Field Trip!

NOTE: This two-hour Field Trip can occur at any time during the unit. The activities can be adapted for a walking Field Trip to a local forest or any park with trees.

Summary

Students visit a local forest. They collect tree core samples and discuss the abiotic and biotic factors that impact tree growth, abundance, and distribution. They also measure diameter-at-breast-height (DBH) and learn about how seeds are dispersed, and how climate change can impact forest ecosystems.

Learning Objectives

Students will be able to:

- Collect tree growth measurements using different types of equipment.
- Define and describe abiotic and biotic factors that influence tree growth, abundance, and distribution.
- Name multiple ways plant seeds are dispersed within a forest.
- Explain how climate change affects forest ecosystems.

Vocabulary

- *Increment Borer:* Hand-operated drilling tool used to extract a cylindrical core from a standing tree.
- *Diameter-at-breast-height (DBH):* The diameter of a standing tree, measured at 4.5 feet above the ground.
- *Abiotic factor:* A non-living condition or thing that influences or affects an ecosystem and the organisms in it.
- *Biotic factor:* A living thing that influences or affects an ecosystem and the organisms in it.
- *Distribution:* The way in which plants or animals of a group or species are spread over an area.

Materials

Part 1

- Letter to Park Manager
- Site Information & Map
- Down to the Core! Video
- Measuring a Tree Video

Part 2

- Field Trip Data Sheet
- Clipboards

Station 1: Tree Core

- Increment borer
- Increment borer instructions
- Tree core sample
- Tree cookie
- Plastic drinking straws
- Tape

Station 2: Scavenger Hunt

- Scavenger hunt cards
- Dry erase markers
- Eraser/paper towels

Station 3: Diameter-at-breast-height (DBH)

- Measuring tapes
- Thumbtacks
- Calculators

Station 4: Seed Dispersal

- Seed Dispersal Activity Cards

Teacher Preparation

- Use the provided "Letter to Park Manager" to contact your local forest management group and gain permission to take tree core samples.
- Copy Site Maps and Site Information (1 per student or group)
- Organize students into 4 groups
- Copy Field Trip Data Sheet (1 per group)
- Gather clipboards and pencils (1 per group)
- Copy Post Field Trip Worksheet (1 per student)

Activities

Part 1 - In-class Discussion

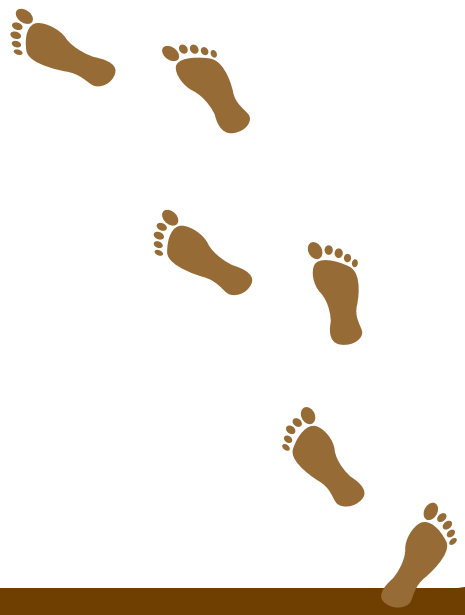
Engage

1. Let's review some of the concepts you have learned about in-class so far. Use the following discussion questions to introduce (or review) key concepts related to forests and climate change. Note that the answers provided are only some of the possible answers students may have. For additional and more detailed answers, refer to Lessons 1 and 2 Pre-Trip Discussion Questions:

- Why are forests important to humans and the environment? Potential answers include:
  - Provide wildlife habitat
  - Recreation and scenery
  - Support the economy and provide jobs
  - Prevent soil erosion and retain water
  - Cool the atmosphere
  - Purify the air by producing oxygen
  - Store carbon
- What is the difference between weather and climate?
  - Weather is the state of the atmosphere at a particular moment, and climate is the average weather conditions for a region over many years (usually 30 or more).

