

Lesson 6: Explaining Other Examples of Plants Growing, Moving and Functioning

Overview

Students practice explaining photosynthesis, biosynthesis, and cellular respiration in other plants and then take the unit posttest.

[Download PDF of Lesson 6 Teacher's Guide](#)

Guiding Question

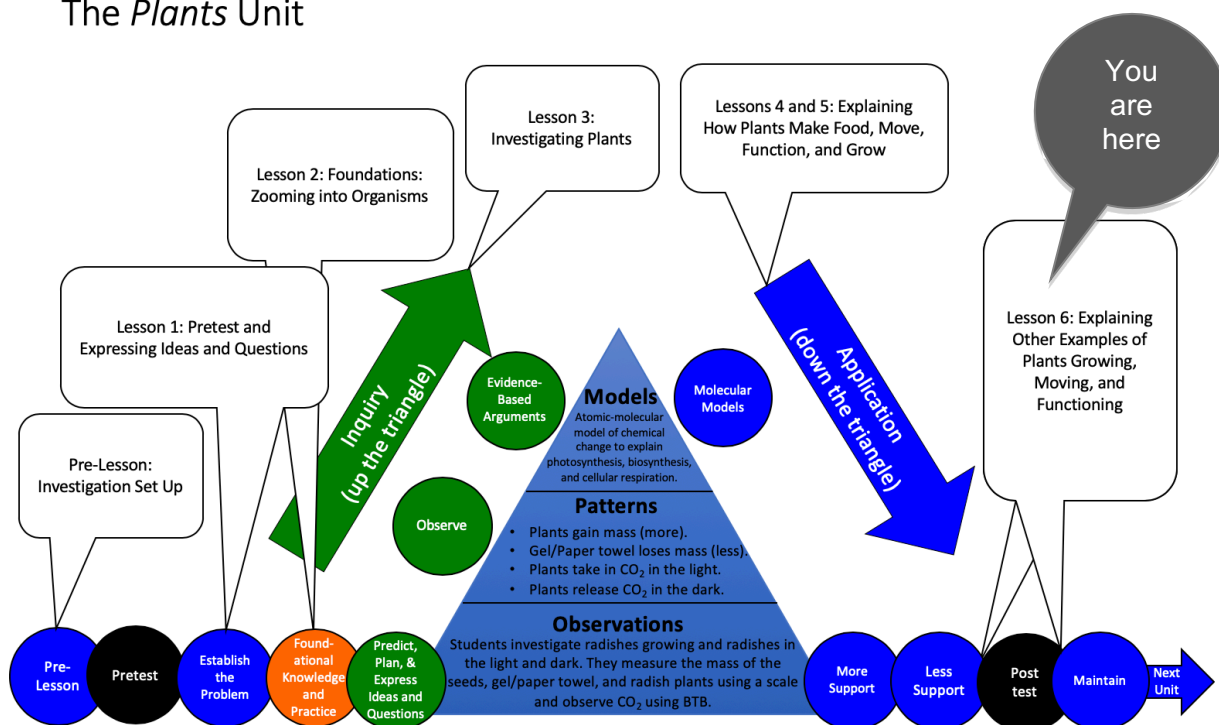
How do other plants grow, move, and function?

Activities in this Lesson

- Activity 6.1: Explaining Other Examples of Plants Growing, Moving, and Functioning (50 min)
- Activity 6.2: Functions of All Plants (50 min)
- Activity 6.3: Comparing Plants and Animals (50 min)
- Activity 6.4: Plants Unit Posttest (40 min)

Unit Map

The *Plants* Unit



Learning Goals

Target Performances

Activity	Target Performance
<i>Lesson 6 – Explaining Other Examples of Animals Growing, Moving, and Functioning (students as explainers)</i>	
Activity 6.1: Explaining Other Examples of Plants Growing, Moving, and Functioning	Students develop integrated accounts of how other plants (Lodgepole pine, <i>Spartina</i> marsh grass, prickly pear cactus) grow, move and function through the processes of photosynthesis, cellular respiration, and biosynthesis.
Activity 6.2: Functions of All Plants	Students develop integrated accounts of how all plants grow, move and function through the processes of photosynthesis, cellular respiration, and biosynthesis.
Activity 6.3: Comparing Plants and Animals	Students compare how matter moves and changes and how energy changes in a growing tree vs. a growing child, connecting macroscopic observations with atomic-molecular models and using the principles of conservation of matter and energy.
Activity 6.4: Plants Unit Posttest	Students show their end-of unit proficiencies for the overall unit goal: Questioning, investigating, and

Activity	Target Performance
	explaining how plants move and change matter and energy as they live, move, and grow.

