

# OpenStax - Concepts of Biology – Chapter 5 – Photosynthesis

Take the next ten minutes and preview the chapter. Be sure to review the “How To” guide if you aren’t sure how to approach previewing the chapter.

## PREVIEW

**Introduction** [Take a moment to read the brief introduction. In one short sentence, summarize what is said.]

5.1 \_\_\_\_\_ [what is the title of the first section of the chapter]

**Learning Objectives.** By the end of this session, you will be able to:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

5.2 \_\_\_\_\_

**Learning Objectives.** By the end of this session, you will be able to:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

5.3 \_\_\_\_\_

**Learning Objectives.** By the end of this session, you will be able to:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

[Underline or highlight the task words in the learning objectives above.]

Take a moment to write what you know about photosynthesis and how it connects to aerobic respiration. No need to look it up, just write out what you know from memory; this isn't about being correct.

Complete the Chapter outline below and write the bolded terms in the column to the right.

5.1	Key Terms
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li>Fig 5.5</li></ul>	
<ul style="list-style-type: none"><li>Fig 5.6</li></ul>	
<ul style="list-style-type: none"><li>Fig 5.7</li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
5.2	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li>Fig 5.9</li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li>Fig 5.12</li></ul>	
<ul style="list-style-type: none"><li>Fig 5.13</li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
5.3	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li>Fig 5.14</li></ul>	
<ul style="list-style-type: none"><li>Fig 5.15</li></ul>	
<ul style="list-style-type: none"><li>Evolution in Action</li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li>Fig 5.17</li></ul>	
<ul style="list-style-type: none"><li></li></ul>	
<ul style="list-style-type: none"><li>Fig 5.18</li></ul>	

Questions [list any questions you have after the preview]

Make a Plan [this chapter is short but complex plan accordingly]

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Look at the Learning Objectives for Section 5.1. We'll be looking at these a little out of order. What should you be able to do after reading this section?



\_\_\_\_\_ the relevance of photosynthesis to other living things.

## 5.1 Introduction & Overview of Photosynthesis [in 1-2 sentences summarize the first four paragraphs (page 117-118)]

Describe the following types of organisms and give an example of each:

Autotroph:	Photoautotroph:	Heterotroph:
Example:	Example:	Example:

### Why is photosynthesis important to all living things?

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Look at the Learning Objectives for Section 5.1. We'll be looking at these a little out of order. What should you be able to do after reading this section?

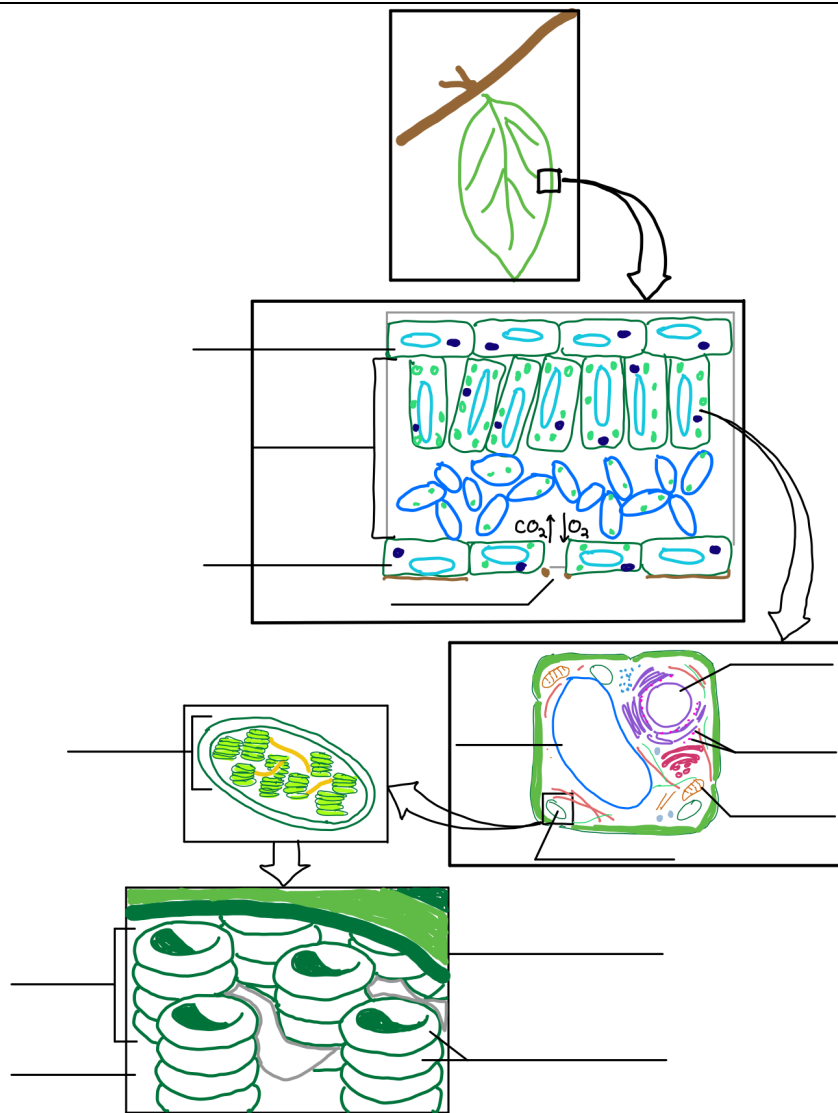
\_\_\_\_\_ the process of photosynthesis