- How might climate change impact forests? Potential answers include:
  - Increasing temperatures could make water less available to plants because it will evaporate quickly.
  - Plant species' distributions may change as the temperature and precipitation changes.
  - Some areas may sequester, or store, less carbon as the plant species change.
- What types of data could scientists collect in order to study how climate change impacts forests? Potential answers include:
  - Annual tree growth
  - Precipitation
  - Temperature
  - Timing of leaf out (when leaves emerge from buds)
  - Species distribution
  - Species abundance

2. Tomorrow you will become scientists in a nearby local forest. This will include taking a tree core sample and measuring diameter-at-breast-height. These two measurements are methods used to measure tree growth without harming the tree. You will also look for abiotic and biotic factors that influence tree growth, abundance, and distribution, and learn about different modes of seed dispersal. Scientists use all these kinds of information to learn more about how climate change impacts forests.
3. Hand out the Field Trip Site Description. Give students 5-10 minutes to read the Site Description. Review the information as a class and pointing out any details you want students to focus on during the field trip. Potential topics of interest could include: the type of forest (deciduous, coniferous, mixed), dominant tree species (oak-hickory, red pine), human impacts and history of the area (plantations, land-use history), and the types of wildlife they might see.
4. **Optional:** Watch the How to Measure Trees Video (2:08 minutes).
5. **Optional:** Watch the Down to the Core! Video (2:01 minutes).
6. End the Pre-Trip discussion by going over your behavior expectations with the students, so they are mentally prepared for an outdoor learning experience.



Part 2

Explore - Field Trip

1. Make sure each of the four student groups has a clipboard, data sheet, and a pencil. For a two-hour field trip, each group will spend 15-20 minutes at each station.

Example Field Trip Schedule

(Total trip time: 2 hours)

9:00-9:20am	Walk or bus to field trip site with station leaders, and divide students into 4 groups.
9:20-10:40am	Rotate between stations (~15 minutes/station with ~5 minutes to rotate).
10:45-11:00am	Walk or bus back to school.

NOTE: This Field Trip can be run two different ways. In Option A, each station has a unique leader and students rotate from station to station. This means they meet a new station leader for each of the four activities. In Option B, each student group stays with the same leader throughout the trip. This means that all field trip leaders must be able to teach each of the four activities. You can decide which option is best for you and your students based on the station leaders, time constraints, and your own preferences.

Station 1 Down to the Core! - Page 1

Station 1 Leader Preparation:

- Read the Station 1 Summary, Background Information, and Instructions.
- Review the Increment Borer Instructions.
- Watch the Down to the Core! Video.
- Check with your supervising teacher or forest supervisor to confirm which tree species are okay to core.
- Practice taking a tree core sample.

Summary: Students are introduced to Station 1 by the station leader and then asked what they already know about tree growth rings and what information scientists can obtain from them (Question 1 on the Data Sheet). They learn what an increment borer is, take a tree core sample, and finish answering Questions 1 and 2 on their Field Trip Data Sheet.

Equipment (keep at station):

- Increment borer instructions
- Increment borer
- Tree cookie
- Plastic drinking straws
- Tape

Background Information: As a tree grows, it produces new cells from an area under its bark. As it does this, the tree grows wider. Early in the summer, when it is warm and water is plentiful, the cells produced are big. These early cells look light-colored in the wood because the cell walls are spaced far apart. As the summer goes on, temperatures usually cool and water often becomes scarce so the cells produced are small. These late cells look dark-colored because the cell walls are closer together. Together the light and dark bands make up one year's growth. By measuring the thickness of an annual ring we know how much the tree grew in that year.

Instructions (notes in italics are a suggested script to follow):

1. When each new group of students arrives, introduce yourself and remind students that this is Station 1 so that they are ready to answer Questions 1 and 2 on the Field Trip Data Sheet. Pass around the tree cookie.

   At this station we are going to talk about how scientists use tree rings to study forests and climate change. First let's review what you already know about tree growth rings. Question 1 on your Data Sheet asks you to list 3 types of information scientists can learn by looking at a tree core sample. Does anyone know how scientists use tree cores? Answers include: tree age (by counting growth rings); how much a tree grew in past years (by measuring growth ring width), seasonal growth patterns (by comparing the width of light and dark rings), past weather conditions (short-term), and past climate conditions (at least 30 years).