NGSS Performance Expectations

Middle School

- MS. Structure, Function, and Information Processing. MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
- MS. Matter and Energy in Organisms and Ecosystems. MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- MS. Matter and Energy in Organism and Ecosystems. MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

High School

- HS. Matter and Energy in Organisms and Ecosystems. HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- HS. Matter and Energy in Organisms and Ecosystems. HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- HS. Matter and Energy in Organisms and Ecosystems. HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
- HS. Matter and Energy in Organisms and Ecosystems. 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.

Background Information

Three-dimensional Learning Progression

In this final lesson of the unit, students have completed the inquiry and application sequences for plant growth and movement. The activities in the previous lessons were designed to walk students through a cognitive apprenticeship model of Establishing the Problem, Modeling, Coaching, and Fading. The results of the unit posttest will help you determine if your students are ready to move on to the final stage: Fading. After the Fading stage, students will be expected to carry forward concepts from this unit into future units. If the results from your posttest imply that a majority of your students are still struggling with certain concepts, it might be valuable to return to some of the main concepts they are struggling with before moving on to the next *Carbon TIME* unit.

Key Ideas and Practices for Each Activity

Activity 6.1 is the first part of the Fading phase of the Application Activity Sequence, which provides students with important less-scaffolded practice with photosynthesis, biosynthesis, and cellular respiration in plants. Students should take more responsibility for their work than in

lessons 4 and 5, which included the Modeling and Coaching phases. Students answer the Three Questions for different plants growing and moving using modified Explanations Tools, coordinating accounts at the macroscopic and atomic-molecular scales. Macroscopic scale accounts include these components:

- the structure of the system (the plant and its cells in this case) and the movement of materials through the system;
- the location where chemical change takes place;
- the materials involved in the chemical change: the reactants going in and the products coming out.

Atomic-molecular scale accounts include three different ways of representing chemical change:

- molecular models, with twist ties to represent units of energy, that students used to physically rearrange the atoms of the reactants into the atoms of the products;
- a chemical equation that shows how atoms are rearranged into new molecules in a compact way (but does not account for energy);
- the Explanations Tool, which provides a way for students to account for changes in matter and energy in writing by answering the Three Questions.

Activities 6.2 and 6.3 together make up the second part of the Fading phase of the Application Activity Sequence. In these activities, students write generalized explanations, which focus on the cellular scale, of how all plants grow, move, and function.

Activity 6.4 includes summative assessment for the unit. You can track students' progress by having them take the unit posttest (identical to the unit pretest) and comparing the results of the two assessments.

Content Boundaries and Extensions

Talk and Writing

This lesson of the unit represents the fading portion of the **Explanations Phase**. This means that students are expected to develop explanations for carbon-transforming processes they studied in this unit in *new* and *novel* contexts. The table below shows specific talk and writing goals for the Explanations phase of the unit.

Talk and Writing Goals for the Explanations Phase	Teacher Talk Strategies That Support This Goal	Curriculum Components That Support This Goal
Examine student ideas and correct them when there are problems. It's ok to give the answers away during this phase! Help students practice using precise language to describe matter and energy .	<i>Let's think about what you just said: air molecules. What are air molecules? Are you talking about matter or energy? Remember: atoms can't be created. So that matter must have come from somewhere. Where did it come from? Let's look at the molecule poster again... is carbon an atom or a molecule?</i>	Molecule Poster Three Questions Poster
Focus on making sure that explanations include multiple scales .	<i>The investigation gave us evidence for what was happening to matter and energy at a macroscopic scale. But what is happening at an atomic-molecular scale? What is happening to molecules and atoms? How does energy interact with atoms and molecules during chemical change? Why doesn't the macroscopic investigation tell us the whole story?</i>	Molecular Models Molecular Modeling Worksheets Explanations Tool PPT Animation of chemical change Powers of Ten Poster

	<i>Let's revisit our scale poster... what is happening to matter at the molecular scale?</i>	
Encourage students to recall the investigation.	<i>When did this chemical change happen during our investigation? How do we know that? What is our evidence? What were the macroscopic indicators that this chemical change took place?</i>	Evidence-Based Arguments Tool Investigation Video
Elicit a range of student explanations. Press for details. Encourage students to examine, compare, and contrast their explanations with others'.	<i>Who can add to that explanation? What do you mean by _____? Say more. So I think you said _____. Is that right? Who has a different explanation? How are those explanations similar/different? Who can rephrase _____'s explanation?</i>	Explanations Tool

Activity 6.1: Explaining Other Examples of Plants Growing, Moving, and Functioning (50 min)

Overview and Preparation

Target Student Performance

Students develop integrated accounts of how other plants (Lodgepole pine, *Spartina* marsh grass, prickly pear cactus) grow, move and function through the processes of photosynthesis, cellular respiration, and biosynthesis.

