Populations and Habitat

Science (Life Science: Carrying Capacity): Grade 3

Revised April, 2019

The activity provides students with an exploration in the population cycles of organisms within a habitat. It centers on the game *Oh Deer!*, originally developed in the 1980s by Project Wild. Originally designed for a grade 3 unit on biological evolution and extinction, these materials can be integrated into any life science unit where interactions between organisms within a habitat is address (such as lessons on food web).

Students will act out a simplified model of population levels between wolves, deer, and the resources they need to survive. They will collect data on the population counts, then analyze their data using graphs and spreadsheets. They will then interact with a spreadsheet-based model of the game, developed to simulate the very rules they played, and compare simulated data from the model to their collected data.

This Integrated Module is designed to illustrate curriculum that integrates computational thinking and physical science. It is based on a model curriculum unit, "Effects of Changes in an Environment on the Survival of Organisms," originally produced by the MA Department of Elementary and Secondary education. As the entirety of the content in these materials is geared toward connecting computational thinking to science, computational thinking skills are not individually called out within the unit.

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Table of Contents

This unit addresses the following standards. For more detail, see the section *Standards Addressed in this Unit* at the end of this document.

MA Sci and Tech Eng Framework/NGSS: 3-LS4-3, 3-LS4-4, Science.Practice.2, Science.Practice.4, Science.Practice.5

MA DLCS Framework: 3-5.CT.a.3, 3-5.CT.c.2, 3-5.CT.e.1, 3-5.CT.e.2, 3-5.CT.e.3

CSTA Computational Thinking Progressions: Data Collection, Data Analysis, Data Representation, Problem Decomposition, Abstraction, Algorithms & Procedures, Simulation.

CSTA K-12 Computer Science Standards: 1B-DA-06, 1B-DA-07, 1B-AP-15.

Overview

Science: Animal Populations within a Habitat

These activities were initially designed to be integrated with the grade 3 life science model curriculum unit titled *Effects of Changes in an Environment on the Survival of Organisms*. They can be used as a standalone activity, or combined with any life science activity that explores animals, habitats, life cycles, or food web.

The lessons reinforce how populations of various organisms affect one another. Here, the variations of a population of deer is studied based on availability of resources. A predator is introduced to begin to experience how various elements within an environment are interdependent.

Science Practices and Computational Thinking

As students play the game, they will have the opportunity to understand the process of developing a valid model of an actual event. They can discuss what parts of the actual habitat are included in the model, and what parts are left out. Then interacting with the spreadsheet-based model, they will see the extension of their game into a model that can be manipulated to react to other scenarios (such as a drought).

By including activities that allow students to graph data they collect, then explain how patterns they see in the graphs represent the phenomenon they were modeling, students start to get a grasp on the kinds of ways scientists leverage data to understand and explain nature. By linking the data they collect (from their physical model) with data simulated by a computer (programmed to follow the same rules), students bolster their computational thinking skills in both areas (modeling and data). These activities can also introduce or reinforce students' skills working with spreadsheets, and more advanced students can learn how to create a robust spreadsheet model based on certain criteria.

Lesson Roadmap

Lesson 1: Introduction – this lesson sets the stage for the unit, having students brainstorm about what the essential elements are required for a particular organism (in this case, deer) to survive.

Lesson 2: Oh Deer! – students take part in an active model of a habitat to generate simulated data for studying the effects of availability of resources on population levels. How the model relates to an actual habitat is discussed. Data collected is then analyzed to help support the observations about the interactions between resources and organisms within a habitat affect one another.

Lesson 3: Introducing a Digital Model – students experience a spreadsheet-based model that digitizes the rules from Oh Deer!, and analyze graphs generated from the model to further their understanding of the interactions between populations within a habitat.

Optional Lesson: Food Web Digital Simulation – students begin to work with a web-based model, originally designed for grade 5 students, that provides a more complex interaction between various mammals and plants.

Suggested Sequence

These activities can be taught separately, or can be integrated into any life sciences unit that teaches about animal habitats, the interaction between populations in a habitat, or the food web.

For instance, below is a sample scope and sequence that shows where these activities may be integrated in the MCU titled *Effects of Changes in an Environment on the Survival of Organisms*, available from MA DESE.

1. Lesson 1: Introduction
2. Lesson 2: Oh Deer!
3. Lesson 3: Introducing a Digital Model
4. *MCU Lesson 4: The Great Kapok Tree*
5. Optional Lesson: Food Web Digital Simulation
6. *MCU Lesson 2: Mass Environmental Change*
7. *MCU Lesson 1: What Caused the Extinction of Dinosaurs*
8. *MCU Lesson 3: Fossils Tell of Long Ago*

This scope is only a suggestion. Tailor the order, as well as the materials in these activities, to best suit your classroom and students.

Lesson 1: Introduction

Lesson Overview: Whole group discussion about Essential Question 3: *What factors are required for the survival of living things?* This will be followed by partner work creating a list of factors that affect survival of living things.

Estimated Time: 45 minutes

Standard(s) addressed in this lesson: As an introductory lesson, no standards are addressed here directly.

Essential Question(s) addressed in this lesson:

- What factors are required for the survival of living things?

Lesson Details

Lesson Opening (10 minutes)

1. Teacher gathers students and introduces an initial question about a familiar animal: "I see squirrels that live outdoors year-round. What do you think the squirrels need in order to survive?"

During the Lesson (30 minutes)

2. After introducing the initial question, the teacher will give students a chance to "turn and talk" about possible answers to this question.
3. Then, students will make notes of possible ideas in their science notebook.
4. After students have an opportunity to record their initial ideas about factors for the survival of living things, the teacher will guide a conversation with students. The teacher will listen to and record student ideas. After that, the teacher will ask a more general question: "Do we think all animals need the same things to survive?" This question is meant not to inform students about the correct answer as much as to get at their current thinking. The intent is to move toward thinking about general needs for all living things, such as food, shelter, water, proper temperature and climate, adaptations for survival, etc.
5. Ask the question: "What might happen in an environment that would keep an organism from getting what they need to survive?" (Alternatively, you can ask "What kind of change to the environment causes an organism to go extinct?")
6. Have students engage in **accountable talk:** get students to not simply answer the teacher's question, but rather to have a group discussion by actively talking and listening to others.

Teacher Note: If you like to use a KWL chart, this might be a time to introduce it and focus on the "K." This lesson is meant to identify students' current thinking about events that could affect populations within a habitat. This should not be a time to introduce new information or to provide background knowledge; the time for introducing new material should come only after you have a good idea of current student thinking.