\_\_\_\_\_ the reactants and products of photosynthesis

\_\_\_\_\_ the main structures involved in photosynthesis

Use Figures 5.5 and 5.6 to summarize the process of photosynthesis. Indicate where each component comes from.

<sup>1</sup>Label the figure below and describe each structure and its role in photosynthesis. Use Figure 5.7 as a guide.



Mesophyll:

Stomata:

Chloroplast:

Thylakoids:

Chlorophyll:

**The Two Parts of Photosynthesis.** Read the passage and summarize it below.

<sup>1</sup> Credit "Leaf" original modification of work by Cory Zanker, modified for worksheet by Kathryn M. Dye



The link to the left is to another overview of photosynthesis, Crash Course's Photosynthesis. It is a little more detailed than the earlier video, and you may find it helpful if you are finding the reactions challenging to follow.



For a much more detailed overview of the light-dependent reactions and Calvin Cycle, check out the link to the right, Khan Academy's Photosynthesis Lessons.

## 5.2 The Light-Dependent Reactions of Photosynthesis [Summarize the introduction to this section (page 122)]

### What is Light Energy? & Absorption of Light

Look at the Learning Objectives for Section 5.2. We'll be looking at these a little out of order. What should you be able to do after reading this section?

\_\_\_\_\_ how the wavelength of light affects its energy and color

Describe the electromagnetic spectrum and answer the Learning Objective:

### Understanding Pigments

Look at the Learning Objectives for Section 5.2. We'll be looking at these a little out of order. What should you be able to do after reading this section?

\_\_\_\_\_ how plants absorb energy from sunlight

What is a pigment? And how do they work?

Learn more about the major pigments involved in photosynthesis by completing the table.