Resources You Provide

- (From previous activity) [3.3 Plants in the Light and Dark Class Results 11 x 17 Poster](#)
- (From previous activity) [3.5 Evidence-Based Arguments Tool for Plants](#)

Resources Provided

- [6.1 Explaining Other Examples of Plants Growing and Moving PPT](#)
- [6.1 Other Plants Readings Lodgepole Pine](#)
- [6.1 Other Plants Readings Prickly Pear](#)
- [6.1 Other Plants Readings Spartina](#)
- [6.1 Lodgepole Pine Worksheet](#)
- [6.1 Prickly Pear Worksheet](#)
- [6.1 Spartina Worksheet](#)
- [6.1 Grading Lodgepole Pine Worksheet](#)
- [6.1 Grading Prickly Pear Worksheet](#)
- [6.1 Grading Spartina Worksheet](#)

Recurring Resources

- [Three Questions 11 x 17 Poster](#) (1 per class)
- [Three Questions Handout](#) (1 per student)

Setup

Prepare several copies of each version of [6.1 Other Plants Readings](#), so that there is one for each student. Gather the class results poster and spreadsheet from Activity 3.3, as well as their completed copies of [3.5 Evidence-Based Arguments Tool for Plants](#). Prepare a computer and a projector to display the PPT.

Directions

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

Display slide 2 of the [6.1 Explaining Other Examples of Plants Moving and Growing PPT](#).

2. Review the ways in which plants use food.

Use Slides 3-5 of the PPT to review what students have learned about how plants use food.

- Slide 3 reminds students that the unit is about all kinds of plants.
- Slide 4 reminds students of structures that all plants have in common at different scales: cells that are made of molecules that are made of atoms.
- Slide 5 reminds students that molecules can either be used for growth through biosynthesis or energy through cellular respiration.

<ul style="list-style-type: none"> • Tell students that their explanations today will be to tell this whole story.
<p>3. Have students complete the reading and corresponding explanation worksheet for one other plant.</p> <p>Display slide 6 of the 6.1 Explaining Other Examples of Plants Growing and Moving PPT.</p> <ul style="list-style-type: none"> • Give each student a copy of one of the 6.1 Other Plants Readings. About 1/3 of the students should read about each plant. • Have students complete the 6.1 Lodgepole Pine/Prickly Pear/Spartina Worksheet for the plant they read about. <p>Modifications: Students can work in pairs or groups with those who have the same plant.</p>
<p>4. Have students who focused on the same plant form a group.</p> <p>Display slide 7 of the 6.1 Explaining Other Examples of Plants Moving and Growing PPT.</p> <ul style="list-style-type: none"> • In their groups, have students discuss their answers and come to consensus about their explanations and answers to the questions.
<p>5. Have students share about how their plant grows, moves, and functions.</p> <p>Display slide 8 of the 6.1 Explaining Other Examples of Plants Moving and Growing PPT.</p> <ul style="list-style-type: none"> • Decide how to have students share the explanation for their plant. <ul style="list-style-type: none"> ○ Students who focused on the same plant 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 plants.
<p>6. Have students discuss the similarities and differences between the plants.</p> <p>Display slide 9 of the 6.1 Explaining Other Examples of Plants Moving and Growing PPT.</p> <ul style="list-style-type: none"> • Have a class discussion about the similarities and differences between the three plants. Students should recognize that the chemical changes are similar in each case and that the rules about atoms and energy always apply.
<p>7. Have students revisit their initial ideas from Lesson 1.</p> <p>Display slide 10. Have students look back at their initial ideas on 1.2 Expressing Ideas and Questions Tool about Plants Growing.</p> <ul style="list-style-type: none"> • 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.
<p>8. Have students revisit their data and unanswered questions from the Radish Investigation.</p> <p>Display slide 11. Have students review their data from 3.3 Plants in the Light and Dark Class Results 11 x 17 Poster.</p> <ul style="list-style-type: none"> • Have students review their evidence-based arguments and unanswered questions from their 3.5 Evidence-Based Arguments Tool for Plants. <p>1. Have them consider how they would now answer their unanswered questions.</p>

Assessment

Use [6.1 Grading Lodgepole Pine/Prickly Pear Cactus/Spartina Worksheet](#) to grade the explanation tools. Although the plants are different, the answers should be similar across all the plants.

