetGuid/2df1ce2a-1b71-4ed4-8a63-991f845b543e

"Air Pollution" https://google.discoveryeducation.com/player/view/assetGuid/600a784d-0cf5-4e2e-a180-5f64f9caf60d

"How Habitats Become Threatened" https://google.discoveryeducation.com/player/view/assetGuid/b97a5518-e592-401d-94f8-0bc874661528

"Land Use in the US: Oil and Gas" https://google.discoveryeducation.com/player/view/assetGuid/5b358771-faa1-4e6c-9a6a-c055a68797e9

"Land Use in the US: Farming and Ranching" https://google.discoveryeducation.com/player/view/assetGuid/9f80748b-0c4e-4065-956d-05901e5b9440

"How Deforestation Harms Diversity:" https://google.discoveryeducation.com/player/view/assetGuid/19bcb7ce-a7d8-428d-b4ba-4a929f1be9c1

"Habitat Destruction" https://google.discoveryeducation.com/player/view/assetGuid/5b0dfeaf-a0ce-4c50-aae7-10c57d54b596

"Preserving and Protecting Habitats" https://google.discoveryeducation.com/player/view/assetGuid/09579fb4-59ad-47e0-bb67-9c899f83e5ab

"Conservation" https://google.discoveryeducation.com/player/view/assetGuid/77d90b47-9510-44d0-8cd4-9aa9352cdd54

"Garbage" https://google.discoveryeducation.com/player/view/assetGuid/5da5ad37-c1f2-4156-b9f4-f7a86e477f22

"Water Pollution" https://google.discoveryeducation.com/player/view/assetGuid/491a9b6c-46c7-4ac1-9f6e-3a58103c8859

"Exploring the Diversity of Life: Act with the Facts" (Full length video, includes several strong segments, break the video up, and only use the segments you find appropriate.)
https://google.discoveryeducation.com/player/view/assetGuid/64a244bc-131b-429a-9a26-c8893bbf1263

Reading Passages:

"Plant a Tree, Change the World": https://google.discoveryeducation.com/player/view/assetGuid/e15edd0e-e0b6-4515-9b8d-3a80625ec97a

"Remote Sensing" https://google.discoveryeducation.com/player/view/assetGuid/e0ed71a0-3a85-46c9-8465-4fbe36a8bb6c

"Garbage Crisis" https://google.discoveryeducation.com/player/view/assetGuid/62effce7-ef74-4b0d-b21f-76e5f798fb3a

"Land Use and Planning" https://google.discoveryeducation.com/player/view/assetGuid/b075eca7-f735-4af4-98cc-e51007896d0c

Interactives:

"Water Pollution and Waste": https://google.discoveryeducation.com/player/view/assetGuid/4d668d96-76c9-411b-b5a4-a85492397509

"Got Habitat" https://google.discoveryeducation.com/player/view/assetGuid/ef2434b4-cd0f-4d8a-9768-a7acf48ebffa
Hands on activity, "Mountain-Top Mining and Biodiversity."
https://google.discoveryeducation.com/player/view/assetGuid/86290dba-8d1f-4442-aede-8eb7a535b5d7
Have students create an analogy map for part one. More about analogy maps can be found here:
https://bscs.org/sites/default/files/_media/community/downloads/making_sense_of_sense-making_nsta_2013.pdf

High Leverage SOS Strategies:
Strategies that are good for summarizing, key ideas, and compare and contrast: (Use instead of the instructional strategy presented as desired based on the needs of your students)
That Sums It Up: https://google.discoveryeducation.com/player/view/assetGuid/47e8de91-8318-4e1f-b6f4-3b26b2eb7f0e
PMI (Good for pro/con lists): https://google.discoveryeducation.com/player/view/assetGuid/3a4f20b8-d41f-4065-a1ed-71b446cc2ac1
Journals: https://google.discoveryeducation.com/player/view/assetGuid/ef317b31-eca2-464a-9cd3-7907aa3433bd
Jigsaw: https://google.discoveryeducation.com/player/view/assetGuid/69D036DD-044C-4757-8C73-E1F9CFAF3979

Common Labs and Activities

Hands On Activity: Carrying Capacity Game
Surveying and Comparing Populations- common lab
Virtual Lab- "Populations…Going Up?"

Materials:

For Common Lab: **Surveying and Comparing Populations.**

Per pair:

- White plastic tray (a white plastic plate will do)
- Trowel or shovel
- Forceps
- Magnifying glass
- Net on a long handle for water of meadow survey
- Eye droppers
- Thermometer
- Binoculars

- Meter stick or measuring tape
- String
- Wooden stakes or 4 pencils
- Paper and writing tool

21st Century Teaching and Student Strategies

- Project Based Learning.
- Ownership and Engagement.
- Collaborative Teaching and Cooperative Learning.
- Citizenship, Leadership, and Personal Responsibility. ...
- Mastery of Curriculum and Higher Order Thinking Skills. ...
- Technology and 21st Century Skills.