7. While students respond to this question, the teacher will take notes on the discussion providing absolutely no feedback verbally or with facial expressions or mannerisms. The

teacher will not respond or correct statements, instead, will guide students to stay focused on the question.
8. After the science talk, in their science notebooks, students will make a list of possible environmental causes that could lead to extinction.
9. Finish with a whole class discussion that may include the asteroids, effects that pesticides, food sources, alterations in habitats, deforestation, invasive species, human behavior, and climate change all play on survival.

***Teacher Note*:** Students might have the misconception that animals rely on humans for survival. Exploring this might be beneficial depending on the characteristics of the class. Students could work in groups to generate lists that compare ways that humans negatively and positively impact the environment / extinction. (For example, rats on the Galapagos Island decreased sea turtle populations / eradicating the rats helped the sea turtle population to rebound.)

Lesson Closing (10 minutes)
10. Teacher previews the unit: "What do you think the squirrels need in order to survive?" is a big question, and with big questions, we have to break them down into smaller pieces so that we can examine the problem closely. When a problem is too big to examine all at once, we need to break it down into smaller sub-problems. We can then investigate the smaller sub-problems to gain knowledge and find solutions. In the next week or two, we are going to examine what organisms need to survive and answer some of the questions you came up with today.
11. Note that students will be using a science notebook throughout the unit to record evidence and their ideas about changes in an environment as well as the plants and animals that live there.

Additional Information for This Lesson

Instructional Materials/Resources/Tools:
- Large paper and markers for KWL chart
- Sticky notes

Assessment
- Science Notebooks will serve as the pre-assessment for the unit. Misconceptions should be noted and addressed in subsequent lessons.

Prior Knowledge Required:
- That living things have certain characteristics including needs for survival, as well as a common understanding of the word "survival."

Anticipated Student Preconceptions/Misconceptions
- Students may believe that human involvement is necessary for the survival of living things.

Lesson 2: Oh Deer!: Modeling a Habitat

Lesson Overview: Students explore the effects of change to an environment on the survival of deer populations through game play. They model interactions within an environment by playing *Oh Deer!*, and collect data to analyze in the next lesson.

Estimated Time: 45–60 minutes

Standard(s) addressed in this lesson: 3-LS4-3, 3-LS4-4, 3.MD.B.3, 3-5.CT.a.3, 3-5.CT.c.2, 3-5.CT.e.1, 3-5.CT.e.2

Essential Question(s) addressed in this lesson:

- What happens to organisms when they cannot meet their needs?
- What kind of changes to the environment causes an organism's population to change?
- Can life cycles be interrupted or changed?

Lesson Details

Lesson Opening (10 minutes)

1. Explain the focus of the unit is on the needs of animals and the effects of changes in an environment on their ability to survive.
2. Review the discussion notes from Lesson 1, specifically highlighting survival of a species, touching upon animals discussed in the previous lesson.
3. Ask students what a habitat is and elicit responses.
4. Explain that a habitat is an area that includes food, water, shelter, and space. Ask students to share some examples of habitats they have learned about (tropical rainforests, deserts, grasslands, woodlands, wetlands, arctic, oceans).
5. Ask what they think happens to plants or animals in the habitat when there is a change to the environment/habitat. Elicit responses.
6. Ask if they think changes in an environment only affect animals or if they affect plants, too. Elicit responses.
7. Optional: present students with "How Wolves Change Rivers" video http://www.yellowstonepark.com/wolf-reintroduction-changes-ecosystem/. Note that this video is also referred to at the end of Lesson 4. You can present the video here as an overview of the complexity of how organisms interact within a habitat to assist in discussions during this lesson about how the *Oh Deer!* game models a habitat (specifically, what attributes are included and which are excluded). You can view it again later to pull together the various activities.
8. Introduce the essential questions for the lesson:
    - What happens to organisms when they cannot meet their needs?
    - What kind of changes to the environment causes populations of an organism to change?
    - Can life cycles be interrupted or changed?

    Say, "These are big questions, so we're going focus on only a small part of them for now. When a problem is too big to examine all at once, we break it down into smaller sub-

problems. We can then investigate the smaller sub-problems to gain knowledge and find solutions."

9. Say, "Today we're going to look at deer more closely. We want to know what happens to deer that cannot meet their needs, and whether certain changes in the environment can interrupt or cause big changes in their life cycle. We'll also see if these changes can cause the whole population to change. These are very big problems."
10. Ask: "What smaller sub-problems or pieces can we focus on for our investigation?" *Answers will vary: food, water, weather, parents, shelter, asteroids, volcanoes, good home, a place to hide, space to move, etc.* Write student responses on the board. After all the responses have been listed, circle food, water, and shelter, and say that today we're going to be investigating these sub-problems to see how they affect the deer's life span if they are missing, whether they cause the deer to go extinct, and whether they interrupt or change their life cycle.

During the Lesson

11. Introduce the activity. Make specific references to what is being MODELED and SIMULATED. Activate prior knowledge by saying the following:

    - Sometimes things we want to examine are too big or too dangerous (like the deer and the wolves in Yellowstone Park) to examine at school, so we need to make a MODEL. A MODEL is a representation of the real-world that has the most important attributes we want to examine.
    - In this game, you will act as the model. You will be deer, food, water, or shelter. [MODELS are static representations of real-world systems that contain the attributes.]
    - In playing the game, we will simulate life in Yellowstone Park. [SIMULATIONS are imitations of real-world actions or processes over time. SIMULATIONS are run on models to see what happens if…]. When the deer get hungry they find food; when they get thirsty they find water; and when they want to hide they find shelter.

Teacher's Note: There are several options for the data collection aspect of the game (recording of counts). The instructions below assume students will keep records in their science notebooks as the game progresses. Prior to playing the game, you can instruct students on how to set up a table in their notebooks for the data, or you can provide them with a handout (two forms, with different formats depending on your students' needs, are included in the Resources section that they can insert in their notebooks). Alternatively, you can 1) have students count and you can record the data in a (preferably large, visible) chart, later having students copy the data into their notebooks, or 2) assign a group of students to be data collectors, and not participate in the game (you can swap them out for other students after a few rounds so all students have a chance to play both roles).

12. Mark two parallel lines on the ground 10 to 20 yards apart. One line will be for deer, and the other for resources. Divide students into two groups (one group will be deer, and the other group will be resources) have each group line up on their respective lines.
13. Take a count of the two groups. This count is count 0.
14. Say, "Now we know who is representing each component of the model, but we're not done with the model yet because each of you has a different role to play. The deer need to find

food, water, and shelter in order to survive in their environment. If they do not, then they will die."

