

Levels of Organization in the Ecosystem

Lesson Overview

In this lesson, students will examine and analyze various ecosystem components to identify and evaluate ecological concepts such as biotic and abiotic factors, species, populations, communities, ecosystems, and biomes. They will research information and construct drawings/diagrams/models that represent and describe the levels of organization within a natural environment, including biotic and abiotic factors.

Alignment

Science Standards

7.EC.5 The student will demonstrate an understanding of how organisms interact with and respond to the biotic and abiotic components of their environments.

7.EC.5A In all ecosystems, organisms and populations of organisms depend on their environmental interactions with other living things (biotic factors) and with physical (abiotic) factors (such as light, temperature, water, or soil quality). Disruptions to any component of an ecosystem can lead to shifts in its diversity and abundance of populations.

7.EC.5A.1 Develop and use models to describe the characteristics of the levels of organization within ecosystems (including species, populations, communities, ecosystems, and biomes).

Science and Engineering Practices

7.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

In addition to develop and use models, students should be asked to ask questions; plan and carry out investigations; analyze and interpret data; use mathematics and computational thinking; engage in argument from evidence; construct explanations; obtain, evaluate, and communicate information; and construct devices or define solutions.

Crosscutting Concepts (from the SDE instructional unit resources document)

2. Cause and effect: Mechanism and explanation: The National Research Council (2012) states that “events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts” (p. 84). Changes that occur to the physical environment can cause changes in the number of organisms within a population.

4. Systems and systems models: The National Research Council (2012) states that “Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering” (p. 84). The levels of organization within ecosystems are a system in ecology. Abiotic and biotic factors interact to create a dynamic system.

ELA Inquiry Standards

Standard 1: Formulate relevant, self-generated questions based on interests and/or needs that can be investigated.

1.1 Develop questions to broaden thinking on a specific idea that frames inquiry for new learning and deeper understanding

Standard 2: Transact with texts to formulate questions, propose explanations, and consider alternative views and multiple perspectives.

2.1 Formulate logical questions based on evidence, generate explanations, propose and present original conclusions, and consider multiple perspectives.

Standard 3: Construct knowledge, applying disciplinary concepts and tools, to build deeper understanding of the world through exploration, collaboration, and analysis.

3.1 Develop a plan of action by using appropriate discipline-specific strategies.

3.4 Organize and categorize important information, revise ideas, and report relevant findings.

Standard 4: Synthesize integrated information to share learning and/or take action.

4.1 Employ a critical stance to demonstrate that relationships and patterns of evidence lead to logical conclusions, while acknowledging alternative views.

4.2 Determine appropriate disciplinary tools and develop a plan to communicate findings and/or take informed action.

4.3 Reflect on findings and pose appropriate questions for further inquiry.

Standard 5: Reflect throughout the inquiry process to assess metacognition, broaden understanding, and guide actions, both individually and collaboratively.

5.1 Acknowledge and value individual and collective thinking; use feedback from peers and adults to guide the inquiry process.

5.2 Employ past and present learning in order to monitor and guide inquiry.

5.3 Assess the processes to revise strategies, address misconceptions, anticipate and overcome obstacles, and reflect on completeness of the inquiry.

ELA Writing

Standard 6: Write independently, legibly, and routinely for a variety of tasks, purposes, and audiences over short and extended time frames.

6.1 Write routinely and persevere in writing tasks over short and extended time frames, for a range of domain specific tasks, and for a variety of purposes and audiences.

ELA Communication

Standard 1: Interact with others to explore ideas and concepts, communicate meaning, and develop logical interpretations through collaborative conversations; build upon the ideas of others to clearly express one’s own views while respecting diverse perspectives.

1.2 Participate in discussions; ask probing questions and share evidence that supports and maintains the focus of the discussion.

1.5 Consider new ideas and diverse perspectives of others when forming opinions regarding a topic, text, or issue.

Connections

- Science
- ELA

Content Connections

Students will interact with text to research and then create a model depicting levels of an ecosystem.

Active Learning Strategies (for Purposeful Reading, Meaningful Writing, and Productive Dialogue)

Lesson A

Think-Pair- Share

Notebooking

Exit Slip

Lesson B

Give Me Five

MTV

Computational Thinking

This lesson addresses computational thinking by allowing students to interact with authentic data to organize and analyze data about ecosystems, represent the data in a model, use evidence, apply logic, construct arguments for their proposed explanations, and evaluate and communicate the information scientifically.

Lesson A - “What is an Ecosystem?”