Special Ed. and ELL Strategies and Resources

Special Education

In the Techbook, complex content is presented using supportive hyperlinks to definitions of key vocabulary and concepts. The Interactive Glossary provides a multimodal, scaffolded experience that enables students with a variety of learning styles/strengths to access grade level content. An inquiry approach using the 5E instructional model (Engage, Explore, Explain, Elaborate, and Evaluate) is an important tool for helping students to understand the scientific process and develop critical thinking skills. In many cases, the skills needed for successful inquiry will require additional support for students with learning disabilities.

Strategies or Tips

- Utilize Assignment Builder to provide a directed inquiry approach for specific students in which they are provided with a detailed procedure or specific set of questions to answer as they proceed to exploration.
- Provide graphic organizers such as spider maps, tables, or cause–and effect charts as appropriate to guide students in note-taking as they explore resources. Model for students how to take notes while watching a video or working through a reading passage. Show students how they can stop, start, and repeat a video clip so they can view materials as many times as necessary or stop to take notes. Allow students to explore the different buttons and links in an interactive or Virtual Lab for several minutes before actually starting the activity. Set a stopwatch or timer and tell students they have x minutes to click through the activity before they actually begin.
- Provide a Main Ideas and Details graphic organizer for students to use to summarize all of their notes. Model for

students how to find the overall main ideas by looking for concepts that repeat in their notes (i.e., concepts covered in multiple resources). Take full advantage of the online medium by allowing students to rewatch videos, re-read passages, or redo activities multiple times. The variety of multimodal Discovery Education resources available makes it possible for students who learn differently to approach the content in the ways they learn best. Provide sentence starters and frames to support students in describing what they learned.

- Add linking questions to student worksheets to fill in more tightly any potential logic gaps. Linking questions should lead students through each thought process required, tying one idea directly to another. Allow students to choose from the various project ideas in order to better suit their learning styles.
- Allow students to type reports or answers to questions rather than writing them out. Allow students to use sketches and diagrams to explain their thinking. Allow students to collaborate with peers on Brief Constructed Responses (BCRs), either discussing their ideas beforehand or writing responses in pairs or small groups. Provide sentence starters, sentence frames, and word banks to support students in demonstrating what they have learned.

ELL's

General Strategies for Supporting ELLs in the Classroom Given the ever-increasing number of English Language Learners in general education, it is in the best interest of school personnel to be aware of ways to support and help students at any English acquisition level. Self -contained classroom teachers as well as content teachers can use these tips to engage and invest ELLs.

- Do not assume background knowledge or experience.
- Do not assume accessibility to resources outside of school.
- Be aware of and respectful of cultural behaviors and restrictions.
- Teach vocabulary through direct instruction.
- Connect vocabulary to the curriculum.
- Provide context-based experiences.
- Access students' prior knowledge, allowing use of L1.
- Tie curriculum to students' life experiences.
- Tie new objectives to past lessons, allowing use of L1.
- Engage in conversational as well as instructional language.
- Integrate reading and writing early on.
- Model correct language.
- Expand student responses.
- Use multicultural materials.

Identify objectives appropriate to each student's current knowledge base.

Familiarize students with the writing process.

For Beginners:

- Use visual aids, especially the "real thing" (realia).
- Model the process and outcome.
- Enunciate clearly; speak slowly in short sentences, in the active voice (not "The trees were consumed by the fire that raged through the forest," but "The fire burned down all the trees.")
- Repeat and restate. Use facial expressions and body language.
- Allow students to demonstrate learning non-verbally.
- Front-load, post/provide, and demonstrate key vocabulary.
- Avoid idioms, colloquialisms, word play, jokes, and words with multiple meanings.
- Ask questions with single word answers, and repeat the answers in short sentences.
- Use cloze exercises.
- Pair students with English speaking partners.
- Reduce workload, especially research and home-based projects.

Intermediates:

- Use visuals (photos, objects).
- Model procedures and products.
- Frontload and reinforce content vocabulary.
- Maintain a posted list of specific science vocabulary.
- Give clear, explicit directions in short sentences.
- Provide assignments commensurate with ELL productive language skills.
- Offer students answer choices and/or provide verbal cueing – say the sentence frame(s) for the answer(s) or start the answer sentence. For example, "What is at the center of an atom? Is it a proton or a nucleus?" or "What is at the center of an atom?
- The center of an atom…." Allow reduced workload/output, extra time, and/or differentiated product.
- Allow English-speaking partners as needed. Provide multisensory input with closed captions and audio text, as in the Techbook.