15. Review the rules for the Oh Deer! game.

> ***Oh Deer!* Rules, part 1**
>
> *At the start of each round:*
> 1. Students in each line face away from each other.
> 2. Each "deer" chooses whether they are seeking food, water, or shelter for the current round, and each "resource" or "habitat component" chooses which kind (food, water, or shelter) they will be for this round. Students can indicate their resource as follows:
>   - Food: clamp their hands over their stomach.
>   - Water: clamp their hands over their mouth.
>   - Shelter: hold their hands together over their head
>
>   Alternatively, you can have students grab and hold colored craft sticks or some other object that will be visible to other students. This option can reduce the likelihood of deer or resources spontaneously changing during the round.
>
> *During the round:*
> 3. Students turn around. Those who are deer look for a resource that matches their choice.
>   - Deer who find a matching resource take the resource back to the Deer line. *These deer find the resource they were looking for, so they survive and reproduce. The "resource" student is used up, so they are no longer a resource, but the deer reproduced, so now they represent a new deer.*
>   - Deer who do not find a match go to the resource line. *Deer that cannot find the resources they need to survive die. Their bodies go into the ground and become resources for the next round.*
>   - Resources that are not chosen return to the resource line. *Resources that are not used remain available for other deer in the next round.*
>
> *Important*:
>   - Deer cannot share resources.
>   - One deer cannot consume more than one resource in a round.
>   - Once students select their resource type, they cannot change during that round.
>   - However, students can change their resource type between rounds.

16. Say, "Now we know how you will behave in the game, so our model is complete. We've added the rules about how the different parts work together. So our goal now is to run a simulation based on the model and collect data from it that we can study later."

17. Have students play a number of rounds (at least 6), recording the two population counts (deer and resources) after each round.

Teacher Note: Emphasize safety in this game. It can be a little bit like tag. You may want to instruct students to gently place their hands on the shoulder of the "habitat component" that they are taking back.

If you are having students create their own tables in their science notebooks, you may want to review that here. Otherwise, make sure the data collection sheets are in their notebook already. It is recommended that students keep their science notebook and pencil nearby, placing it behind the lines before starting the next round.

18. Introduce a wolf into the habitat. Identify a third area separate from the first two. This will be the "wolf den." Select one of the resource students to be the first wolf and have them stand in the den. If you have pennies or other garments that can be easily put on and taken off, you may want to have students who are wolves use them to identify themselves during the game.

19. Review the rules below that describe how the wolves work.

Oh Deer! Rules, part 2

At the start of each round: Follow rules as in part 1. In this model, wolves only eat deer, and do not seek other types of resources.

During the round: Students who are deer or resources operate the same way they did before, with one added twist:

4. Students who are wolves select a deer to eat this round.
    - Wolves cannot eat deer who have already found a matching resource cannot be eaten by a wolf. *The deer who find their resource are strong, and successfully escape the wolf. [Note: this rule is optional, as it may lead some students to be overly aggressive in their play. Without this rule, the likelihood that the entire deer population gets wiped out before the end of the game is fairly high.]*
    - Wolves who find a free deer take the deer back to the wolf den. *These wolves find the resource they were looking for, so they survive and reproduce. The deer is eaten, so the student is no longer a deer, but the wolf reproduces, so now that student plays a wolf.*
    - Wolves who do not find a free deer to eat go to the resource line. *Wolves that cannot find the resources they need to survive die. Their bodies go into the ground and become resources for the next round.*

Important:

- Wolves cannot share deer. *In the wild, however, wolves often do share deer.*
- One wolf cannot consume more than one deer in a round.
- Once students select their resource type, they cannot change during that round.
- However, students can change their resource type between rounds.

20. Continue playing rounds of Oh Deer! as time permits. Add a new column to the data collection to count the wolves (so each round will have three counts: deer, resources, and wolves). In order to have enough data to see patterns in the next lesson, playing 15 rounds or more is best.

21. (Optional) You can limit the habitat in a variety of ways so students understand there is a relationship between animals that are able to meet their needs for survival/reproduction. For instance, you can secretly tell the resource group that there's a drought, so none of them can choose water for the current round. (Other options include: a blight to make food unavailable, and an extreme weather event such as a hurricane to restrict shelter.)

Lesson Closing

22. At the end of game, bring students back to the classroom/gathering space to debrief the experience. Ask general questions such as:
    a. What did you notice about the deer population between each round?
    b. What happened once the predator was introduced?
    c. In nature, what factors do you think would influence the population changes?
23. Ask students to think about how the activity modeled an actual habitat. Ask questions such as:
    a. What do you think is being simulated in this activity? How? *The daily life of deer. During the game the deer need to find certain things to live, and if they don't they will die*.
    b. What is included in this model? What is not? *Deer, wolves, food, water, and shelter are included. Weather conditions, temperature, predators, other animals, and space are not included. Wolves also need water and shelter, but our model didn't include that.*
    c. How well do you think the simulation went? How might you change the rules to make sure it represents changes in deer population better? *Did all students follow the rules? How might you make sure the rules are changed so you get better data?*
    d. What is the concept being illustrated in the simulation? What is being simulated in this game? *The need and search for food, water, and shelter and the consequences of not finding what you need (death) is simulated; how the number of deer goes up and down.*
    e. What question(s) do you think this simulation is going to help you answer? *How much of each habitat component and how many deer are needed to reduce the number of deaths (stabile ecosystem). Or the essential questions from this lesson: What happens to organisms when they cannot meet their needs? What kind of changes to the environment causes an organism's population to change? Can life cycles be interrupted or changed?*

Additional Information for This Lesson

Objectives

- Students will be able to recognize and explain that different changes in environment can affect the survival of animals.
- Students will be able to recognize that animals can have different responses to different changes in environment such as fluctuations in population.
- Students will be able to recognize that different animals have different needs that may or may not be met by a particular environment.
- Students will understand that changes in an environment can be investigated by breaking the problem down into sub-problems.
- Students will be able to make a list of sub-problems to investigate when addressing a larger problem.
- Students will be able to explain what a model shows and does not show.
- Students will understand that changes in an environment can be investigated through simulations.
- Students will be able to collect data from a simulation to answer a question.
- Students will be able to create a bar graph from data they collected.

- Students will enter data collected from a simulation into a spreadsheet program to create graphs that show fluctuations in habitat components and the population of a model animal (deer), and use graphs to analyze patterns and draw conclusions.

Prior Knowledge Required:

- Plants and animals depend on their surroundings to get what they need to live.
- There are a variety of plants and animals living in any particular area.
- Survival of a population is dependent on reproduction.
- Students should be able to identify different kinds of information and collect data using digital technologies. (K-2.CTc.1 and K-2.CTc.2)
- Students should be able to describe a model and simulation. (K-2.CT.e.1 and K-2.CT.e.2)

Anticipated Student Preconceptions/Misconceptions

- Students may be unclear about the specifics of what certain animals eat, or believe that bigger animals have better chances of surviving a change.