Station 1 Down to the Core! - Page 2

2. Show students the increment borer.

   Today we will use a piece of scientific equipment called an increment borer to collect a tree core sample. This is the same tool used by professional forest ecologists like Dr. Ibáñez at the University of Michigan. This increment borer is used to take a small cylindrical core sample from a tree. The entire sample is small enough to fit inside a drinking straw. Ask students, why might taking a smaller, cylindrical core sample using an increment borer be a better research method than taking a tree cookie? [Answer: In order to get a tree cookie you must cut down the entire tree, and as a result the tree would die. However, when you take a tree core sample using an increment borer, you can study tree growth without killing the tree you are measuring.]

3. **MAIN ACTIVITY: COLLECT A TREE CORE SAMPLE.** Start the borer until it is 1"-2" into the tree, and then let each student turn the borer. Encourage as many students as possible to practice taking a tree core using the increment borer. Extract the core and carefully pass it around. Put the sample into a plastic straw to protect it from breaking. You can give it to one student to take home or to the teacher to keep in the classroom. If multiple students want to take home the tree core sample, you can also break the core into pieces.

4. Have students look at the tree core sample to see if they can count the rings by eyesight or identify periods of fast growth and periods of slow growth. You can discuss what the growing conditions are like for the tree that was cored. For example is the tree in the shade, on a hill, or by a stream? What is the soil like? Have the students guess how the tree's environment might affect the growth rates they see on the tree's core. NOTE: Students may notice all the tree cores show trees grow more when they are young (near the tree's core) and grow less when they are old (near the bark). This is not from growing conditions so much as from the tree life cycle. To simplify the unit, we don't go much into this trend. Yet if students bring it up it is good to know why this happens. You can think of it similarly to how people grow most quickly in childhood, but slow down as they get older. Unlike people, however, trees never stop growing larger.

5. **Optional:** Explain to the students why you chose this tree species.

   Since this activity is to practice taking a sample only, we wanted to take a core sample from common or invasive tree species, or species that are not currently threatened by diseases and pests. Taking a core sample is a little stressful for a tree, and we want to support the growth of native and rare species.

6. **Wrap Up:** Make sure students answer Question 2 on their Data Sheet before they move on to the next station. Question 2 asks what might have caused the differences in growth ring width that they see between two tree core samples? Answers may include variations in species and factors that influence growth, like precipitation, temperature, and soil conditions.

Station 2 Scavenger Hunt - Page 1

Station 2 Leader Preparation:

- Read the Station 2 Summary, Background Information, and Instructions.
- Search the site for factors shown on the scavenger hunt cards so you can help point out these factors to students during the activity.
- Brainstorm how these factors impact tree growth, abundance, and distribution.

Summary: Students are introduced to Station 2 by the station leader and then asked to list abiotic and biotic factors and describe how these factors influence tree growth, abundance, and distribution (Questions 3 & 4 on their Data Sheet). They spend 5-10 minutes looking for specific factors during a Scavenger Hunt, and share what they found with the group.

Equipment (keep at station):

- Scavenger hunt activity cards
- Dry erase markers
- Eraser/paper towels

Background Information: Many factors influence tree growth (how much a tree grows), abundance (the number of trees present in a particular area), and distribution (the way in which a group of trees is spread over an area). These include biotic (living) and abiotic (non-living) factors. Biotic factors that influence tree growth, abundance, and distribution include disease, fungi, insects, mammals, and birds. These living organisms can infect trees with harmful diseases, damage or eat living tissue, or cut down trees (in the case of humans). All of these factors can lead to reduced tree growth, tree death, and changes in tree species' distributions. They can also impact trees by distributing seeds or helping smaller trees to grow as old trees are decomposed. Abiotic factors that influence tree growth, abundance, and distribution include temperature, precipitation, soil conditions, and climate change. Trees require specific ranges of temperature and precipitation, and certain soil conditions, to survive, grow, and propagate. Climate change influences many abiotic factors because it is changing the amount and duration of many factors.

Instructions (notes in italics are a suggested script to follow):

1. When each new group of students arrives, introduce yourself and remind students that this is Station 2 so that they are ready to answer Questions 5 and 6 on the Field Trip Data Sheet.

