Lesson 1: Unit Pretest and Features of Ecosystems

Overview

Students take the pretest, share their ideas about where carbon is located in ecosystems, identify which carbon is organic versus inorganic, and identify the type of organisms (producers, herbivores, carnivores, and decomposers) that exist in ecosystems.

Download PDF of Lesson 1 Teacher's Guide

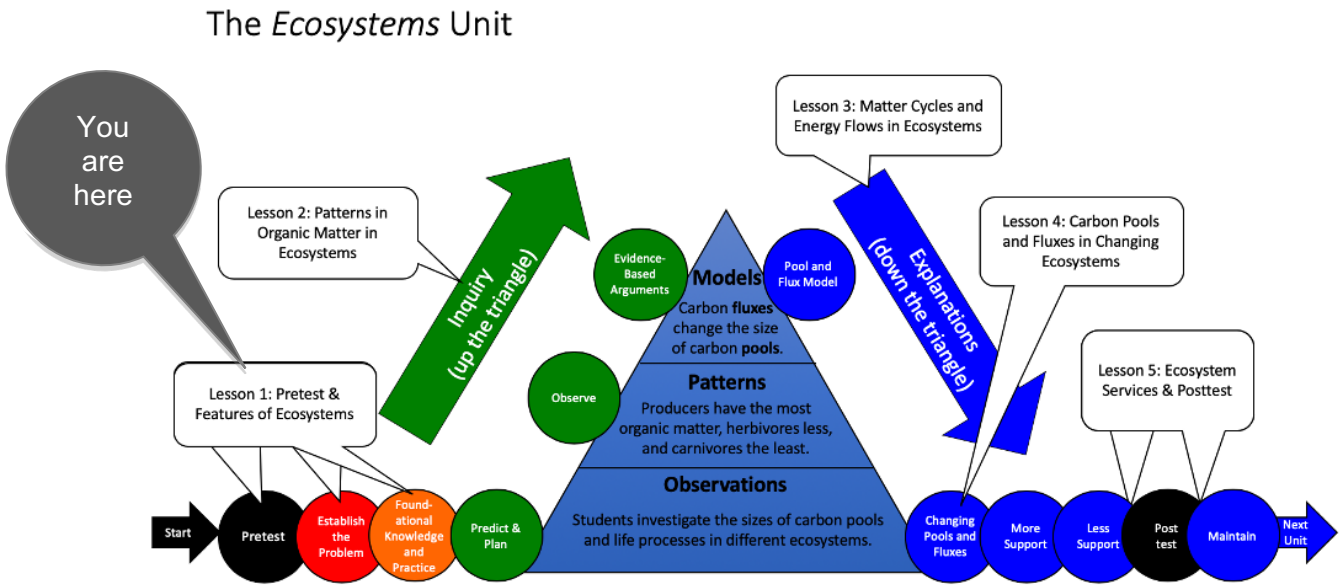
Guiding Question

How many foxes can live in a meadow?

Activities in this Lesson

- Activity 1.1: Ecosystems Unit Pretest (20 min)
- Activity 1.2: Expressing Ideas and Questions for Patterns in Ecosystems (40 min)
- Activity 1.3: Carbon Pools (30 min)

Unit Map



Learning Goals

Target Performances

Activity	*Target Performance*
Lesson 1 – Pretest and Features of Ecosystems (students as questioners)	
Activity 1.1: Ecosystems Unit Pretest	Students show their initial proficiencies for the overall unit goal: Questioning, investigating, and explaining how carbon cycles and energy flows in ecosystems.

Activity	*Target Performance*
Activity 1.2: Expressing Ideas and Questions for Patterns in Ecosystems	Students ask and record specific questions about changes in matter and energy in response to the unit driving question: How many foxes can live in a meadow?
Activity 1.3: Carbon Pools	Students identify where carbon atoms are located in ecosystems and groups of organisms that have similar functions (carbon pools).

NGSS Performance Expectations

This lesson helps students start thinking about all of the NGSS performance expectations for this unit but does not focus on their mastery on of any of them.