Instructional Materials/Resources/Tools:

- Video access and projection equipment
- Oh Deer! Game Directions adapted from "Project Wild Teacher's Guide" and *http://www.beaconlearningcenter.com/documents/313_01.pdf*
- "How Wolves Change Rivers" video http://www.yellowstonepark.com/wolf-reintroduction-changes-ecosystem/
- Space (playground, gym, etc.)
- Clipboard and paper to collect data
- Oh Deer! Data Collection Table handout (optional, 2 forms available)
- Craft sticks or print cards (optional)
- Masking tape to mark area (optional)
- Large flip chart with the same data table to record class data

Instructional Tips/Strategies/Suggestions for Teacher:

- This game involves movement and touching. Be sure to explain the expectations for behavior before starting. For the purposes of this lesson, "habitat" and "environment" are interchangeable terms. The activity is best conducted in a space with room to move. Students will need to make a graph that represents iteration of the game.
- Between each round, it is recommended that all students sit down. Then, they should count how many deer there are and how many natural resources there are. When the predator is introduced, that should also be counted. Students should record this data in their science notebook (sample data collection sheets are included in the resources). Teachers can either allow students to create their own models/representations or the teacher can suggest that students create a table.
- For larger groups (such as if multiple classrooms are combined to run the simulation together), you may want to have half students be the scientist-observers, and half the simulation participants. The scientist-observers record the data while the participants act in the simulation. Then halfway through, have the groups switch so each student has a chance to play both roles.

- It is recommended that a teacher or staff member digitally record (video) the game so that the deer population, natural resources, and predator can be seen. This would allow the video to be played in the classroom, and the teacher can pause the recording at the end of each round. This will allow all students to check their numeric data of the environmental populations before making their graph.
- This lesson integrates several computational thinking standards:
    - Abstraction: A key skill in investigating complex real-world problems is the ability to break the problem down into smaller sub-problem. Students learn how to identify sub-problems that can be examined/investigated to gather information, gain knowledge, and find solutions. Throughout the lesson, emphasize and question students on the relationship of the sub-problems being investigated and the larger problem they are trying to address.
    - Data: Students continue to build on their data collection and analysis skills by using a spreadsheet to graph data collected from an investigation. Deliberate practice and reinforcement of this skill will lead to acquisition of this skill that can later be developed into more complex knowledge and skills. Find opportunities for students to graph throughout the year.
    - Modeling and Simulation: Students continue to refine their skills in modeling by identifying what is and is not being shown in a model. Students also refine their understanding of simulations and how to use them to answer real-world questions. Throughout the lesson, question students on the concepts, features, and behaviors illustrated in the simulation. Emphasize the use simulations to collect data to answer the lesson's real-world questions.

Lesson 3: Analyzing Data and Using a Digital Model

Lesson Overview: Students analyze the data collected during Lesson 2 from playing *Oh Deer!* They record their data in a table, draw graphs, and look for patterns in the graphs. They then interact with a spreadsheet-based model that follows the same rules as the game, and look for the patterns simulated by that model, seeing if they are similar to the ones they collected. Through the data analysis, they make observations and conjectures about how the various populations affect each other.

Estimated Time: 30–45 minutes

Standard(s) addressed in this lesson: 3-LS4-3, 3-LS4-4, 3.MD.B.3, 3-5.CT.c.2, 3-5.CT.e.2, 3-5.CT.e.3

Essential Question(s) addressed in this lesson:

- What happens to organisms when they cannot meet their needs?
- What kind of changes to the environment causes an organism's population to change?
- Can life cycles be interrupted or changed?

Lesson Details

Lesson Opening (5 minutes)

1. Remind students of the data they collected from playing *Oh Deer!* Ask them what each number represents. *Students may answer simply, "the number of students in that line." If they do not offer further detail, ask them to think about what each student represented.*

During the Lesson

2. Have students place the data from the simulation into their own data table. If a video was taken, it might be good to replay the video so that students can check their data.
3. Using "Science Talk" (see the link under Unit Resources), encourage them to talk about what they experienced and saw in the simulation and encourage them to use the data as evidence for their reasoning. For example, they saw a small herd of deer (seven students in a class size of 28) begin by finding more than enough of its habitat needs. However, because the population of deer expanded over two to three rounds of the activity until it exceeded the carrying capacity of the habitat; there was not sufficient food, water, shelter, and space for all members of the herd. At that point, deer died from lack of water, food, or shelter or from overcrowding, and they returned as part of the habitat. The graph will show the relationships among the number of deer in a habitat, the number of habitat components, and the ability of the deer to survive and reproduce, and how those quantities change (and what patterns emerge) over time. Note that this discussion should continue after students have graphed their data, as the purpose of creating the graphs is to help students get a better sense of the patterns in the data, which (typically) can be seen more clearly using graphs.

4. (Optional) From their own data tables, have students create graphs of the populations using graph paper. Begin by modeling for the whole class how to set up the graph, and draw the data for the first one or two years. Once the data are graphed, ask students if the graphs match the observations they made during the "Science Talk" discussion, or if they want to change or add any observations based on the graphs.

Teacher Note: You can use this opportunity to reinforce creating bar charts to address mathematics standards. If students have experience creating bar charts of more than one quantity, you can have them graph both deer and wolves on one chart. Example data and charts are included in the resources. If students have experience creating or viewing line charts, they are more appropriate for analyzing data such as this.

5. Have individual or pairs of students enter the data and create a graph using a spreadsheet program (e.g., Google Sheets or Microsoft Excel). [*Depending on your classroom resources and available time, you may want to demonstrate creating the graph using a spreadsheet instead of having students do it themselves.*]
    a. Model for the whole class how to set up a table and enter data. Emphasize that now that they have collected all these data, they need to try to organize them, analyze them, and come to conclusions based on them. Technology tools are good ways to create graphs of different types to answer different questions.
    b. Once all the data are entered, model for the whole class how to create a bar graph from the data. (Note that software programs call vertical-bar graphs "column charts"). Add the chart title and the horizontal and vertical axes titles from the chart tools layout menu.
    c. Have students compare the graphs made on the computer with the ones they created by hand. Do they match?
    d. Change the graph type to a line graph. Discuss how this is a different way of looking at the same set of data. Ask them to revisit the analyses they've already made, and decide if they see any patterns more clearly using this kind of graph instead of the bar graph.
6. Ask students for their observations from the line graphs. (NOTE: Depending on the number of rounds you played and the quality of the data students collected, not all observations may be possible. In that case, you can defer discussion of those aspects until step 8.) Common observations may include:
    - They look like mountains, with peaks and valleys.
    - The lines go up and down usually, but sometimes it takes a few steps.
    - The lower the population gets, the longer it takes to move back up the graph.
    - The pattern in the deer population gets messed up when the wolves start.