Differentiation & Extending the Learning

Differentiation

- Handout the [6.1 Other Plants Readings](#) strategically to form strong groups
- Give readings to all groups so that students can read along as groups present their results
- Students should highlight important information individually
- Have groups present their findings orally to the whole class, rather than using the jigsaw model
- Use [6.1 Other Plants Worksheets](#) as a review for the test. Have students complete all three before the test.

Modifications

- Students can work in pairs or groups with those who have the same plant.

Extending the Learning

Have students read the articles and/or watch the videos listed in the Digging Deeper section of the [6.1 Other Plants Readings](#).

Activity 6.2: Functions of All Plants (50 min)

Overview and Preparation

Target Student Performance

Students develop integrated accounts of how all plants grow, move and function through the processes of photosynthesis, cellular respiration, and biosynthesis.

Resources You Provide

- computers (1 per pair of students, for option 2 in step 2)
- blank posters (1 per pair of students or small group, for option 3 in step 2)

Resources Provided

- [6.2 Functions of All Plants PPT](#)
- [6.2 Functions of All Plants Worksheet](#) (1 per student for option 1 in step 3)
- [6.2 Grading Functions of All Plants Worksheet](#)

Recurring Resources

- [Three Questions 11 x 17 Poster](#) (1 per class)
- [Three Questions Handout](#) (1 per student)

Setup

Decide how students will construct their explanations (see options in step 3 of the directions). If students will use the worksheet, prepare one copy of [6.3 Functions of All Plants Worksheet](#) for each student. If students will create a PowerPoint, check that computers or tablets are working and ready. If students will make a poster, get one poster for each pair of students or small group. Decide how you will have students present their explanations (see step 4 of the directions). Prepare a computer and a projector to display the PPT.

Directions

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

Display slide 2 of the [6.2 Functions of All Plants PPT](#).

- 2. Have students explain the primary functions that animals have in common.**

Display slide 3 of the [6.2 Functions of All Plants PPT](#). Tell students they will be constructing explanations that answer three questions about the functions of plants that are shared by all plants.

Option 1: Have students construct their explanations on [6.2 Functions of All Plants Worksheet](#) in pairs. Students' explanations can include words, illustrations, diagrams, and/or charts. Students may need additional sheets to answer each of the questions.

Option 2: Have students construct their explanations in a PowerPoint presentation in pairs for each of the questions.

Option 3: Have students construct their explanations on a poster in pairs or small groups.

For all options, display slide 4 of the PPT and remind students that good answers to questions about plant cells should address each of the four numbered questions of the [Three Questions Poster](#) (or [Handout](#)).

3. Allow students to share their explanations with the class.

Display slide 5 of the [6.2 Functions of All Plants PPT](#). Provide students an opportunity to share their explanations with the class.

- Decide how you will have students present depending on the option you chose in step 2 and the needs of your students and classroom.
 - If students did option 1, they could verbally share their explanations or share them with the class using a document camera.
 - If student did option 2, they could present their PPT to the class.
 - If students did option 3, they could share their posters with the whole class or you could organize a gallery walk in which students circulate the classroom and view the posters.
- Have students share feedback on their classmates' explanations as to if the explanations addressed each of the Three Questions.

4. Lead a discussion about how student ideas have changed over time.

Display slide 6 of the PPT. Have students consider how their ideas changed with regard to scale, movement, and carbon. What do they know about how plants grow and move now that they didn't know before this unit?

Assessment

Use the [6.2 Grading the Functions of All Plants Worksheet](#) to grade students' explanations. Regardless of how students constructed their explanations, they should include similar information.

Differentiation & Extending the Learning

Differentiation

- Provide sentence stems for explanations of each process.

Modifications

Activity 6.3: Comparing Plants and Animals (50 min)

Overview and Preparation

Target Student Performance

Students compare how matter moves and changes and how energy changes in a growing tree vs. a growing child, connecting macroscopic observations with atomic-molecular models and using the principles of conservation of matter and energy.