   At this station we are going to focus on how different factors impact tree growth, abundance, and distribution. You will look for abiotic (non-living) and biotic (living) factors that exist in these woods and describe how these factors impact the trees all around us.

Station 2 Scavenger Hunt - Page 2

2. **Optional:** Go over the difference between tree growth, tree abundance, and tree distribution. See background information above for help.

3. Review the definitions of abiotic (non-living) and biotic (living). Ask students to answer Question 3 on their Data Sheet. This question asks them to list 4 biotic and 4 abiotic factors present in the forest. Potential Answers:

   Abiotic Factors

   - Weather (temperature, precipitation)
   - Climate (long-term weather patterns)
   - Amount of sunlight
   - Soil conditions (pH, temperature, mineral content, water availability)

   Biotic Factors

   - Diseases
   - Insects
   - Mammals
   - Birds

4. **MAIN ACTIVITY: SCAVENGER HUNT.** Give each student or pair of students an activity card and dry erase marker. Ask students to spend at least 5 minutes looking for the factors on their card and filling out their answers using the marker. NOTE: Some factors will be more obvious than others to interpret and find (e.g., squirrel's nest may be easier to find than trail damage caused by humans or erosion). Remind students that they may need to look not only around them, but down, up, and look closely at their surroundings. Walk between the students to help them and keep them on track.

5. After the 5 minutes is up, call the students back together and discuss what they found as a group. Try to get each student or pair of students to describe a unique factor they found, whether it is abiotic or biotic, and how it might influence tree growth, abundance, and distribution. You can have them fill out Question 4 on the Data Sheet as you discuss as a group. *How could one of the factors you found influence tree growth, abundance, or distribution?*

6. **Optional Discussion: Adaptations.** If time allows, review some of the adaptations trees and other plants have that help them coexist with all these abiotic and biotic factors.

   Trees and other plants have adapted to thrive in specific conditions. In other words, trees can only grow in areas their adaptations permit them to survive. ADAPTATION EXAMPLE 1: Some plants have adapted to produce sweet berries. Birds are attracted to these berries. When the birds eat the berries they fly to another location and drop the seeds (after they have been digested) in a new area. This helps that plant species disperse into a new area, potentially expanding its distribution. ADAPTATION EXAMPLE 2: A hot and dry climate favors plants adapted to growing those conditions. Plants with adaptations that require periods of cold weather or lots of water would not live or reproduce in that same hot and dry climate. As climate change increases average local temperatures, this could create dry conditions that would impact trees that are adapted to grow in only a specific range of temperatures.

Station 3 Diameter-at-breast-height (DBH) - Page 1

Station 3 Leader Preparation:

- Read the Station 3 Summary, Background Information, and Instructions.
- Watch Measuring A Tree Video and practice measuring DBH.
- Practice measuring and recording DBH for several trees.

Summary: Students are introduced to Station 3 by the station leader and then asked what they already know about methods scientists use to measure tree growth. They learn how to measure diameter-at-breast-height (DBH) using simple equipment, and answer Questions 5 and 6 on their Data Sheet.

Equipment (keep at station)

- Measuring tapes
- Thumbtacks
- Calculator

Background Information: Circumference is the length of the boundary of a circle (or tree trunk). Diameter is the length of a straight line passing from side to side through the center of a circle (or tree trunk). Diameter-at-breast-height, or DBH, is technically the diameter of a tree measured at 4.5 feet above the ground. DBH is also supposed to be measured on the uphill side of the tree and above any branches or large knots that may exist at that height. DBH is probably the most common and important measurement made on standing trees. This is because it is an easy measurement to take, and DBH can reveal so many other important tree attributes and values, including tree growth, wood volume, and basal area. Foresters, ecologists, and naturalists all record the diameter of trees in the same standardized way. To measure DBH at this station, students use some simple household items to first find circumference and use some simple math to find the diameter-at-breast-height or DBH.

Instructions (notes in italics are a suggested script to follow):

1. When each new group of students arrives, introduce yourself and remind students that this is Station 3 so that they are ready to answer Questions 5 and 6 on the Data Sheet.