Background Information

Three-dimensional Learning Progression

In previous *Carbon TIME* units, students learned to explain macroscopic processes (plant growth, combustion, decay, etc.) in terms of atomic molecular processes. In this unit, they must connect the macroscopic and atomic molecular scales to matter cycling and energy flow at the larger ecosystem scale. Here are some questions to think about as you read your students' pretest responses and listen to their ideas:

- *Are they distinguishing between individual plants and animals and populations or trophic levels?* Students will need to learn that food chains and food webs tell about relationships between populations and flows of matter and energy, not just "who eats who."
- *Are they distinguishing matter from energy?* Matter and energy move together through food chains and food webs, so students can confuse organic matter with the chemical energy in organic matter and still answer a lot of questions correctly, but matter and energy "go their separate ways" at the beginning and end of food chains and food webs:
  - Producers get matter ONLY from CO_2, water, and minerals, and energy ONLY from sunlight.
  - When organisms use organic matter for cellular respiration, ALL the matter goes back into CO_2, water, and minerals, while ALL the energy leaves the ecosystem as heat (which is ultimately radiated out into space). So, matter cycles and energy flows through ecosystems.
- *Are they connecting scales?* Students will need to apply what they learned about transformations of matter and energy in individual organisms to ecosystem-scale processes—to see how matter cycling and energy flow in ecosystems result from the atomic-molecular processes of photosynthesis, biosynthesis, digestion, and cellular respiration. Many students find this a hard connection to make. This lesson will help students begin thinking about these ideas and will give you a chance to see where your students are starting.

Key Ideas and Practices for Each Activity

In Activity 1.1, the unit pretest is useful for two purposes. Your students' responses will help you decide how much detail you want to include during the unit. If your students are mostly at Level 2 in the carbon learning progression, you may want to focus on the main ideas (like the tracing

of matter and energy and the Four Questions. Your students' responses will also provide a starting point for discussions about the focus for this unit.

In Activity 1.2, through the discussion, students will come to recognize that they have many different ideas about how matter cycles and energy flows in ecosystems (using a meadow ecosystem as an example), as well as unanswered questions. We expect many students to express Level 2 or Level 3 ideas, for example, that focus on food chains or webs instead of forms of matter and energy, how matter cycles, and how energy flows in ecosystems through carbon transforming processes.

In Activity 1.3, students consider where carbon is located in ecosystems and are introduced to the idea of carbon pools. They use ideas from the *Systems and Scale* unit to think about what carbon in an ecosystem is organic vs. inorganic.

Content Boundaries and Extensions

Activity 1.1: Ecosystems Unit Pretest (20 min)

Overview and Preparation

Target Student Performance

Students show their initial proficiencies for the overall unit goal: Questioning, investigating, and explaining how carbon cycles and energy flows in ecosystems.

Resources You Provide

- Pencils (1 per student)

Resources Provided

- 1.1 Ecosystems Unit Pretest (1 per student)
- 1.1 Assessing Ecosystems Unit Pretest

Setup

Print one copy of the 1.1 Ecosystems Unit Pretest for each student.

Directions

1. Describe the unit pretest.

Explain the purpose of the unit pretest to students:

- It will help you as a teacher understand how students think about how carbon cycles and energy flows in ecosystems.
- It will help them think about what they know and what questions they have.

2. Have students take the unit pretest.

Distribute copies of 1.1 Ecosystems Unit Pretest to be completed with paper and pencil.

Assessment

Use the 1.1 Ecosystems Unit Pretest to assess students' understanding of ecosystems in terms of learning progression levels. You should not give your students grades on the pretest or expect your students to know the correct answers. The document 1.1 Assessing Ecosystems Unit Pretest has assessment guidelines and identifies correct responses and explaining how students' responses reveal their learning progression levels.

Differentiation & Extending the Learning

Differentiation

- If classroom in includes English Language Learners or have other special needs and considerations, you may want to read questions aloud and discuss meaning of questions.

Modifications

Extending the Learning

Activity 1.2: Expressing Ideas and Questions for Patterns in Ecosystems (40 min)

Overview and Preparation

Target Student Performance

Students ask and record specific questions about changes in matter and energy in response to the unit driving question: How many foxes can live in a meadow?