Time Required – One class period (60 minutes) plus 15 minutes for travel time outdoors and back

Disciplinary Vocabulary – abiotic, biomes, biotic, community, consumers, ecosystem, habitat, niche, population, producers, species

Materials Needed:

- Index cards with the following words written, one word per card. Have enough sets for every two students.
 - Organism (species)
 - Populations
 - Communities
 - Ecosystems
 - Biomes
 - Biosphere (*optional, not essential for students to know at this grade level*)
- Levels of Organization Handout (attached)
- Student notebook
- Digital camera or video camera (optional)
- Hand lenses
- Ecosystem Observations Activity Sheet

Formative Assessment Strategies: Students will be assessed by the active learning strategies, TIPS, Notebooking, and Exit Slips, to see if they understand the terminology associated with ecosystems.

Misconceptions: Lower elementary-school students can understand simple food links involving two organisms. Yet they often think of organisms as independent of each other but dependent on people to supply them with food and shelter. Upper elementary-school students may not believe food is a scarce resource in ecosystems, thinking that organisms can change their food

at will according to the availability of specific sources. Students of all ages think that some populations of organisms are numerous to fulfill a demand for food by another population. Middle-school and high-school students may believe that organisms are able to effect changes in bodily structure to exploit habitats or that they respond to a changed environment by seeking a more favorable environment.

Safety Note(s): Follow school safety rules when taking students outside. Remind students to refrain from handling organisms, even those that may be harmless.

Focus Question:

What are some characteristics of the different levels of organization in an ecosystem?

Engage

1. Post this question for students to see: “What do the Mojave Desert, a teaspoon of soil, a stream, a mature oak tree, an iceberg, a school playground, and an animal carcass have in common?”
2. **Think-Pair-Share:** Have students take a few minutes to think about this question silently, then with a partner, share their ideas. Have volunteers share with whole group. These ideas may be posted on chart paper or board. (Answer: They are all ecosystems supporting many populations.)
3. Give pairs of students a set of index cards with the lesson’s key words on them. Have students arrange the cards from the smallest unit to the largest. It is not necessary for students to have the cards correctly arranged at this point. (Arrangement from smallest to largest: organism, population, community, ecosystem, biome, biosphere)
4. Have a few groups share their arrangement of cards with the class, giving evidence as to why they chose to arrange the cards in that manner.
5. Return to the opening question, have students share any new ideas they may have with their partner and again with the whole group.
6. Give each pair of students a copy of the handout *Levels of Organization* (**attached**) to reveal the correct arrangement of the levels of organization of the living world. Have students make observations about the characteristics that they see in each level. Student pairs should describe characteristics they are seeing at each level. Additional information can be found at <http://eschooltoday.com/ecosystems/levels-of-organisation-in-an-ecosystem.html>.

7. Discuss these levels of organization, including niches and habitats. **(See support document)**. Additionally, the teacher may want to say “Ecology is the study of how living things interact with each other and their environment. **(If you have taught the material on cells previously)**, we learned in a previous unit about the levels of organization within an organism: cell-tissue-organ-organ system-organism. Now we are looking at the levels of organization starting at an individual (i.e., organism) and ending with the biosphere (i.e., earth). Individuals consist of the same species. A group of individuals is a population. Several populations make up a community. An ecosystem includes both biotic (living) and abiotic (non-living) things within an area. Ecosystems within a certain climate are called biomes, and all the biomes put together make up the biosphere.
8. Ask students why might scientists be interested in studying the levels of organization? (examples: The scientists at the U.S. Fish and Wildlife Service are interested in macro-ecosystems ranging from shallow streams to watersheds the size of the Mississippi River's. Many other scientists are interested in smaller sized ecosystems. For example, when forensic scientists are estimating a time of death, the ecosystem of interest is limited to the body under investigation. An agronomist may be interested in the ecosystem of a teaspoon of soil, and a microbiologist in the ecosystem of an animal's gut. Every centimeter of the planet is part of an ecosystem. The most familiar natural ecosystems are our backyards or parks near our home).

Explore

1. Explain that students will be making scientific observations of the levels of organization outside of the classroom. *(Remind students of safety precautions.)* Tell them that each student will individually select an area outdoors and you want each person to pay close attention to what sounds, smells, sights, etc. are present. You may want to give general directions about where they are allowed to go and how big of an area that you want them to observe. They will only have a limited amount of time to record observations.
2. Students will need to take **notebooks**, writing utensils, and hand lenses outside. Digital cameras or video cameras are optional. Students may want to take pictures of the area in which they are making observations, which can later be printed out and glued into their notebooks.
3. Have students, **individually**, choose an observation area.
4. Students should take approximately 10-15 minutes to sketch the area, keeping in mind any organisms they may see. Students should also explain any interactions among and/or between organisms, including any sounds being made, or any odors they may smell. Students should label both abiotic(nonliving) and biotic (living) features of their observation area. Students can use the ***Ecosystem Observations Activity Sheet*** to record observations.