   At this station we will measure tree diameter-at-breast-height or DBH for short. DBH is a very useful measurement because it is standardized, fast, simple, and does not harm the tree. You can also measure DBH repeatedly in a short period of time to double-check your efforts. Keep in mind that DBH shows how large a tree is now, but not how the tree grew earlier in its life. If you want to look at past tree growth you would need to measure DBH for the same tree over several years, and that is exactly what many forest ecologists and foresters do. If you collect a DBH measurement each year from the same tree, you can track how much that tree grows annually.

Station 3 Diameter-at-breast-height (DBH) - Page 2

2. Ask students, what is another method for looking at past tree growth patterns? Hint: You may have already used this method today at Station 1!

3. **MAIN ACTIVITY: Measure DBH for 4 Trees.** Students may need to be reminded of the difference between circumference and diameter.

   Circumference is the length of the boundary of a circle (or tree trunk). Diameter is the length of a straight line passing from side to side through the center of a circle (or tree trunk). To measure DBH at this station, you will use the string to first find circumference. Then you can use some simple math to find the diameter-at-breast-height or DBH.

   CALCULATION HELP: Diameter can be expressed as: Diameter = Circumference/π

   Example: At 4.5 feet above the ground, the circumference of the tree is 46.5 centimeters, So…

   diameter at breast height = 46.5/3.14

   diameter at breast height ≈ 14.8 cm

4. Demonstrate to the entire group how to find DBH using a measuring tape, string, and pin (ask students to help you with this demonstration so that they get used to using the equipment and are more engaged):
   - Stand next to the trunk of the tree and use the measuring tape to measure 4.5 ft. above ground on the trunk.
   - Mark this spot with the pin.
   - Wrap the measuring tape around the tree trunk, just above the pin. Make sure it is level.
   - Find where the measurement tape overlaps itself, and record this measurement as the tree's circumference. Remember to record the units (cm or in).
   - To find the final DBH (diameter), divide the circumference by pi (3.14) using the calculator and record this measurement on their data sheet under Question 5. Remember to record the units (cm or in).

5. Divide students into pairs and have them follow the steps above to find DBH for three additional trees.

6. **Wrap Up:** Make sure the students answer Question 6 on their Data Sheet. Question 6 asks, What was the largest tree diameter your group found? Do you think that this is the oldest tree of the four trees you measured? Why or why not? NOTE: Students may think that the tree with the largest DBH is also the oldest. This is usually a good assumption, but remind them that this may not be the case because a larger tree could have just grown faster in a short time. Some tree species grow faster than others.]

Station 4 Seed Dispersal - Page 1

Station 4 Leader Preparation:

- Read the Station 4 Summary, Background Information, and Instructions.
- Read the Seed Dispersal Activity Cards.

Summary: Students are introduced to Station 4 by the station leader and then asked to brainstorm a list of 6 different ways seeds are dispersed (Question 7 on their Data Sheet). Then they learn more about specific tree species' seed dispersal strategies by participating in a hands-on activity and complete Question 8 on their Data Sheet.

Equipment (keep at station)

- Seed Dispersal Activity Cards

Background Information: Seed dispersal is the movement or transport of seeds away from the parent plant. Some plants rely on living organisms to help them scatter, or "disperse", their seeds. Other species disperse their seeds via other environmental routes such as wind or water. Animals disperse seeds in several ways. First, some seeds have barbs or other structures that get tangled in animal fur or feathers, and are then carried to new sites. Other plants produce their seeds inside fleshy fruits that then get eaten by animals and distributed when the fruit is digested, the seeds pass through their digestive tract, and the seeds are finally dropped in a new location. Some animals bury seeds to save for later, but may not return to get the seed. It can grow into a new plant. A good example of this is a squirrel burying an acorn that never gets eaten. Wind dispersed seeds are typically smaller seeds that have wings or other hair-like or feather-like structures. Plants that produce wind blown seeds, like dandelions, often produce lots of seeds to ensure that some of the seeds are blown to areas where the seeds can germinate. Aquatic plants or plants that live near water have seeds that can float. Plants that grow along streams and rivers have seeds that float downstream, and therefore germinate at new sites. The size of the seed is not a factor in determining whether or not a seed can float. For example, coconuts are protective cases for seeds that float, allowing coconut trees to disperse to new areas.