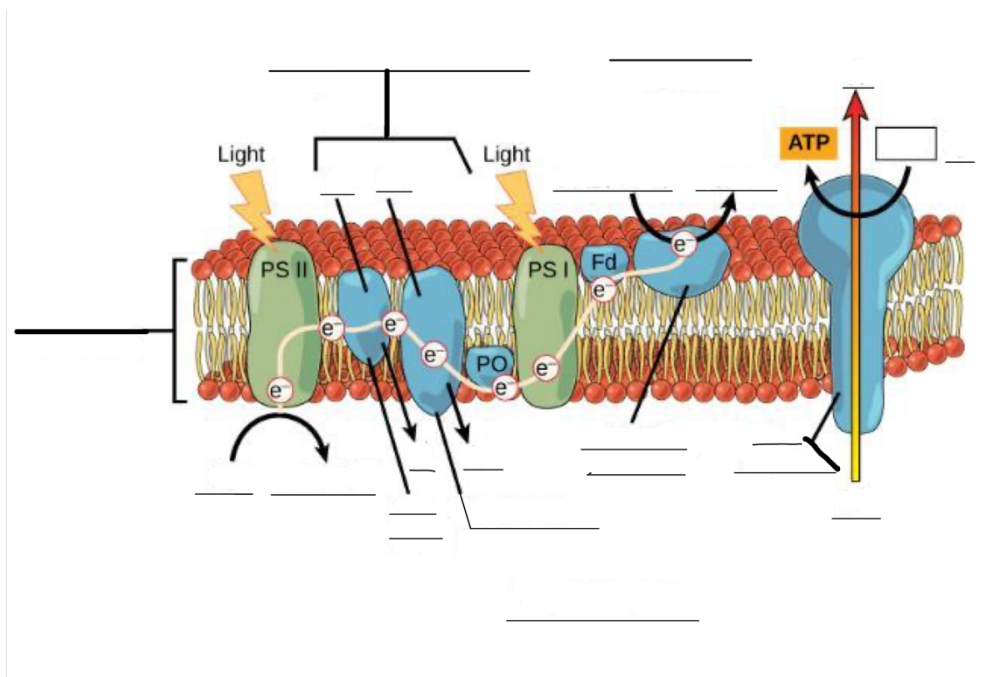
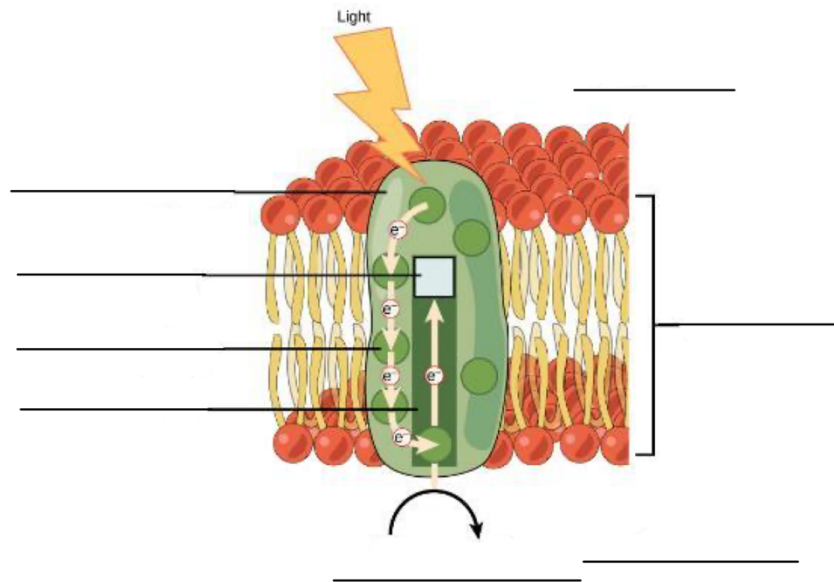
chlorophyll <i>a</i> :	chlorophyll <i>b</i> :
Explain why a plant would have more than one pigment:	

## How Light-Dependent Reactions Work

Look at the Learning Objectives for Section 5.2. What should you be able to do after reading this section?

\_\_\_\_\_ how and where photosynthesis takes place within a plant.

Label the figures below and describe what is happening step-by-step. Refer to Figures 5.12 and 5.13<sup>2</sup>.