Resources You Provide

- sticky notes (1 for each student)

Resources Provided

- 1.2 Expressing Ideas and Questions for Patterns in Ecosystems PPT
- 1.2 Expressing Ideas and Questions Tool for Ecosystems (1 per student)
- 1.2 Assessing Expressing Ideas and Questions Tool for Ecosystems
- 1.2 Ecosystems Storyline Reading: Learning from the Work of Bonnie McGill (1 per student)

Recurring Resources

- Questions, Connections, Questions Student Reading Strategy
- (Optional) Big Idea Probe: Wolves and Deer (1 per student)
- (Optional) Assessing the Big Idea Probe: Wolves and Deer

Setup

Print one copy of the 1.2 Expressing Ideas and Questions Tool for Ecosystems, Big Idea Probe: Wolves and Deer (optional), and 1.2 Ecosystems Storyline Reading for each student.

Directions

1. Have students discuss the pretest.

Ask students to write down questions they have after taking the pretest (for instance, on their 1.2 Expressing Ideas and Questions Tool for Ecosystems). Explain that we will try to answer most of those during the *Ecosystems* Unit.

2. (Optional) Have students complete the Big Idea Probe: Wolves and Deer.

If you decide to use the Big Idea Probe: Wolves and Deer, have students complete it and share their ideas. See Assessing the Big Idea Probe: Wolves and Deer and the educator resource Using Big Idea Probes for suggestions about how to use the Big Idea Probe.

3. Use the instructional model to show students where they are in the course of the unit.

Show Slide 2 of the 1.2 Expressing Ideas and Questions for Patterns in Ecosystems PPT.

4. Students complete the Expressing Ideas and Questions Tool on their own.

Show Slide 3 of the 1.2 Expressing Ideas and Questions for Patterns in Ecosystems PPT.

- Tell students that now they will take a few minutes to think and record their ideas and questions about ecosystems on their own.
- Give each student one copy of 1.2 Expressing Ideas and Questions Tool for Ecosystems.
- Give students about 10 minutes to complete the tool as individuals.

- Encourage students to think about things they have seen in the world to help inform their ideas.

5. Students compare their own ideas with the ideas of a partner.

Show Slide 4 of the 1.2 Expressing Ideas and Questions for Patterns in Ecosystems PPT.

- Tell students that now that they have had a chance to record their ideas and questions on their own, it is important to compare their ideas to their classmates' ideas to see how they are similar and different, and also so we know how many different ideas there are in the class.
- Divide students into pairs and have students compare their ideas on the 1.2 Expressing Ideas and Questions Tool for Ecosystems with each other. As students are sharing, circulate through the groups. Consider asking questions such as *Do you agree with each other about XX? Where did you learn about that? What experiences have you had to help you with your explanation*?
- At this point, do not correct any wrong ideas; treat this as brainstorming.
- Pay attention to patterns in students' ideas, or specific individual ideas that diverge from the patterns as both may be valuable to discuss as a whole class later.

6. Post ideas for class discussion.

Tell students that now that they have had a chance to write their ideas as individuals and as pairs, it is important to look at the range of ideas in the class. Again, at this point, do not correct any wrong ideas. Treat this as brainstorming: all ideas are on the table.

- Show Slide 5 of the 1.2 Expressing Ideas and Questions about Ecosystems PPT.
- Give each pair 2 sticky notes.
- Tell students to write their most important idea from their Expressing Ideas and Question Tools on a sticky note and put it on the board under the "Your Ideas" column.
- Tell students to write their most important question from their Expressing Ideas and Questions Tools on a sticky note and put it on the board under the "Your Questions" column.

7. Have a whole class discussion.

Lead a whole class discussion to examine the variety of student ideas and questions on the board. Draw out and press students to build on their ideas about how a fox in a meadow ecosystem gets the matter and energy it needs to live and grow.

This is the consensus-seeking stage of the *Carbon TIME* Discourse Routine. It is especially important for students to agree on some shared questions.

- Show Slide 6 of the 1.2 Expressing Ideas and Questions for Patterns in Ecosystems PPT. Note that this slide is a duplicate of the previous one but with a new heading. Take this time to discuss students' ideas, organize them according to patterns, etc.
- Later, you can use this duplicate slide as a record of class ideas for the future, either by saving the post-it notes or by taking a picture of them. You may want to record the students' ideas and questions on a class Driving Question Board.