Instructions (notes in italics are a suggested script to follow):

1. When each new group of students arrives, introduce yourself and remind students that this is Station 4 so that they are ready to answer Questions 7 and 8 on the Field Trip Data Sheet.

   At this station you will learn about how unique adaptations allow plants to disperse their seeds. Plants cannot move around like animals, so how do they move into new habitats? They produce seeds that can disperse to new places, near and far. Seeds have different ways of dispersing away from their parent plants. How seeds disperse varies by plant species.

Station 4 Seed Dispersal - Page 2

2. Ask students to brainstorm a list of 6 ways seeds disperse and compile the list under Question 7 on their Data Sheet. Potential Answers:
   - Falling
   - Rolling
   - Wind
   - Water
   - Bursting
   - Animals - eating & excreting
   - Animals - burying/storing
   - Animals - attaching & falling off
   - Humans - gardening, landscaping, restoration, forestry, farming

3. **MAIN ACTIVITY: Seed Dispersal Activity.** Divide students into partners and give each pair one of the laminated Activity Cards. This activity can also be done individually if you have a small group and would like them to use all the Activity Cards.

   Each of your cards describes one type of seed and how it is dispersed. You have 5 minutes to read the card and decide where their seed would end up today if it were released from its parent tree.

4. Walk around between the groups to see if they need hints to get started. If the students are struggling, remind them to think about how their seed is spread and how successful this dispersal strategy would be given the present-day conditions (such as presence of wind, water, hills or animals). After the 5 minutes is over, gather the students and tour the locations where they have put their seeds. Have the students explain how their seed spreads and why they chose its final spot.

5. **Wrap Up:** Make sure the students answer Question 8 on their Data Sheet. Question 8 asks, Why is it important for seeds to disperse away from the parent plant? Accept student answers (there are many correct answers to this question).

   Seeds require optimal growing conditions, and dispersing away from the parent plant allows plants to spread and take advantage of new habitat. Another reason is that many saplings cannot grow in close proximity to their parent trees due to competition for resources like light, nutrients, and water. The parent trees' leaves can shade tree seedlings out. This reduces the amount of sunlight available for photosynthesis. Seedlings would also have to compete with their parents' roots for nutrients and water. Moreover, pathogens and insects that attacked their species would be attracted to the parents. Growing further away from the parents would reduce the chances that these negative factors find the seedlings and damage them as well.

Part 3

Extend & Evaluate (Post-Field Trip)

1. Discuss students' answers to the data sheet questions in class.
2. Ask students, How could climate change impact the forest ecosystem you visited, or the trees you measured?
3. Assign the Post Field Trip Worksheet.

Michigan Grade Level Content Expectations (Grade 7)

- S.IP.07.13 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens, thermometer, models, sieves, microscopes, hot plates, pH meters) appropriate to scientific investigations.
- S.IP.07.14 Use metric measurement devices in an investigation.
- S.IP.07.16 Identify patterns in data.
- E.ES.07.41 Explain how human activities have changed the land, oceans, and atmosphere of the Earth resulting in the reduction of the number and variety of wild plants and animals, sometimes causing extinction of species.
- E.ES.07.42 Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere (car exhaust, industrial emissions, acid rain, and natural sources) and how pollution impacts habitat.
- L.OL.07.61 Recognize the need for light to provide energy for the production of carbohydrates, proteins, and fats.

Next Generation Science Standards (Middle School)

Performance Expectations

Students who demonstrate understanding can:

- MS-LS1.4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Science and Engineering Practices

Engaging in Argument from Evidence

- Use 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-LS1-4)

Constructing Explanations and Designing Solutions

- Construct a scientific explanation based on valid and reliable evidence obtained from sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5)

Analyzing and Interpreting Data

- Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)

Disciplinary Core Ideas

LS1.B Growth and Development of Organisms

- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)
- Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)

LS2.A Interdependent Relationships in Ecosystems

- Organisms, and populations or organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)

Crosscutting Concepts

Cause and Effect

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4, MS-LS1-5)
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)