<sup>2</sup> Credit OpenStax Concepts of Biology, Figures modified by Kathryn M. Dye

## Generating an Energy Carrier: ATP & Generating Another Energy Carrier NADPH

Read and summarize these two sections:

Compare and contrast the light-dependent reaction to the electron transport chain (chapter 4):

### 5.3 The Calvin Cycle [Summarize the introduction to this section (page 127)]

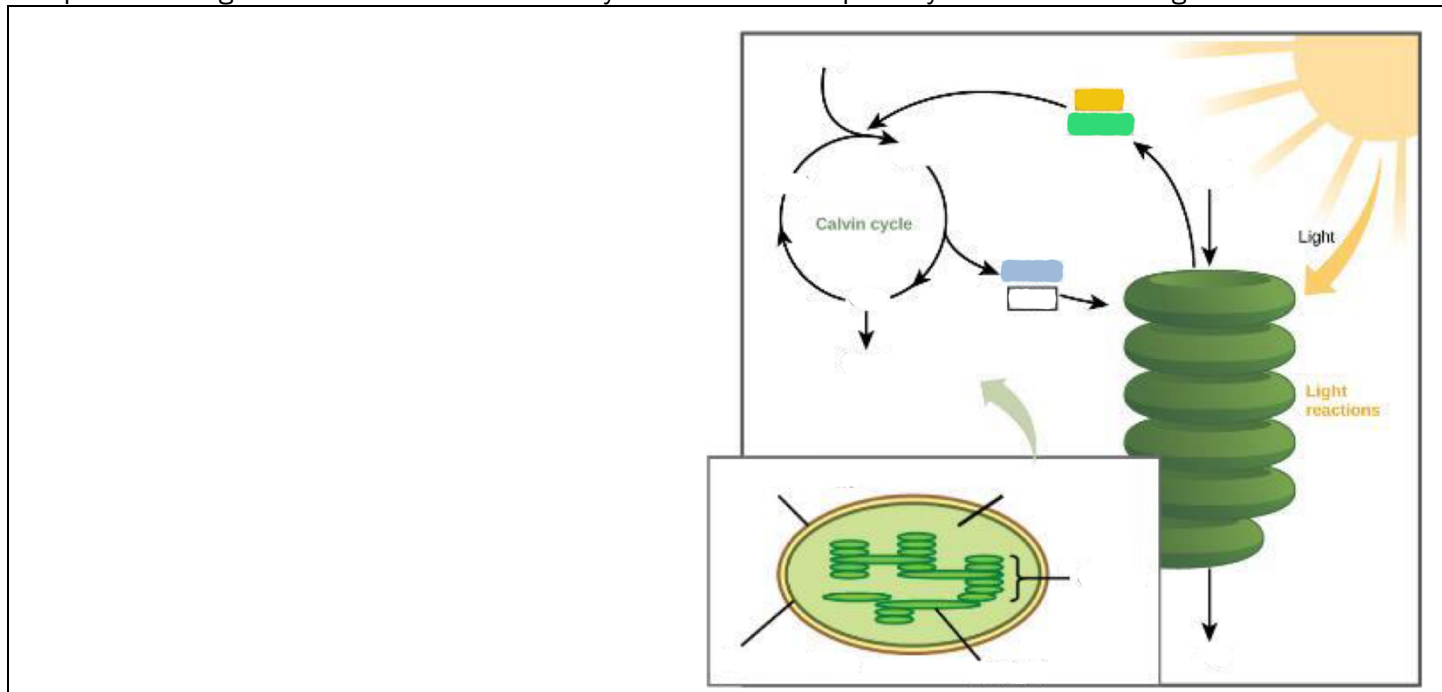
**The Interworkings of the Calvin Cycle.** Look at the Learning Objectives for Section 5.3.  
What should you be able to do after reading this section?

\_\_\_\_\_ the Calvin cycle.

