Lesson 5: Ecosystem Services and Posttest

Overview

Students learn about how humans depend on ecosystem products and services to survive and how we manage ecosystems to provide products and services that we want, as well as how increasing one product or service can decrease others. They develop posters about different ecosystems and complete the unit posttest.

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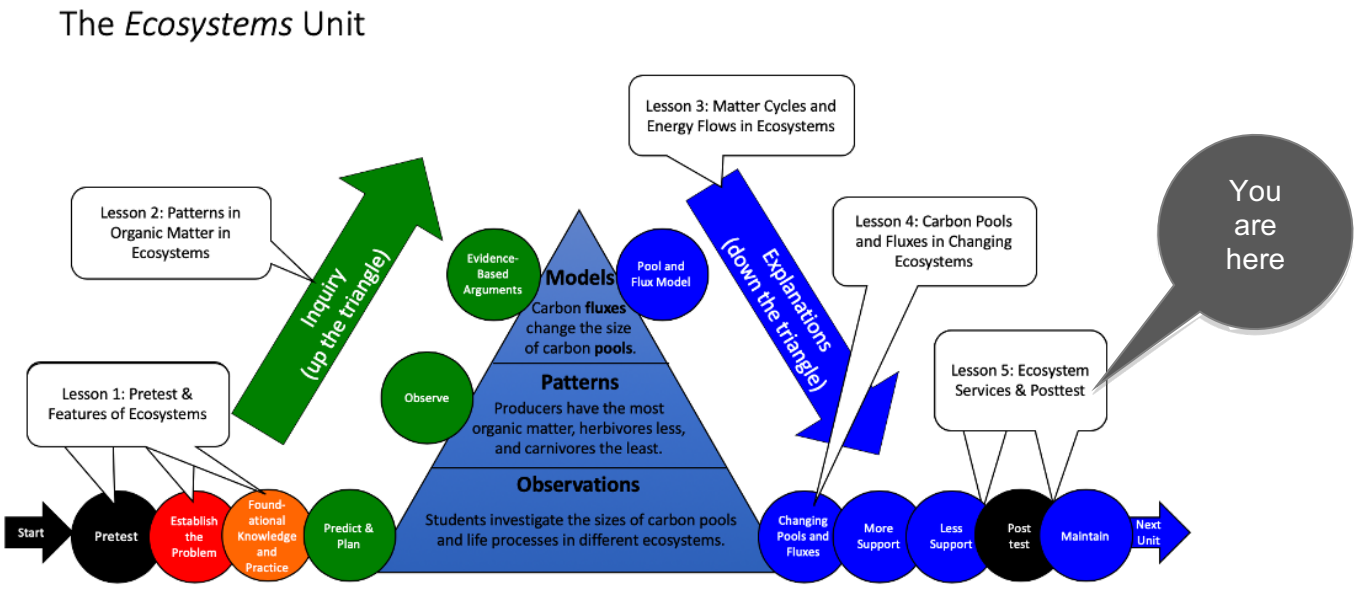
Guiding Question

How do humans change ecosystems to provide products and services that we need?

Activities in this Lesson

- Activity 5.1: Introduction to Ecosystem Products and Services (40 minutes)
- Activity 5.2: Ecosystem Products and Services Jigsaw (50 minutes)
- Activity 5.3a or 5.3b: Ecosystem Posters (40 minutes)
- Activity 5.4: Ecosystems Unit Posttest (20 minutes)

Unit Map



Learning Goals

Target Performances

Activity	*Target Performance*
Lesson 5- Ecosystems Services and Posttest (students as explainers)	
Activity 5.1: Introduction to Ecosystem Products and Services	Students explain how humans change matter cycling and energy flow in ecosystems to produce products and services.

Activity	*Target Performance*
Activity 5.2: Ecosystem Products and Services Jigsaw	Students explain how humans manage matter cycling and energy flow in specific ecosystems to produce products that they need (beef, corn, forest).
 Activity 5.3a: Ecosystem Posters **OR**	Students use posters to explain matter cycling, energy flow, and ecosystem services in a different ecosystem.
 Activity 5.3b: Ecosystem Posters	Students use posters to explain matter cycling, energy flow, ecosystem services, and effects of disturbances in a different ecosystem.
Activity 5.4: Ecosystems Unit Posttest	Students show their end-of unit proficiencies for the overall unit goal: Questioning, investigating, and explaining how carbon cycles and energy flows in ecosystems.