    Some observations you may want to discuss with students. Ask them to point out examples in the chart, and have them explain why the data act this way.
    - When the deer population is high, the next year the wolf population rises. When the deer population goes down, the next year the wolf population goes down. [*That's because in a year with a lot of deer, the wolves can consume them and survive (and reproduce). If the deer are scarce, wolves die off.*]
    - When the wolf population goes down, the next year the deer population rises. When the wolf population goes up, the deer population goes down. *[That's because when*

there aren't a lot of wolves, more deer survive and can reproduce. If there are a lot of wolves, they consume a lot of deer so there may not be enough for all of them.]

Teacher Note: If you also chose to introduce other variations while playing the game, such as drought, blight, or hurricane, ask students to describe any disruptions they can see in the patterns of the graph.

7. When students have completed their graphs, have them print them out and glue them into their journals, making sure they date the entry.
8. Show the spreadsheet model of the game available at https://go.edc.org/oh-deer-simulation. Depending on your time and the level of your class, you may want to briefly view the data page and highlight the data that are being graphed (and how the columns match students' data). Then, show the chart and ask students if they can see the same patterns they discussed before. (NOTE: When you click the "Recalculate" button, the chart will be redrawn. Each time it may look very different, but similar patterns can be found (you may have seen or discussed these in step 6):
    a) Each time the population of deer goes up, the population of wolves rises in the next one or two years. (More deer means more food for wolves, so they reproduce and flourish.)
    b) As the population of wolves increases, the population of deer decreases. (More wolves eat more deer.)
    c) If the population of deer or wolves gets very low, it can take several years to rebound.

Oh Deer! Game Directions adapted from "Project Wild Teacher's Guide" and *http://www.beaconlearningcenter.com/documents/313_01.pdf*

Lesson Closing (25 minutes)

9. Ask students to look at and think about the data from the simulation (and the graphs they created from them) and write a response to these prompts in their science journals:
    - Describe how the deer population changed as the habitat components changed. When does the deer populations grow? When does it shrink? What patterns do you see?
    - What change in habitat caused the largest decrease to the deer population? What is your evidence?
    - What do all animals need in order to survive and reproduce?
10. Revisit the essential questions for the lesson: "These were big questions before we started our game. When a problem is too big to examine all at once, we make a model that includes only some details of what we're studying so we can start to understand how some parts work together. What parts of the habitat did we include in our model? *Deer, wolves, food, water, and shelter (drought, blight, and/or hurricane as well if those variations were explored).* By focusing on smaller parts of the large problem, we could examine the relationship of these components and collect some data to help us answer these questions:
    - What happens to organisms when they cannot meet their needs?
    - What kind of changes to the environment causes an organism's population to change?

- Can life cycles be interrupted or changed?

Call attention to the original list made at the beginning of the activity. Ask students again to think of some parts of an actual habitat that were not included in the model.

Additional Information for This Lesson

Objectives

- Students will be able to recognize and explain that different changes in environment can affect the survival of animals.
- Students will be able to recognize that animals can have different responses to different changes in environment such as fluctuations in population.
- Students will be able to recognize that different animals have different needs that may or may not be met by a particular environment.
- Students will understand that changes in an environment can be investigated by breaking the problem down into sub-problems.
- Students will be able to make a list of sub-problems to investigate when addressing a larger problem.
- Students will be able to explain what a model shows and does not show.
- Students will understand that changes in an environment can be investigated through simulations.
- Students will be able to collect data from a simulation to answer a question.
- Students will be able to create a bar graph from data they collected.
- Students will enter data collected from a simulation into a spreadsheet program to create graphs that show fluctuations in habitat components and the population of a model animal (deer), and use graphs to analyze patterns and draw conclusions.

What students should know and be able to do before starting this lesson:

- Plants and animals depend on their surroundings to get what they need to live.
- There are a variety of plants and animals living in any particular area.
- Survival of a population is dependent on reproduction.
- Students should be able to identify different kinds of information and collect data using digital technologies. (K-2.CTc.1 and K-2.CTc.2)
- Students should be able to describe a model and simulation. (K-2.CT.e.1 and K-2.CT.e.2)

Anticipated Student Preconceptions/Misconceptions

- Students may be unclear about the specifics of what certain animals eat, or believe that bigger animals have better chances of surviving a change.

Instructional Materials/Resources/Tools:

- Graph paper and pencils
- Computer and projector
- Student Computers
- Sample Graphing worksheet (see resources at the end of this unit)

Instructional Tips/Strategies/Suggestions for Teacher:

- This lesson uses prior knowledge of Modeling and Simulation learning in K–2 standards (K-2.CT.e.1 and K-2.CT.e.2) from the DLCS Framework. Throughout the module, emphasize the use of MODELS and SIMULATIONS as tools to gather data about the world.
    - MODELS are static representations of real-world situations, problems, or systems that contain the ATTRIBUTES we want to examine.
    - SIMULATIONS are imitations of real-world actions, processes, or systems over time. SIMULATIONS are run on models to see what happens if… or to see how well a solution will work. The data collected from SIMULATIONS are analyzed to help select the "best" solution to a question or problem.
- Add unfamiliar concepts to the KWL chart to either come back to later (in the W column) or as something they understand (L column).
- This game involves movement and touching. Be sure to explain the expectations for behavior before starting. For the purposes of this lesson, "habitat" and "environment" are interchangeable terms. The activity is best conducted in a space with room to move. Students will need to make a graph that represents iteration of the game.
- Between each round, it is recommended that all students sit down. Then, they should count how many deer there are and how many natural resources there are. When the predator is introduced, that should also be counted. Students should record this data in their science notebook (sample data collection sheets are included in the resources). Teachers can either allow students to create their own models/representations or the teacher can suggest that students create a table.
- For larger groups (such as if multiple classrooms are combined to run the simulation together), you may want to have half students be the scientist-observers, and half the simulation participants. The scientist-observers record the data while the participants act in the simulation. Then halfway through, have the groups switch so each student has a chance to play both roles.
- It is recommended that a teacher or staff member digitally record (video) the game so that the deer population, natural resources, and predator can be seen. This would allow the video to be played in the classroom, and the teacher can pause the recording at the end of each round. This will allow all students to check their numeric data of the environmental populations before making their graph.
- This lesson integrates several computational thinking standards:
    - Abstraction: A key skill in investigating complex real-world problems is the ability to break the problem down into smaller sub-problem. Students learn how to identify sub-problems that can be examined/investigated to gather information, gain knowledge, and find solutions. Throughout the lesson, emphasize and question students on the relationship of the sub-problems being investigated and the larger problem they are trying to address.
    - Data: Students continue to build on their data collection and analysis skill by using a spreadsheet to graph data collected from an investigation. Deliberate practice and reinforcement of this skill will lead to acquisition of this skill that can later be developed into more complex knowledge and skills. Find opportunities for student to graph throughout the year.

