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# NYC Companion Lesson



# Reading “How Do Trees Grow So Huge Without Eating?”

## Overview

The article “How Do Trees Grow So Huge Without Eating?” builds on and expands students’ understanding of cellular respiration and introduces the process of photosynthesis by tracking the molecules produced during photosynthesis, which then become available for cellular respiration. Following the Active Reading approach, students read and annotate the article on their own, and then they discuss their annotations with a partner. To build their understanding of photosynthesis and the cyclical relationship between photosynthesis and cellular respiration, students reread a section of the article. The purpose of this lesson is for students to learn that through the process of photosynthesis, plants produce glucose and oxygen that can then be used for cellular respiration.

**Recommended Placement:** *Metabolism*, after Lesson 3.5

**Suggested Time Frame:** 60 minutes (first and second reads can be spread across two class periods)

## NYS P–12 Science Learning Standards

### Performance Expectations

- **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-LS1-7:** Develop a model to describe how food molecules are rearranged through chemical reactions to release energy during cellular respiration and/or form new molecules that support growth as this matter moves through an organism.



### Disciplinary Core Ideas

- **LS1.C: Organization for Matter and Energy Flow in Organisms:**
  - Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)
  - Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)
- **PS3.D: Energy in Chemical Processes and Everyday Life:**
  - The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6)
  - Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)

### Science and Engineering Practices

- **Practice 1:** Asking Questions
- **Practice 8:** Obtaining, Evaluating, and Communicating Information

### Crosscutting Concepts

- Energy and Matter

### Vocabulary

- cellular respiration
- energy
- glucose
- oxygen
- photosynthesis



## Materials & Preparation

### Materials

#### For the Class

- Reading “How Do Trees Grow So Huge Without Eating?” copymaster
- Annotation Tracker
- 1 large index card\*
- marker\*

#### For Each Student

- Student Edition: “How Do Trees Grow So Huge Without Eating?” article
- student sheets\*
  - Reading “How Do Trees Grow So Huge Without Eating?”
  - Second Read of “How Do Trees Grow So Huge Without Eating?”

\*teacher provided

### Preparation

- 1. Print Reading “How Do Trees Grow So Huge Without Eating?” copymaster.** Locate the Reading “How Do Trees Grow So Huge Without Eating?” copymaster on the New York City Resources webpage: [www.amplify.com/amplify-science-new-york-city-resources](http://www.amplify.com/amplify-science-new-york-city-resources). Make one copy of all pages for each student.
- 2. Create and post vocabulary card on the classroom wall.** With a marker, write “photosynthesis” in

large print on a large index card.  
Post this card on the classroom wall.

### 3. Prepare for Active Reading.

Before class, preview the “How Do Trees Grow So Huge Without Eating?” article. Review the first few sentences carefully as you prepare to model Active Reading. For a full description of preparing for an Active Reading day, see *Metabolism* Lesson 2.2, Lesson Brief, Preparation. **Note:** In order to achieve the full benefit of this approach, it is highly recommended that students use sticky notes to annotate the Student Editions directly.

### 4. Print one copy of the Annotation Tracker for each class.

A blank copy is available in your digital teacher’s guide in *Metabolism* Lesson 2.2, Lesson Brief, Digital Resources. If you plan to use the Annotation Summary Sheet to track students’ annotations or wish to review the Annotation Tracker Instructions, these are also available in Lesson 2.2, Digital Resources.

### 5. Make sure the Active Reading Guidelines are clearly visible.

If they are not posted on your classroom wall, write them on the board before class. (See Active Reading Guidelines on the Reading “How Do Trees Grow So Huge Without Eating?” student sheet.)



**6. Plan to model Active Reading.** To model the Active Reading approach, you will need to have students follow along as you read aloud the first few sentences of the article. If you have a document camera in your classroom, consider projecting and annotating the article as you read aloud. Alternatively, you can project the article from the PDF available on the New York City Resources webpage.