Calvin Cycle  
animation →

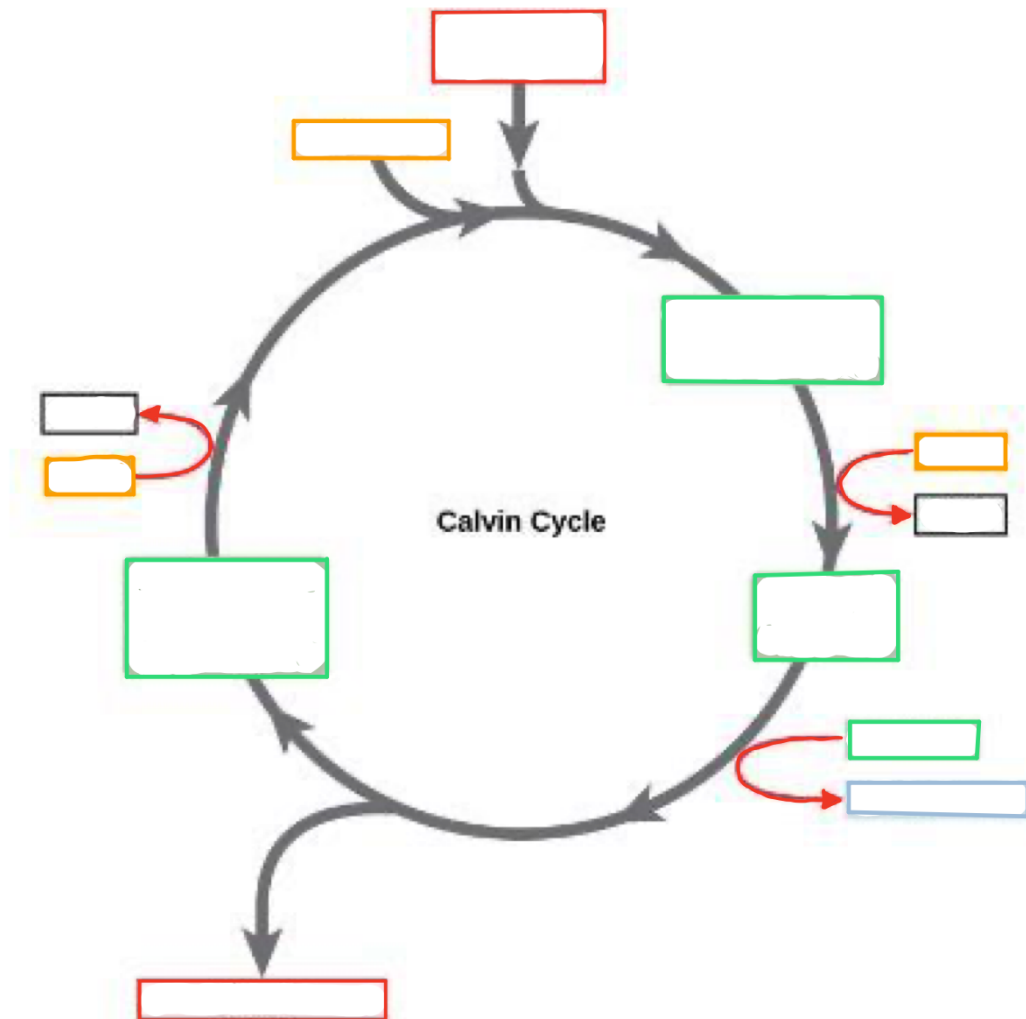


Complete the diagram and describe the Calvin Cycle as it relates to photosynthesis. Refer to Figure 5.14<sup>3</sup>.



<sup>3</sup> Credit OpenStax Concepts of Biology, Figure modified by Kathryn M. Dye

Complete the diagram and describe the Calvin Cycle step-by-step. Refer to Figure 5.14<sup>4</sup>



Look at the Learning Objectives for Section 5.3. What should you be able to do after reading this section?

\_\_\_\_\_ carbon fixation.

What is carbon fixation, and how does it relate to photosynthesis?

<sup>4</sup> Credit OpenStax Concepts of Biology, Figure modified by Kathryn M. Dye



Read the **Evolution in Action** and watch the video box and describe how photosynthesis in dry-climate plants differs.



### Photosynthesis in Prokaryotes.

Watch the video and read the section (page 129). What happened on Earth after photosynthesis evolved? How does photosynthesis in prokaryotes differ from photosynthesis in eukaryotes?