- Modeling and Simulation: Students continue to refine their skills in modeling by identifying what is and is not being shown in a model. Students also refine their understanding of simulations and how to use them to answer real-world questions. Throughout the lesson, question students on the concepts, features, and behaviors illustrated in the simulation. Emphasize the use simulations to collect data to answer the lesson's real-world questions.

Assessment

- Collect and review science notebooks.

Optional Lesson: Food Web Digital Simulation

Lesson Overview: Students explore a web-based digital model that is similar to the one they used before. They use this model to experience how an actual habitat is much more complex than what they studied in the *Oh Deer!* game.

Estimated Time: 45–90 minutes (see *Instructional Tips/Strategies/Suggestions for Teacher* below), plus 35 minutes optional activity

Standard(s) addressed in this lesson: 3-LS4-4, 3-5.CT.e.2, 3-5.CT.e.3

Essential Question(s) addressed in this lesson:

- What happens to organisms when they cannot meet their needs?
- What kind of changes to the environment causes an organism's population to change?
- What factors are required for the survival of living things?
- Can life cycles be interrupted or changed?

Lesson Details

Lesson Opening (15 minutes)

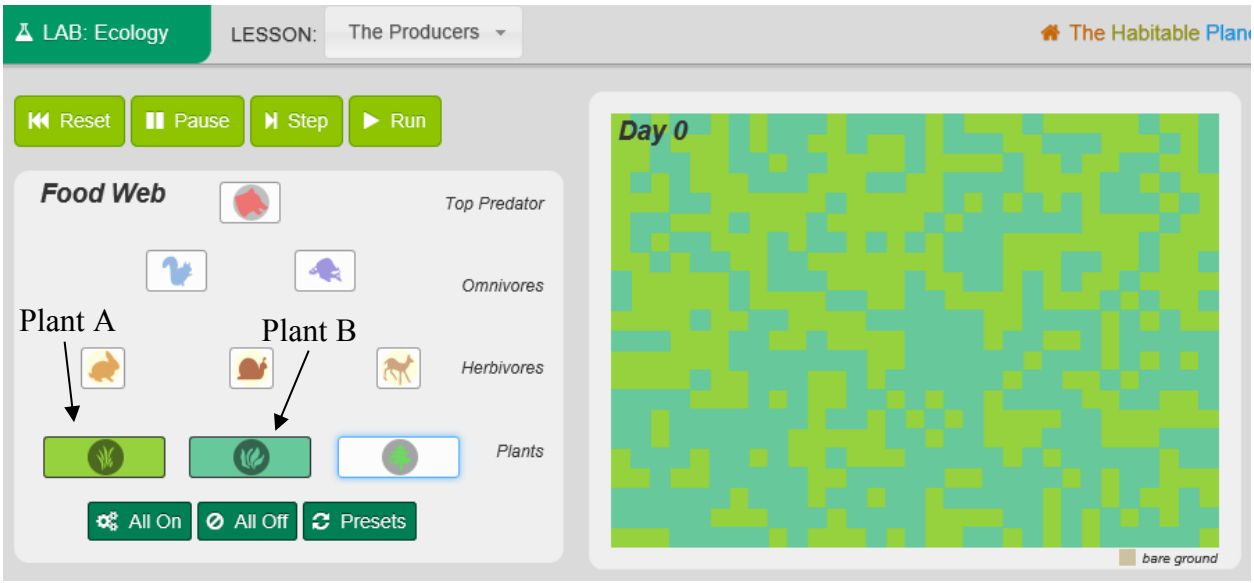
1. Ask students why we might use a digital simulation, and elicit responses.
2. Explain that the spreadsheet they used in Lesson 3 was a kind of digital model. We use digital models when:
   - There are many different parts in a system you want to investigate, such as predators, omnivores, herbivores, and plants in a habitat.
   - A system is too small to see or too big to bring in the classroom to investigate: like the wild outdoors.
   - What we're trying to study would happen too fast or take too long to investigate: like the changes in populations of different species in a habitat over many years.
3. Show students **Digital Simulation of Food Web:**
   https://www.learner.org/courses/envsci/interactives/ecology/ecology.html
   This website simulates a variety of situations in which the survival of different plants and animals is dependent on several factors. This model has many more components that what was studied in *Oh Deer!* Have students:
   - Select the Food Web from the Lesson drop down list.
   - Click Run.
4. Ask students what concepts they think are being illustrated by the simulation. Elicit responses.
5. Have students look at the graph generated by the model, and read the key to them. Ask students what the graph is showing. You may need to reset and run the food web simulation again.
6. Introduce the essential questions for the lesson:
   - What happens to organisms when they cannot meet their needs?
   - What kind of changes to the environment causes an organism's population to change?
   - What factors are required for the survival of living things?

- Can life cycles be interrupted or changed?

Today we're going to investigate these questions by using the simulation to see what happens in the real world when different plants and animals live together.

During the Lesson (20 minutes)
Adapted from the Annenberg Learner Ecology Lab Digital Simulation of Food Web: Producer Lesson

7. If two students will be sharing one computer, present students with the "Pair Programming" video https://www.youtube.com/watch?v=vgkahOzFH2Q (2:30 minutes)
8. In the simulation, Plant A and Plant B are turned "on"; that means we are putting them in our simulation. You can see the buttons are colored and the screen has both plant A and plant B colors showing. You can turn the plants on and off by clicking on them.



9. Tell students: Today's challenge is to get two plants to happily coexist. Explain that *coexist* means living together in the same space.
10. Step 1: *If students are working in pairs, have students take their positions and assume their driver or navigator roles.* Our first question is "Can we get two plants to co-exist?" Imagine the ecosystem is newly forming after a fire or flood and the first colonizers in the ecosystem are, of course, producers. This simulation has three types of producer plant: A, B, and C. Predict what will happen in this ecosystem, and record your prediction in a data table in your science notebook. Then run the simulator to 100 time steps, and record the population numbers for both plants. Answer the following:
    - Which two plants can co-exist?
    - Did you find one producer to be dominant?
    - What conclusions have you come up with?
    - What question(s) do you have?