NGSS Performance Expectations

High School

- Ecosystems: Interactions, Energy, and Dynamics. HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems at different scales.
- Ecosystems: Interactions, Energy, and Dynamics. HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- Ecosystems: Interactions, Energy, and Dynamics. HS-LS2-6: Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Middle School

- Matter and Energy in Organisms and Ecosystems. MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- Earth's Systems. MS-ESS2-1. Develop a model to describe the cycling of earth's materials and the flow of energy that drives this process.

Background Information

Three-dimensional Learning Progression

In Lesson 5, students consider several real-world situations to apply their understanding of ecosystems and carbon cycling. Thinking about real-world situations will help students apply their knowledge and understand the relevance of this topic.

Key Ideas and Practices for Each Activity

In Activity 5.1, students are introduced to human managed ecosystems and ecosystem products and services. Students complete a reading about these ideas and then apply them to new ecosystems.

In Activity 5.2, students read about one human managed ecosystem and the services and products it provides. They then share with peers to learn about other human managed ecosystems in a jigsaw-style discussion.

In Activity 5.3a (1-turtle) or 5.3b (2-turtle), students review what they have learned throughout the unit by creating ecosystem posters focused on tracing matter and energy within an ecosystem.

Activity 5.4 includes the unit posttest. As you look at your students' responses to the posttest questions, consider how well their answers reflect their progress toward understanding ecological matter cycling and energy flow, and answering the Large-Scale Four Questions for a variety of ecosystems. See 5.4 Grading Ecosystems Unit Posttest for assistance in interpreting your students' responses.

Content Boundaries and Extensions

Activity 5.1: Introduction to Ecosystem Products and Services (40 min)

Overview and Preparation

Target Student Performance

Students explain how humans change matter cycling and energy flow in ecosystems to produce products and services.

Resources Provided

- 5.1 Introduction to Ecosystem Products and Services PPT
- 5.1 Ecosystem Images (1 set per class)
- 5.1 Ecosystem Products and Services Reading (1 per student)
- 5.1 Products and Services in Different Ecosystems Worksheet (1 per student)
- 5.1 Assessing Products and Services in Different Ecosystems Worksheet

Recurring Resources

- Questions, Connections, Questions Student Reading Strategy

Setup

Print one copy of 5.1 Products and Services in Different Ecosystems Worksheet and 5.1 Ecosystem Products and Services Reading for each student. Print one set of 5.1 Ecosystem Images and hang the images up around the classroom. Prepare a computer and projector to display the 5.1 Introduction to Ecosystem Products and Services PPT.

Directions

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

Show Slide 2 of the 5.1 Introduction to Ecosystem Products and Services PPT.

2. Introduce human managed ecosystems.

Show Slide 3. Ask students to share ideas about how people are a part of ecosystems and how people use ecosystems.

3. Have students read about ecosystem products and services.

Show Slide 4 to introduce how humans are a part of ecosystems.

- Have students read 5.1 Ecosystem Products and Services Reading using the Questions, Connections, Questions Student Reading Strategy. See 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.
- Show Slide 5. Have students discuss the questions based on the reading.

4. Have students identify the products and services of different ecosystems.

Use Slide 6 to introduce the activity. Pass out the 5.1 Products and Services in Different Ecosystems Worksheet to each student.

- Have students answer the first two questions using the reading.

- Review the answers as a class. Make a list on the board of ecosystem products and services.
- With a partner, have students rotate through each of the 5.1 Ecosystem Images hanging around the classroom. Students should talk with their partner about the products and services that might be provided by each ecosystem and then record their answers in the table on their 5.1 Products and Services in Different Ecosystems Worksheet.

5. Discuss products and services in different ecosystems.

Use Slides 7-10 to have a discussion about the products and services that might be provided by some of the ecosystems (These ecosystems will be discussed again in Activity 5.3).

- Discuss how the products and services of the different ecosystems are alike and different.