8. Students read the Ecosystems Storyline Reading

Show Slide 7 of the 1.2 Expressing Ideas and Questions for Patterns in Ecosystems PPT. Have students partner-read the 1.2 Ecosystems Storyline Reading which explains the storyline of the unit and connects it to the work of scientist Dr. Bonnie McGill. Read using the Questions, Connections, Questions Student Reading Strategy. See the Engaging Students with Readings

and the Questions, Connections, Questions Reading Strategy Educator Resource document for information about how to engage students with this strategy.

- After pairs are finished reading, have students share with the class what they found interesting and any questions they have.

9. Save the Expressing Ideas and Questions Tools for later.

Show Slide 8 of the 1.2 Expressing Ideas and Questions for Patterns in Ecosystems PPT.

- Tell students that they will revisit these ideas and question later in the unit to see how their thinking changes and what they have learned.
- The class can also return to shared ideas on Slide 6.

Assessment

Use the 1.2 Assessing Expressing Ideas and Questions Tool for Ecosystems to note how students are responding. Do not tell them what Level 4 types of responses you are looking for, just that you are interested in how they are thinking about ecosystems right now.

Tips

Check to see what types of ideas and questions students have about ecosystems.

Differentiation & Extending the Learning

Differentiation

- Refer back to Expressing Ideas and Questions Tools from past units as a model.
- Strategic grouping with strong speakers
- Provide sentence stems to aid individual writing and for discussion
- Insist on ideas and questions from **all** students
- Emphasize that there are no incorrect answers and check for alternative ideas that may be cultural in nature

Modifications

Extending the Learning

Activity 1.3: Carbon Pools (30 min)

Overview and Preparation

Target Student Performance

Students identify where carbon atoms are located in ecosystems and groups of organisms that have similar functions (carbon pools).

Resources Provided

- 1.3 Carbon Pools PPT
- 1.3 Carbon Pools Reading (1 per student)

Recurring Resources

- Learning Tracking Tool for Ecosystems (1 per student)
- Assessing the Learning Tracking Tool for Ecosystems
- Questions, Connections, Questions Student Reading Strategy

Setup

Open the 1.3 Carbon Pools PPT and project it. Print one copy of the 1.3 Carbon Pools Reading for each student.

Directions

1. Use the instructional model to show students where they are in the course of the unit.

Show Slide 2 of the 1.3 Carbon Pools PPT.

2. Students brainstorm initial ideas about ecosystems.

Ask students to share their ideas and questions about ecosystems. Students will likely have heard the word "ecosystem" before. You may want to tell them that the word combines two Greek root words that mean "house" (eco) and "to combine" (system).

- What ideas do they have about what defines an ecosystem?
- Show students Slide 3 from 1.3 Carbon Pools PPT to define an ecosystem.
- Ask if the students can name some ecosystem types (desert, forest, prairie, tundra, etc.).

Accommodation: Before having students come up with examples of ecosystems, give an example so students have a frame of reference (e.g., desert, rainforest).

3. Have students identify the meadow ecosystem and things that live there.

Have students locate a meadow ecosystem in the aerial photo in Slide 4 and then show Slide 5 which outlines the meadow ecosystems in red. *Note: the meadow image on Slides 4 and 5 is from 44°00'19.99" N 85°58'59.62" W in Manistee National Forest. Historical imagery of this meadow can be viewed in Google Earth. It is likely a man-made meadow since it didn't exist before 2009.*

- Show Slide 6. Have students look at the pictures of meadows and identify features of a meadow ecosystem.
- Have students list all of the living things that they think may live in a meadow and record them on the board or on Slide 7.

Accommodation: Before having students identify a meadow on the aerial map, go over what a meadow is and describe its natural features (e.g., long grasses, wildflowers, open spaces).

Provide as much as you think you need to without giving too much away. Allow students time to draw or list the living things that live in a meadow ecosystem before compiling a class list.

4. Have students discuss where carbon is located in this ecosystem.

Have students list all the places where they would find carbon in an ecosystem in Slide 8 (or on the board). Examples include plant and animal tissues, soil (dead material as well as microorganisms) and air.