Explain

1. After returning to the classroom, have students add any additional information to their drawings and observations.
2. In groups of 2-4, have students describe their drawings and observations to each other, noting interactions among and between the biotic and/or abiotic features.
3. **Exit Slip**-Following student dialogue, students should write their own definitions of the levels of organization of the living world.

Extend

1. Students may observe a model ecosystem, such as a terrarium or aquarium, identifying and analyzing interactions, using biotic and abiotic factors.
2. Students may research the 6 ecosystems upon which life on Earth most heavily depends:
 - Agroecosystems - the farms where we grow our food and the livestock production systems-ranches and hog farms, for example-where we produce meat products.
 - Forest ecosystems - the woodlands where we hike, cut timber, and hunt.
 - Freshwater ecosystems - the lakes, streams, and rivers we fish in, boat on, transport our goods over, and rely on for drinking water.
 - Grassland ecosystems - meadows, prairies, pampas, savannas, and steppes where we graze our cattle.
 - Coastal ecosystems - the beaches where we play, the marine waters we trawl, the reefs and atolls that line coasts in tropical waters and buffer our coastlines.
 - Urban ecosystems - Even cities and suburbs are ecosystems, where greater concentrations of economic and educational opportunities are offered and where nearly half of the world's populations live.
3. Students may research current issues and topics threatening the Earth's species, populations, communities, ecosystems, and/or biomes.
<http://eschooltoday.com/ecosystems/what-is-an-ecosystem.html> more threats to ecosystems

Lesson B- Ecosystem Models

Time Required – One class period (60 minutes)

Disciplinary Vocabulary – abiotic, biomes, biotic, community, consumers, ecosystem, habitat, niche, population, producers, species

Materials Needed:

- *Large piece of paper (11X14) or bulletin board paper*
- *Markers, Colored Pencils*
- *Devices (if available) for students to design computerized models*

Formative Assessment Strategies: Students will be assessed by creating an MTV (making thinking visible) model and Give Me Five responses.

Misconceptions: Lower elementary-school students can understand simple food links involving two organisms. Yet they often think of organisms as independent of each other but dependent on people to supply them with food and shelter. Upper elementary-school students may not believe food is a scarce resource in ecosystems, thinking that organisms can change their food at will according to the availability of particular sources. Students of all ages think that some populations of organisms are numerous in order to fulfill a demand for food by another population. Middle-school and high-school students may believe that organisms are able to effect changes in bodily structure to exploit particular habitats or that they respond to a changed environment by seeking a more favorable environment.

Focus Question:

What are the characteristics of each ecological level for different ecosystems?

Engage

1. Play the Ecology song (<https://www.youtube.com/watch?v=FYvQfwtI3Fo> by Mr. Parr as students are entering the classroom. Ask students to write down words that they hear in the song or see on the screen that they know or recall.
2. Use the **Give Me Five** Strategy to gather responses from five random students. Share with students that some of the words that they may not be as familiar with will be terms that they will learn as you continue to study ecology.

Explore

1. Say, “Today, you will work in small groups (2 or 3 students per group) to create a visual model or representation of the characteristics of the different ecological levels (levels of an ecosystem).”
2. You will have a choice as to whether your group creates a MTV (Making Thinking Visible) poster on paper or a computerized visual (Google Drawing, slides, etc.)
3. The criteria for creating your MTV are as follows:
 - a) As a team, choose an organism that you would like to explore.
 - b) You may choose to start with the broadest level (biome) and end with the narrowest level (organism) or you may choose to represent the levels of organization from the smallest (organism) to the largest (biome).
 - c) Draw or find pictures to represent each level. You may not use labels or notes of any kind. You may need to research online if you are uncertain about the habitat or interactions of your organism. The site <http://eschooltoday.com/ecosystems/what->

- [is-a-biome.html](#) gives a list of the major biomes and describes each. Each member of the team should be able to describe what your picture means.
- d) **NOTE TO TEACHER:** Circulate as students work and present their pictures to provide feedback, ask probing questions, and note any misconceptions. You may want to set a time limit for drawing/exploration/creating models.