6. Preview the next activity.

Use Slide 11 to tell students that in the next activity they will focus in on specific ecosystem products and services that relate to carbon cycling. Specifically, they will be learning about water, food, and carbon sequestration in three different human managed ecosystems.

Assessment

During this activity, check to see if students are able to identify products and services using the information provided in the reading. Use 5.1 Assessing Products and Services in Different Ecosystems Worksheet to get a sense of students' understanding of ecosystem products and services.

Differentiation & Extending the Learning

Differentiation

- Use strategic grouping to ensure strong partners for the 5.1 Ecosystem Products and Services Reading activity.
- Have students highlight important information in the reading individually before joining with their partner.

Modifications

Complete 5.1 Products and Services in Different Ecosystems Worksheet as a class instead of in stations around the classroom.

Extending the Learning

Encourage students to explore the ecosystem services in the activity more in depth using online resources.

Activity 5.2: Ecosystem Products and Services Jigsaw (50 min)

Overview and Preparation

Target Student Performance

Students explain how humans manage matter cycling and energy flow in specific ecosystems to produce products that they need (beef, corn, forest).

Resources You Provide

- (From previous lesson) 1.2 Expressing Ideas and Questions Tool for Ecosystems

Resources Provided

- 5.2 Ecosystem Products and Services Jigsaw PPT
- 5.2 Beef Ecosystem Products and Services Reading
- 5.2 Corn Ecosystem Products and Services Reading
- 5.2 Forest Ecosystem Products and Services Reading
- 5.2 Beef Ecosystem Products and Services Worksheet
- 5.2 Corn Ecosystem Products and Services Worksheet
- 5.2 Forest Ecosystem Products and Services Worksheet
- 5.2 Grading Beef Ecosystem Products and Services Worksheet
- 5.2 Grading Corn Ecosystem Products and Services Worksheet
- 5.2 Grading Forest Ecosystem Products and Services Worksheet

Recurring Resources

- Learning Tracking Tool for Ecosystems (1 per student)
- Assessing the Learning Tracking Tool for Ecosystems

Setup

Prepare one copy of 5.2 Reading and corresponding 5.2 Worksheet for each student with one third of the students receiving the reading and corresponding worksheet for each ecosystem. Prepare a computer with a projector to display the 5.2 Ecosystem Products and Services Jigsaw PPT.

Directions

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

   Display Slide 2 of the 5.2 Ecosystem Products and Services Jigsaw PPT.

2. **Review how matter cycles and energy flows in ecosystems.**

   Use Slides 3-5 of the PPT to review what students have learned about matter and energy in ecosystems.

   - Slide 3 reminds students of how matter cycles and energy flows in ecosystems.
   - Slide 4 reminds students of carbon pools and fluxes.
   - Slide 5 reminds students that ecosystems are actually open systems that provide products and services.

3. Have students complete the reading and corresponding worksheet for one ecosystem.

Display Slide 6 of the 5.2 Ecosystem Products and Services Jigsaw PPT.

- Give each student a copy of one of the 5.2 Ecosystem Products and Services Readings. About one third of the students should read about each ecosystem.
- Have students complete the 5.2 Ecosystem Products and Services Worksheet for the ecosystem they read about. Students can work individually or in pairs or groups with those who have the same ecosystem.

4. Have students who focused on the same ecosystem form a group.

Display Slide 7 of the 5.2 Ecosystem Products and Services Jigsaw PPT. Have students who read about the same ecosystem form a group. Depending on the size of your class, you may have multiple small groups for each ecosystem.

- In their groups, have students discuss their answers to the questions on the worksheet and come to consensus.

5. Have students share about how their ecosystem functions.

Display Slide 8 of the 5.2 Ecosystem Products and Services Jigsaw PPT.

- Decide how to have students share the information for their ecosystem.
  - Students who focused on the same ecosystem can present to the whole class. They could make a poster to share.
  - Students can form groups of three with students who focused on each of three ecosystems.

6. Have students discuss the similarities and differences between the ecosystems.

Display Slide 9 of the 5.2 Ecosystem Products and Services Jigsaw PPT.

- Have a class discussion about the similarities and differences between the three ecosystems.
- Focus the discussion on the differences between the corn farm and the beef farm, and the wind composition in and out of each ecosystem.