- Remind students that in the *Systems & Scale* Unit they learned that organic carbon is bonded to hydrogen or other carbon atoms, while inorganic carbon is not. Organic molecules (such as $C_6H_{12}O_6$) have high energy bonds and inorganic molecules (such as CO_2) do not.
- On Slide 9, have students list the types of molecules they would find the carbon atoms in, and which of the molecules are organic versus inorganic.
- Go back to Slide 8 (or the board) and put a star next to all of the places where carbon is organic. Reminder: the inorganic carbon is in carbon dioxide in the atmosphere. All of the other carbon is organic.

Accommodation: Before going into too much depth about carbon and where to find inorganic and organic carbon, prepare or copy and paste some of the slides from the *Systems and Scale* Unit (5.3 Organic vs. Inorganic PPT Slides 15-20) to provide concrete visuals of the different ways carbon is present in the living world.

5. Have students identify groups of organisms that have similar roles in an ecosystem.

Use the picture of a meadow in Slides 10-13 to identify producers, herbivores, carnivores and decomposers in an ecosystem. Introduce the role of each of those type of organisms.

6. Introduce students to the idea of "pools" of carbon.

Use the animation on Slides 14-16 to show how scientists categorize organisms into particular "pools" of carbon.

- Tell students that in the next few lessons, we will think about soil organic carbon as the location of both decomposers (bacteria and fungi) and also dead plants and animals waiting to decay.

7. Have students read the Carbon Pools Reading.

Show Slide 17 of the 1.3 Carbon Pools PPT. Have students partner-read the 1.3 Carbon Pools Reading which explains how carbon pools are identified and measured. Read using the Questions, Connections, Questions Student Reading Strategy. See the the Questions, Connections, Questions Reading Strategy Educator Resource document for information about how to engage students with this strategy.

- After pairs are finished reading, have students share their ideas about the italicized questions at the end of the reading.

8. Have a discussion about where you're headed in the *Ecosystems Unit* and complete the Learning Tracking Tool for this activity.

Show Slide 18 of the 1.3 Carbon Pools PPT to discuss where the class is moving in the *Ecosystems Unit.*

Show 19 of the 1.3 Carbon Pools PPT.

- Pass out a Learning Tracking Tool for Ecosystems to each student.

- Have students write the activity chunk name in the first column, "Expressing Ideas and Questions" and their role as the “Questioner.”
- Have a class discussion about what students did during the activity chunk. When you come to consensus as a class, have students record the answer in the second column of the tool.
- Have a class discussion about what students figured out during the activity chunk that will help them in answering the unit driving question. When you come to consensus as a class, have students record the answer in the third column of the tool.
- Have a class discussion about what students are wondering now that will help them move towards answering the unit driving question. Have students record the questions in the fourth column of the tool.
- Have students keep their Learning Tracking Tool for future activities.
- Example Learning Tracking Tool

Activity Chunk	What Did We Do?	What Did We Figure Out?	What Are We Asking Now?
Expressing Ideas and Questions Questioner	Take a pretest and share initial ideas on the Expressing Ideas and Questions Tool about different populations in a meadow ecosystem.	We already have some ideas and questions about ecosystems. Ecosystems have different carbon pools: CO_2, producers, consumers, decomposers, soil organic carbon.	What makes carbon pools larger or smaller?

Assessment

Use the ideas students share during class about ecosystems to formatively assess their familiarity with various ecosystems, types of organisms, and organic versus inorganic carbon.

This Unit builds on previous knowledge about organic versus inorganic carbon and systems at different scales. If students experience difficulty making the connections in this lesson, they should be provided further instruction or review before moving on. See particularly Lesson 2 and Activity 5.3 of the *Systems and Scale* unit.

Tips

Check to see if students are able to identify the difference between organic and inorganic carbon at this point in the unit.

Differentiation & Extending the Learning

Differentiation

- Ask students to name examples of producers, herbivores, carnivores, and decomposers from their own experience.
- Ask students to identify examples of producers, herbivores, carnivores, and decomposers from a trip outside to the school grounds or pictures of familiar ecosystems.

Modifications

Have students draw an image of an ecosystem of their choice during step 3 and list the types of organisms that might live there. Then during step 5, have students identify producers,

herbivores, carnivores and decomposers in the ecosystem they drew. If they don't have an organism in each role, encourage them to draw a new organism to play that role in their ecosystem.

Extending the Learning

Have students use online satellite imagery to take a picture of their neighborhood and identify where the carbon is located near their home or school.