Explain

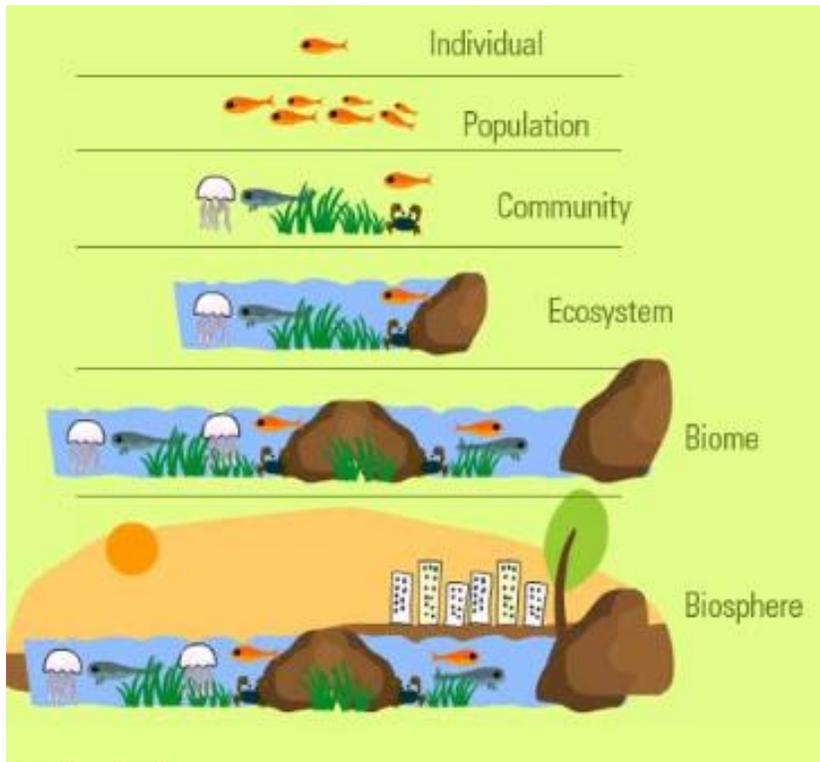
1. Say "When your team has completed your drawings, you should describe what your picture means and how it represents your thinking about the levels of ecological organization."
2. **NOTE TO TEACHER :** This may be done in a number of ways-
 - a. Form small groups randomly and have students take turns presenting their pictures to each other.
 - b. Form small groups based on similarities or differences in the pictures and have students take turns presenting their pictures to each other.
 - c. If students created the pictures in collaborative small groups, each group may present their thinking to the whole class.

Extend

1. Peer Review- Have individual students review a project created by another team. Create a rubric for scoring the project. Ask students how they would know if a group understood the levels of organization in an ecosystem. **Suggestion-** give points for the following: flow from large to small or small to large (sequencing is correct), characteristics are correct (description of each if needed), when do abiotic factors appear, creativity, teamwork, visual appeal, etc.
2. More resources:
 - <https://www.youtube.com/watch?v=gyJwuNxN9rl>- Video Lesson for any student who is absent or needs remediation
 - https://www.youtube.com/watch?v=GUY_-LK_I0c (Ecosystems Song) Students could create a song to convey the levels of organization.
 - <https://youtu.be/EdKhQVHc3Ao> Ecology introduction video with examples
 - <https://www.youtube.com/watch?v=GlnFylwdYH4> Introduction to Ecology Video

Levels of Organization

In the margin to the right of the words in the diagram below, 1) describe what you see in each level and 2) indicate the parts with (A) for abiotic or nonliving or (B) for biotic or living.



<http://eschooltoday.com/ecosystems/levels-of-organisation-in-an-ecosystem.html>

List the six levels of organization from smallest to largest.

Define species and circle the level above in which you would see species introduced?

Define habitat- _____

Define niche- _____

Ecosystem Observations Activity

OBSERVATIONS -Make descriptive observations using your senses about the ABIOTIC (non-living) factors around you.

1. How strong is the wind? What does it sound like? Where is it coming from?

2. What does the water look, sound, and smell like? What color is it?

3. What is the relative temperature?

4. Look at the soil and the rocks.
 - a) Physical description - color, texture, size, shape
 - b) How does the soil feel - sandy, claylike, moist, and dry?
 - c) How do the rocks feel?

OBSERVATIONS-Make descriptive observations using your senses about the BIOTIC (living) factors around you.

1. Make observations about ANY two animals. Describe their characteristics and their environment in detail.

2. Make observations about a single tree, shrub or other plant. Describe their characteristics and their environment in detail.

3. How do the biotic components interact with each other and the abiotic components of an ecosystem?

Adapted from Adrienne Bones, Colorado Springs, Colorado- HS Biology Teacher