Step 1	**Plant A**	**Plant B**
Prediction: starting population		
Prediction: ending population		
Starting population		
Ending population		

11. Step 2: *If students are working in pairs, have students switch roles.* Our question now is "Can adding an herbivore in the ecosystem help two plants to coexist?" Now you'll add an herbivore into the ecosystem. An herbivore native to the ecosystem should feed primarily on the dominant species. Click on herbivore A (the rabbit), and choose "eats plant A." Predict and record what will happen in the ecosystem, and record your prediction in the data table in your science notebook. Then, run the simulator and record your results. Answer the following:
    - Does adding the herbivore establish a more stable ecosystem?
    - Is one producer still dominant over the other?
    - How do producer population numbers with the presence of an herbivore compare to your first simulation?
    - What conclusions have you come up with?
    - What question(s) do you have?

Step 2	**Plant A**	**Plant B**	**Herbivore A**
Prediction: starting population			
Prediction: ending population			
Starting population			
Ending population			

12. If time permits, have students explore the simulation on their own. They should ask their own questions, make predictions, record data, and draw conclusions. If students are working in pairs, have students switch roles every question.

Teacher Note: As more plants and animals are added, the food web simulation may be difficult to follow if you click "run" at the top of the website (it runs through the simulation quickly). However, if you click "step," the simulation changes one step at a time and slows down to a speed that students can follow.

Lesson Closing (10 minutes)

13. Ask students to look at and think about the data from the simulation and write a response to these prompts in their science journals:
    - From the data in your data table and the graphs created, describe how the plant populations changed as the herbivore(s) were added to the ecosystem.
    - What types of factors from the real world were included in the simulation?
    - What types of factors from the real world were left out?
    - What kinds of questions would you like to ask that aren't easily addressed by the simulation? What might you change about the simulation that would make it more useful for you?

14. Present (or revisit) the video "How Wolves Change Rivers" http://www.yellowstonepark.com/wolf-reintroduction-changes-ecosystem/. Note that this video was also referred to at the start of Lesson 2. Present the video here as an example of the complexity of how organisms interact within a habitat, and help students pull together the various activities in preparation for discussing the essential questions of the lesson.
15. Revisit the essential questions of the lesson: These were big questions. When a problem is too big to examine all at once, we need to break it down into smaller sub-problems. By focusing on smaller parts of the large problem, we can investigate the relationship of these components and collect some data to help us answer these questions:
    - What happens to organisms when they cannot meet their needs?
    - What kind of changes to the environment causes an organism's population to change?
    - What factors are required for the survival of living things?
    - Can life cycles be interrupted or changed?

Extended Learning/Practice (30 minutes)

Adapted from the Annenberg Learner Ecology Lab Digital Simulation of Food Web: Food Web Lesson

16. Challenge: See how big you can make your food web and still have all of the species survive to the end of the simulation.
17. Step 1: First try choosing only one organism from each level (i.e., one plant, one herbivore that eats that plant, one omnivore that eats the herbivore, and the top predator that eats the omnivore). Students should predict whether (a) each species will survive, (b) each species will increase or decrease in number, and (c) whether the plant will survive. Record predictions in a data tables in your science notebooks, and then run the simulation twice and record your data. Answer the following:
    - Was your species survival predictions correct? How did you arrive at your prediction? What differences were there between your predictions and the simulation?
    - Did any of the species increase in number? What could account for this increase?
    - Which species decreased in number? What might account for this decrease?
    - What would happen to this imaginary ecosystem if the plants (producers) were to die out?
18. Step 2: Now try a more real-life scenario by clicking the "all on" button. The model shows who eats whom. Predict which populations will (a) die out, (b) increase in numbers, or (c) decrease in numbers, and record your predictions. Run the simulation twice, and record the results in your data table. Then try to modify who eats whom in order to ensure the survival of all species, and record what was changed in your chart. Finally, answer the following:
    - Was your prediction correct? How did you arrive at your prediction? What differences were there between your prediction and the simulation?
    - Were you able to modify the food web so that each species survived? Explain how you decided what changes to make.
19. Wrap-up: Ecosystems have an extremely complex web of cause and effect. Changing one connection or altering the population of any species within an ecosystem can have dire, cascading effects on all others within that ecosystem. Consider the following:
    - In this model, how could humans who do not live in the ecosystem still manage to alter the flow of the food web?

Additional Information for This Lesson

Objective:

Student will understand:

- Plants and animals depend on each other and their environment for continued survival.
- Scientific arguments rely on relevant evidence and logical reasoning.
- Changes in an environment can be investigated through simulations.

Students will know:

- If a plant or animal disappears, it can affect the rest of the habitat.
- One organism can have many roles in an environment (habitat, food, etc.)
- Some changes to an environment can lead to reduction in ability of an organism to survive, which can lead to the extinction of that organism.
- Categorical data can be used to compare relative amounts or numbers of organisms in a population, due to different events or at different times.
- What a model shows and does not show.
- How to collect data from simulations to answer a question.

Instructional Materials/Resources/Tools:

- Student Computers
- Computer, video access, and projector
- Annenberg Learner Ecology Lab Digital Simulation of Food Web Lesson Overview: https://www.learner.org/courses/envsci/interactives/ecology/index.php
- Annenberg Learner Ecology Lab Digital Simulation of Food Web: https://www.learner.org/courses/envsci/interactives/ecology/ecology.html
- Pair Programming Protocol: https://www.youtube.com/watch?v=vgkahOzFH2Q
- Driver/Navigator Dos and Don'ts cards
- "How Wolves Change Rivers" video http://www.yellowstonepark.com/wolf-reintroduction-changes-ecosystem/

What students should know and be able to do before starting this lesson:

- How to productively contribute to "Science Talk"
- Plants and animals depend on their surroundings to get what they need to live.
- There are a variety of plants and animals living in any particular area.
- Survival of a population is dependent on reproduction.
- Students should be able to identify different kinds of information and collect data using digital technologies. (K-2.CTc.1 and K-2.CTc.2)
- Students should be able to describe a model and simulation. (K-2.CT.e.1 and K-2.CT.e.2)

Anticipated Student Preconceptions/Misconceptions

- Students may believe that human involvement is necessary for the survival of living things.
- Students may be unclear about the specifics of what certain animals eat, or believe that bigger animals have better chances of surviving a change.