Resources Provided

- [6.3 Comparing Plants and Animals PPT](#)
- [6.3 Comparing a Growing Tree and a Growing Child Worksheet](#) (1 per student)
- [6.3 Grading Comparing a Growing Tree and a Growing Child Worksheet](#)

Recurring Resources

- [Three Questions 11 x 17 Poster](#) (1 per class)
- [Three Questions Handout](#) (1 per student)
- (Optional) [Big Idea Probe: Houseplant for a Busy Family](#) (1 per student)
- (Optional) [Assessing the Big Idea Probe: Houseplant for a Busy Family](#)
- [Plants Learning Tracking Tool](#) (1 per student)
- [Assessing the Plants Learning Tracking Tool](#)

Setup

Prepare one copy of [6.3 Comparing a Growing Tree and a Growing Child Worksheet](#) for each student. Prepare a computer and a projector to display the PPT. If you are using it, print one copy of the [Big Idea Probe: Houseplant for a Busy Family](#) for each student.

Directions

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

Display slide 2 of the [6.3 Comparing Plants and Animals PPT](#).

- 2. Have students compare flames and animals.**

Display slide 3 of the [6.3 Comparing Plants and Animals PPT](#). Tell students they will be comparing what they learned about in the Animals Unit with what they have learned about plants.

- Pass out the [6.3 Comparing a Growing Tree and a Growing Child Worksheet](#) to each student.
- Have students complete the comparison individually or in pairs.
- Students may need to look back at their Process Tools from *Animals*.

Display slide 4 of the PPT and remind students that good answers to questions about both plants and children should address each of the four numbered questions of the [Three Questions Poster](#) (or [Handout](#)).

- 3. Allow students to share their explanations with the class.**

Display slide 5 of the [6.3 Comparing Plants and Animals PPT](#).

Go through the worksheet with the class and have students share their ideas. At this point in the unit, students should have scientifically correct explanations. Check that they are following the rules about matter and energy.

4. (Optional) Have students complete the Big Idea Probe: Houseplant for a Busy Family for the final time.

If you decided to use the [Big Idea Probe: Houseplant for a Busy Family](#), have students complete it and share their ideas again. Have students discuss how their ideas have changed throughout the unit. See [Assessing the Big Idea Probe: Houseplant for a Busy Family](#) for suggestions about how to use the Big Idea Probe.

5. Have students complete an exit ticket.

Show slide 6 of the [6.3 Comparing Plants and Animals PPT](#).

- Conclusions: How does how the plant you studied move, grow, and function differently from other plants?
- Predictions: What is the same about how all plants move, grow, and function?
- 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 in to the next activity.

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

Show slide 7 of the [6.3 Comparing Plants and Animals PPT](#).

- Pass out a [Learning Tracking Tool for Plants](#) to each student.
- Have students write the activity chunk name, "Explaining Other Examples" and their role, "Explainer" in the first column.
- 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.
- Example Learning Tracking Tool

Activity Chunk	What Did We Do?	What Did We Figure Out?	What Are We Asking Now?
Explaining Other Examples	Practice explaining photosynthesis, biosynthesis, and cellular respiration in other plants, and	All plants use the same carbon-transforming processes (photosynthesis,	How do decomposers grow, move, and function?

5.	Explainer	take the unit posttest.	biosynthesis, and cellular respiration) to move, grow, and function.	
----	-----------	-------------------------	--	--

Assessment

Use the [6.3 Grading the Comparing a Growing Tree and a Growing Child Worksheet](#) to grade students' work.

Differentiation & Extending the Learning

Differentiation

Modifications

Activity 6.4: Plants Unit Posttest (40 min)

Overview and Preparation

Target Student Performance

Students show their end-of unit proficiencies for the overall unit goal: Questioning, investigating, and explaining how plants move and change matter and energy as they live, move, and grow.

Resources You Provide

- pencils (1 per student)

Resources Provided

- [6.4 Grading the Plants Unit Posttest](#)
- [6.4 Plants Unit Posttest](#)

Setup

Print one copy of the [6.4 Plants Unit Posttest](#) for each student. If you are administering the pretest on the computer, register the class on the NREL website in advance, and prepare one computer with an Internet connection per 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 what happens when plants move, grow, and function.
- It will help them think about what they learned and how their ideas changed over time.

2. Have students take the unit posttest.

Distribute copies of [6.4 Plants Unit Posttest](#) to be completed with paper and pencil.

Assessment

Students should be able to answer the questions correctly, so it is reasonable to grade them at this point. Use [6.4 Grading the Plants 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 plants that are not provided.

Modifications