**7. Prepare for On-the-Fly Assessment.** The second read section of this lesson provides an opportunity to informally

assess students' understanding of photosynthesis. Refer to the On-the-Fly Assessment in the Assessment section of this lesson for details about what to look for and how you can use the information to maximize learning by all students.

**8. Immediately before the lesson, have on hand the following materials:**

- “How Do Trees Grow So Huge Without Eating?” article
- student sheets
- Annotation Trackers

## Science Background

Photosynthesis is the process by which plants and other producers use energy from sunlight to change carbon dioxide and water into oxygen and glucose. During photosynthesis, carbon dioxide ( $\text{CO}_2$ ) and water ( $\text{H}_2\text{O}$ ) react to produce glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) and oxygen ( $\text{O}_2$ ). This chemical reaction takes place inside the chloroplasts of producers (plants, algae, and some bacteria) and requires an energy input in the form of light from the sun. This light energy is transformed into chemical energy, which is stored in the form of glucose.

Cellular respiration is the process by which organisms convert chemical energy from foods and nutrients into chemical energy in high-energy carrier molecules such as adenosine triphosphate (ATP) that cells can then use to power their functions. Organisms can use various sugars and fats for cellular respiration, but cellular respiration with glucose is the most common. Cellular respiration of glucose is a complex, multistep process in which glucose and oxygen molecules are chemically rearranged to form carbon dioxide and water molecules, resulting in the production of ATP. Although this is an oversimplification, this process can be thought of as the reverse of photosynthesis.



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Unlike photosynthesis, which is only conducted by producers, cellular respiration is carried out by producers, consumers, and decomposers. Like other organisms, producers use the process of cellular respiration to release the energy stored in glucose. The primary difference is that producers manufacture their own glucose, while consumers and decomposers get molecules that they can use for cellular respiration from the things they eat.



## Instructional Guide

### First Read of “How Do Trees Grow So Huge Without Eating?”

**1. Introduce the article and make a connection to students’ background knowledge.**


 You have been learning about how humans get the molecules they need to grow and release energy. Today, we will read an article called “How Do Trees Grow So Huge Without Eating?” about how plants get the molecules they need.

- 2. Model Active Reading.** Read the first few sentences of the article aloud. Ask questions and make connections as you model the Active Reading process.
- 3. Review Active Reading Guidelines.** Before students begin reading, point out the Active Reading Guidelines on the classroom wall.
- 4. Distribute the Reading “How Do Trees Grow So Huge Without Eating?” student sheets.**
- 5. Prompt students to read and annotate independently.** Direct students to the “How Do Trees Grow So Huge Without Eating?” article in their Student Editions. Circulate as students read, providing support as needed.
- 6. Review the process for discussing annotations.** When most students have finished reading and annotating, explain that students will choose one or two annotations to share with a partner. They should select questions or connections that they find interesting or those that will help them better understand what they read.
- 7. Provide a moment for students to select the annotations they will share with their partners.**
- 8. Prompt partners to discuss annotations.** Circulate as pairs discuss, using the Annotation Tracker and listening for questions and connections that you would like to invite students to share during the class discussion.
- 9. Prompt partners to prepare for class discussion.** Ask them to choose an interesting or unanswered question or connection that they would like to share with the class. Explain that they can discuss the same annotations they shared with their partners if the questions are still unresolved.
- 10. Facilitate a brief class discussion about annotations.** Invite students to share their questions and connections. Encourage students to respond to one another and to look back at the article in order to answer their peers’ questions.
- 11. Highlight exemplary or noteworthy annotations.** Refer to your Annotation Tracker and invite students to share those annotations you noted. Provide specific, positive feedback as students share, noting when annotations show evidence of Active Reading. Examples might include annotations that make a connection to science ideas, use vocabulary from the unit, or instances in which students were able to answer their own questions.