7. Have students revisit their initial ideas from Lesson 1.

Display Slide 10. Have students look back at their initial ideas on 1.2 Expressing Ideas and Questions Tool for Ecosystems.

- Ask them to share some of their initial ideas, their thinking about how their ideas have changed, and what their initial questions were.
- Ask them how they would now answer their initial questions.

8. Have students complete an exit ticket.

Show Slide 11 of the 5.2 Ecosystem Products and Services Jigsaw PPT.

- Conclusions: How do humans change ecosystems to get the products and services we need?
- Predictions: What happens to other ecosystem services when humans disturb an ecosystem to get more of one product or service?
- On a sheet of paper or a sticky note, have students individually answer the exit ticket questions. Depending on time, you may have students answer both questions**, assign**

students to answer a particular question, or let students choose one question to answer. Collect and review the answers.

- The conclusions question will provide you with information about what your students are taking away from the activity. Student answers to the conclusions question can be used on the Driving Question Board (if you are using one). The predictions question allows students to begin thinking about the next activity and allows you to assess their current ideas as you prepare for the next activity. Student answers to the predictions question can be used as a lead into the next activity.

9. Have a discussion to complete the Learning Tracking Tool for this activity.

Show Slide 12 of the 5.2 Ecosystem Products and Services Jigsaw PPT.

- Pass out a Learning Tracking Tool for Ecosystems to each student.
- Have students write the activity chunk name in the first column, "Ecosystems Products and Services, Explainers"
- 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?
Ecosystems Products & Services Explainer	Explain how humans manage ecosystems to provide products and services that we want, as well as how increasing one product or service can decrease others.	We change ecosystems to provide products and services that we need, but those changes can harm other services.	How are humans affecting carbon cycles and energy flows in the whole world?

Assessment

Use 5.2 Grading Ecosystem Products and Services Worksheets to grade the worksheets.

Differentiation & Extending the Learning

Differentiation

- Hand out the 5.2 Ecosystem Products and Services Readings strategically to form strong groups.

- Give all readings to all student so that students can read along as other groups present their results.
- Students could highlight important information in the reading individually before joining with their partner or group.
- Have groups present their findings orally to the whole class, rather than using the jigsaw model.
- Use 5.2 Ecosystem Products and Services Worksheets as a review for the test. Have students complete all three before the test.

Modifications

Extending the Learning

Have students read the articles and/or watch the videos listed in the Digging Deeper sections of the 5.2 Ecosystem Products and Services Readings.

Activity 5.3a: Ecosystem Posters (40 min)

Overview and Preparation

You should choose either Activity 5.3a or Activity 5.3b. Both activities involve students in making posters about ecosystems. In Activity 5.3a, the posters do not include disturbances and their effects; in Activity 5.3b, they do making it appropriate for students who completed Lesson 4.

Target Student Performance

Students use posters to explain matter cycling, energy flow, and ecosystem services in a different ecosystem.

Resources You Provide

- Poster paper or boards (1 per group)

Resources Provided

- 5.3a Ecosystem Posters PPT
- 5.3a Ecosystem Posters Handout (1 per group)

Setup

Print one copy of the 5.3a Ecosystem Posters Handout for each group. Prepare a computer and projector to display the 5.3a Ecosystems Posters PPT.

Directions

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

Display Slide 2 of the 5.3a Ecosystem Posters PPT.

2. Have a class discussion about the elements of an ecosystem.

Show Slide 3.

- Have a whole class discussion about what makes an ecosystem.
- Focus on the question: what elements does an ecosystem need? Make sure students note the need for producers, herbivores, carnivores, soil carbon, carbon dioxide, and sun.

3. Students work in groups on their ecosystem posters.

Display Slide 4.

- Divide students into groups of four.
- Pass out a 5.3a Ecosystem Posters Handout and a poster paper or board to each group.
- Have each group choose which ecosystem they will focus on, making sure that at least one group is doing each of the ecosystems.
- Have students to continue to work through the questions on 5.3a Ecosystem Posters Handout as they complete their posters. All questions will be completed on each poster.

4. Students do a gallery walk of the posters.

Display Slide 5. Display each of the posters around the room.

- Have groups walk around the room and look at each poster.
- While at each poster, students should discuss the questions on Slide 5 with their group.