Instructional Tips/Strategies/Suggestions for Teacher:

- Students (and you) may benefit from setting aside time (if available) before the lesson to allow students to "free play" with the model. You can describe the basics of the model and then let them experiment and note observations prior to progressing to the specific experiments outlined in this lesson. (Doing so allows students to play up front to promote focused time later.)
- This lesson uses prior knowledge of Modeling and Simulation learning in K–2 standards (K-2.CT.e.1 and K-2.CT.e.2) from the DLCS Framework. Throughout the module, emphasize the use of MODELS and SIMULATIONS as tools to gather data about the world.
    - MODELS are static representations of real-world situations, problems, or systems that contain the ATTRIBUTES we want to examine.
    - SIMULATIONS are imitations of real-world actions, processes, or systems over time. SIMULATIONS are run on models to see what happens if… or to see how well a solution will work. The data collected from SIMULATIONS are analyzed to help select the "best" solution to a question or problem.
- Add unfamiliar concepts to the KWL chart to either come back to later (in the W column) or as something they understand (L column).
- This lesson uses an adapted version the Producers Lesson from the Annenberg Learner Interactive Ecology Lab: https://www.learner.org/courses/envsci/interactives/ecology/producers.php. Familiarize yourself with the simulation and controls.
- If two students will be sharing one computer, use the Driver/Navigator pair programing protocol. The Driver and Navigator are a team working together to accomplish a task. The Driver is the only one of the pair that can touch the keyboard, mouse, or touchscreen. The Navigator keeps track of what needs to be done and makes suggestions on the next steps. Drivers and Navigators should switch for every question. More details: https://www.youtube.com/watch?v=vgkahOzFH2Q
- This lesson integrates several computational thinking standards in Modeling and Simulation. Students continue to refine their skills in modeling by identifying what is and is not being shown in a model. Students also refine their understanding of simulations and how to use them to answer real-world questions. Throughout the lesson, question students on the concepts, features, and behaviors illustrated in the simulation. Emphasize the use of simulations to collect data to answer the lesson's real-world questions.

Teacher preparation before students arrive:

- Have student computers on and the Food Web Simulation open to the Producers lesson (click producers from the lesson drop down menu).
- If students are working in pairs print out the Driver/Navigator Dos and Don'ts cards and place near the computers for students' easy reference.

Standards Addressed in This Unit

MA Science Frameworks/Next Generation Science Standards

These activities partially address, and are designed for use with unit(s) that address, the following Science standards:

3-LS4-3 Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved.]

3-LS4-4 Analyze and interpret data about changes in the environment in an area and describe how the changes may affect the ability of organisms that live in that area to survive and reproduce. [Clarification Statement: Environmental changes should include changes to landforms, distribution of water, climate, and availability of resources. Changes in the environment could range in time from a season to decades. Data should be provided.] [Assessment Boundary: Assessment is limited to a single environmental change, however, it is understood that environmental changes are complex.]

Science.Practice.2. Developing and using models

Science.Practice.4. Analyzing and interpreting data

Science.Practice.5. Using mathematics and computational thinking

MA Mathematics Framework/CCSS Mathematics

3.MD.B.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs.

These activities reinforce the following Standards for Mathematical Practice from CCSS:

MP2 Reason abstractly and quantitatively.

MP3 Construct viable arguments and critique the reasoning of others.

MP6 Attend to precision.

MA Digital Literacy and Computer Science standards

3-5.CT.a.3 Make a list of sub-problems to consider, while addressing a larger problem.

3-5.CT.c.2 Individually and collectively collect and manipulate data to answer a question using a variety of computing methods (e.g. sorting, totaling, averaging) and tools (such as a spreadsheet) to collect, organize, graph, and analyze data.

3-5.CT.e.1	Individually and collaboratively create a simple model of a system (e.g. water cycle, solar system) and explain what the model shows and does not show.
3-5.CT.e.2	Identify the concepts illustrated by a simulation (e.g., ecosystem, predator/prey, invasive species).
3-5.CT.e.3	Use data from a simulation to answer a question, individually, and collaboratively.

CSTA Computational Thinking Progressions

Data Collection:	The process of gathering appropriate information.
Data Analysis:	Making sense of data, finding patterns, and drawing conclusions.
Data Representation:	Depicting and organizing data in appropriate graphs, charts, words, or images.
Problem Decomposition:	Breaking down tasks into smaller, manageable parts.
Abstraction:	Reducing complexity to define main idea.
Algorithms & Procedures:	Series of ordered steps taken to solve a problem or achieve some end.
Simulation:	Representation or model of a process. Simulation also involves running experiments using models.

CSTA K-12 Computer Science Standards

1B-DA-06	Organize and present collected data visually to highlight relationships and support a claim.
1B-DA-07	Use data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea.
1B-AP-15	Test and debug (identify and fix errors) a program or algorithm to ensure it runs as intended.

Additional Information for This Unit

A Note on Vocabulary

The unit's content focus will be on deep understanding of the concepts, rather than memorization of vocabulary, which should only be shared with students in the context of their investigations; it is not particularly helpful to introduce the new vocabulary before the experience.

A Note on Recording

Students should build the habit of recording their thinking in multiple ways. Many schools suggest all students use science notebooks for the recording, as tools for telling the story of an investigation. Teachers can also provide separate sheets for different kinds of recording. Sometimes these sheets can be made by students directly in notebooks. Third graders sometimes need sheets that are scaffolded, and which can be stapled into notebooks paying attention to chronology. Examples of such sheets appear at the end of this unit. By third grade, students should start building their ability to create their own tables, and make decisions on how to organize their data.

Science Dispositions for the Unit

- Everyone can be a scientist.
- Scientists are curious and learn by asking questions and exploring different ways to answer them.
- Scientists gather evidence to answer their questions in many ways -observing, investigating, and seeking information from reliable sources.
- When investigating, scientists change only one thing at a time to make it a fair test.
- Scientists share their claims and evidence with others who may or may not agree with their findings.
- The most important tools of scientists are their minds, imaginations and creativity. However, they often use tools and technology to obtain more information than they can gather with their senses.

Unit Resources

Additional Instructional Materials:

- *Oh Deer!* Data Collection Table handout (optional, Form 1 OR Form 2)
- *Oh Deer!* Sample Data and Bar Charts
- *Oh Deer!* Sample Bar Chart
- *Oh Deer!* Sample Line Chart
- Pair Programming: Driver/Navigator Dos and Don'ts

Unit Sources:

- *Oh Deer!* Game Directions adapted from "Project Wild Teacher's Guide" and http://www.beaconlearningcenter.com/documents/313_01.pdf
- "How Wolves Change Rivers" video http://www.yellowstonepark.com/wolf-reintroduction-changes-ecosystem/
- Annenberg Learner Ecology Lab Digital Simulation of Food Web Lesson Overview: https://www.learner.org/courses/envsci/interactives/ecology/index.php
- Pair Programming Protocol: https://www.youtube.com/watch?v=vgkahOzFH2Q

Supplies Summary

- Computer with internet access
- Projection equipment
- Student Computers
- Space (playground, gym, etc.)
- Large flip chart
- Science notebooks or Clipboards to collect data
- Craft sticks or print cards (optional)
- Masking tape to mark area (optional)
- Graph paper
- Sticky notes
- Markers
- Pencils
- Driver/Navigator Dos and Don'ts cards