## Second Read of “How Do Trees Grow So Huge Without Eating?”

12. **Set purpose for rereading “How Do Trees Grow So Huge Without Eating?”** Explain that students will reread paragraphs 2 and 3 of the article in order to understand where plants get the glucose molecules they need for releasing energy and growing.
13. **Distribute the Second Read of “How Do Trees Grow So Huge Without Eating?” student sheets and direct students to complete Part 1.**
14. **Have partners share information that they found.** Partners should discuss information that helps them understand where plants get the glucose they need for energy and growth.
15. **Lead a brief class discussion about Part 1.** Ask students to share information. Highlight those responses that attempt to track the atoms in glucose molecules back to air and water.
16. **Direct students to complete Part 2.**
17. **Have partners share ideas.** Partners should discuss where the glucose in lettuce comes from. Circulate as partners discuss so you can listen to their responses.
18. **On-the-Fly Assessment: Understanding Photosynthesis.** For further suggestions on how to support students’ understanding of photosynthesis, refer to the On-the-Fly Assessment in the Assessment section of this lesson.
19. **Introduce the vocabulary word *photosynthesis*.**

 Photosynthesis is the process by which plants and other producers use energy from sunlight to change carbon dioxide and water into oxygen and glucose.

Point out that the vocabulary word is posted on the classroom wall. Note that students can also find the definition in the glossary at the back of their Student Editions.

20. **Make a connection to the unit.** Remind students that they have been learning about cellular respiration and how this process allows organisms to get the energy they need. Ask students to share their thinking about how photosynthesis helps plants and other organisms get the energy they need.





# On-the-Fly Assessment: Students’ Understanding of Photosynthesis

## Look for:

Students should be building the understanding that plants use energy from light to make glucose by rearranging the atoms in carbon dioxide and water (the process of photosynthesis). As students discuss the question in Part 2 of the Second Read of “How Do Trees Grow So Huge Without Eating?” student sheets, look for them to demonstrate the understanding that plants form glucose molecules through the process of photosynthesis. Students should infer that since lettuce is a plant, the glucose molecules that the rabbit ate were made in the lettuce. Students should explain that energy from the sun was used to rearrange the atoms that make up carbon dioxide and water, forming glucose in the lettuce.

## Now what?

If students are not showing an understanding of how glucose is made through the process of photosynthesis, return to the photosynthesis diagram in the article. Project the diagram and ask students the following questions:

- Which molecules are formed during photosynthesis?  
[Glucose and oxygen.]
- What is required for photosynthesis to happen?  
[Energy, carbon dioxide, and water.]
- How many carbon atoms are in glucose?  
[Six.]
- Where did that carbon come from?  
[There are six carbon atoms in the carbon dioxide atoms, and those atoms become part of the glucose.]

Finally, have students trace the oxygen and hydrogen atoms in glucose back to the water and carbon dioxide molecules. Help students conclude that all the atoms that comprise glucose come from the atoms in carbon dioxide and water.



## Reading “How Do Trees Grow So Huge Without Eating?”

1. Read and annotate the “How Do Trees Grow So Huge Without Eating?” article.
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Now, choose and mark a question or connection, either one you already discussed or a different one that you would like to discuss with the class.
4. Answer the reflection question below.

Rate how successful you were at using Active Reading skills by responding to the following statement:

**As I read, I paid attention to my own understanding and recorded my thoughts and questions.**

- Never
- Almost never
- Sometimes
- Frequently/often
- All the time

### Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

## Second Read of “How Do Trees Grow So Huge Without Eating?”

### Part 1

Reread paragraphs 4 and 5 of the article. As you read, highlight and annotate information that helps you understand where plants get the glucose molecules they need to release energy and grow. You will use that information to help you answer the question in Part 2.

### Part 2

A rabbit eats a piece of lettuce. After its digestive system breaks down the lettuce, the rabbit is able to use glucose molecules from lettuce to release energy. Where did the glucose in the lettuce come from?

The lettuce plant made the glucose through photosynthesis. During photosynthesis, atoms that make up carbon dioxide and water rearrange to form glucose and oxygen by using energy from the sun.