5. Have a whole class review discussion.

Using Slide 6, have a whole class discussion about how carbon cycles and energy flows in ecosystems using the carbon cycling diagram.

Assessment

Students should be able to respond to the questions for their ecosystem on their poster. They should recognize how carbon cycles and energy flows. They should also be able to identify ecosystem products and services and tradeoffs for management of those services.

Differentiation & Extending the Learning

Differentiation

- Strategically select ecosystems for specific groups.
- Have students attempt to answer the questions about their ecosystem individually before joining with the group to discuss and create the poster.
- Have groups present their posters in front of the class rather than having groups rotate through each poster.

Modifications

Activity 5.3b: Ecosystem Posters (40 min)

Overview and Preparation

You should choose either Activity 5.3a or Activity 5.3b. Both activities involve students in making posters about ecosystems. In Activity 5.3a, the posters do not include disturbances and their effects; in Activity 5.3b, they do making it appropriate for students who completed Lesson 4.

Target Student Performance

Students use posters to explain matter cycling, energy flow, ecosystem services, and effects of disturbances in a different ecosystem.

Resources You Provide

- Poster paper or boards (1 per group)

Resources Provided

- 5.3b Ecosystem Posters PPT
- 5.3b Ecosystem Posters Handout (1 per group)

Setup

Print one copy of the 5.3b Ecosystem Posters Handout for each group. Prepare a computer and projector to display the 5.3b Ecosystems Posters PPT.

Directions

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

Display Slide 2 of the 5.3b Ecosystem Posters PPT.

2. Have a class discussion about the elements of an ecosystem.

Show Slide 3.

- Have a whole class discussion about what makes an ecosystem worksheet.
- Focus on the question: what elements does an ecosystem need? Make sure students note the need for producers, herbivores, carnivores, soil carbon, carbon dioxide, and sun.

3. Students work in groups on their ecosystem posters.

Display Slide 4.

- Divide students into groups of four.
- Pass out a 5.3b Ecosystem Posters Handout and a poster paper or board to each group.
- Have each group choose which ecosystem they will focus on, making sure that at least one group is doing each of the ecosystems.
- Have students to continue to work through the questions on 5.3b Ecosystem Posters Handout as they complete their posters. All questions will be completed on the poster.

4. Students do a gallery walk of the posters.

Display Slide 5. Display each of the posters around the room.

- Have groups walk around the room and look at each poster. While at each poster, students should discuss the questions on Slide 5 with their group.

5. Have a whole class review discussion.

Using Slide 6, have a whole class discussion about how carbon cycles and energy flows in ecosystems using the carbon cycling diagram.

Assessment

Students should be able to respond to the questions for their ecosystem on their poster. They should recognize how carbon cycles and energy flows. They should also be able to identify ecosystem products and services and tradeoffs for management of those services.

Differentiation & Extending the Learning

Differentiation

- Strategically select ecosystems for specific groups.
- Have students attempt to answer the questions about their ecosystem individually before joining with the group to discuss and create the poster.
- Have groups present their posters in front of the class rather than have groups rotate through each poster.

Modifications

Activity 5.4: Ecosystems Unit Posttest (20 min)

Overview and Preparation

Target Student Performance

Students show their end-of unit 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

- 5.4 Ecosystems Unit Posttest (1 per student)
- 5.4 Grading the Ecosystems Unit Posttest

Setup

Print one copy of the 5.4 Ecosystems Unit Posttest for each student.

Directions

1. Describe the unit posttest.

Explain the purpose of the unit posttest 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 students think about what they learned and how their ideas changed over time.

2. Have students take the unit posttest.

Distribute copies of 5.4 Ecosystems Unit Posttest to be completed.

Assessment

Students should be able to answer the questions correctly, so it is reasonable to grade them at this point. Use 5.4 Grading the Ecosystems Unit Posttest to check student answers.

Differentiation & Extending the Learning

Differentiation

- Read the questions aloud to the class. Reframe or reword questions for clarity.
- Provide sentence stems for written responses.
- Provide visual aids for any examples of ecosystems that are not provided.

Modifications

Extending the Learning

Have students compare their answers from the pretest with their answers from the posttest to see how their ideas have changed over the course of the unit.