That time oxygen almost killed everything! →



**The Energy Cycle.** Look at the Learning Objectives for Section 5.3. What should you be able to do after reading this section?

\_\_\_\_\_ how photosynthesis works in the energy cycle of all living organisms.

Read the section then summarize & diagram how photosynthesis and aerobic respiration are related to each other.

**Congratulations!** You've finished chapter 5. Now take a moment and reflect on what you've learned. Look back over the activity and see if you have any questions or if there is anything you want to ask about during the next class, in office hours, or on a class discussion board. Put them in the box below.

**Reflection.** Good job, you finished the Chapter 5 reading guide for Concepts of Biology. This type of learning is often new to students and can take time to become accustomed to the amount of effort needed to learn the material.

Take a few minutes to think and write about your experience with this first chapter.

**Planning.** Students new to taking science courses often underestimate the amount of time that will be needed to prepare for class and complete the assignments. Take a few minutes and plan for the next week or so, when can you make time to do practice problems for Chapter 1? When will you be able to start working on Chapter 2? By keeping a plan, you'll find it easier to see if you're getting your work done. [See the 'How To' guide for an example.]

Complete the three retrieval activities in separate sessions as they will be most effective if spaced out. They also increase in difficulty as you go, so be sure to complete them in order and without referring to your notes. Treat this as a quiz, anything you aren't able to answer, you can look up after you finish.

### **RETRIEVAL ACTIVITY #1**

1. Define **autotroph**, **photoautotroph**, and **heterotroph**.
  
  
  
  
  
  
  
  
  
  
2. What is the formula/equation for **photosynthesis**?
  
  
  
  
  
  
  
  
  
  
3. a) In what part of the **plant** does photosynthesis occur? [HINT: think of a plant structure]
  
  
  
  
  
  
  
  
  
  
- b) In what type of **cell** does photosynthesis occur? And in what **organelle**?
  
  
  
  
  
  
  
  
  
  
4. There are **two parts** to photosynthesis, what are they? And what happens during each?
  
  
  
  
  
  
  
  
  
  
5. Describe the **relationship** between photosynthesis and aerobic cellular respiration in relation to the carbon cycle.

**Reflect and Review** Now that you've finished the first retrieval exercise, correct your work, refer to the book and your Reading Activity answers. List any of the topics you were not able to recall in the box below; these are areas you need to spend more time reviewing. This exercise focused on **direct recall of knowledge**, a good way to improve this level of information is by using flashcards with definitions, and outlines of the lists.

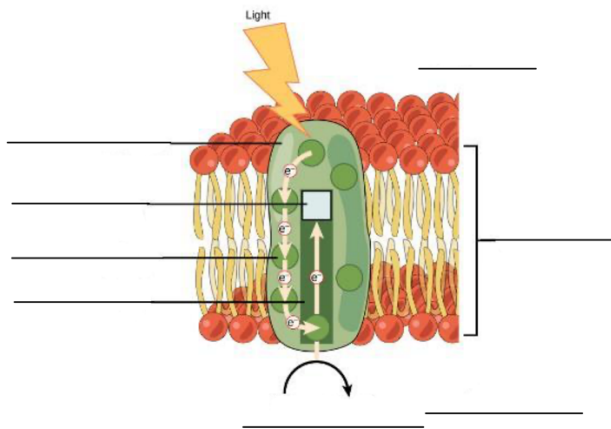
	Plan when you'll do the next exercise:
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**RETRIEVAL ACTIVITY #2** Before beginning this activity, make sure you have reviewed any of the content you had trouble with on the previous activity. This activity focuses on the next level of content knowledge: **Understanding**, which means you need to have more than just a grasp of the definitions.

1. Why do leaves appear green? Explain using what you know about wavelengths of light and the light-dependent reaction of photosynthesis.

2. There are two major pigments: chlorophyll *a* and chlorophyll *b*. Explain why a plant would have more than one pigment.

3. Label and describe the light-dependent reaction of photosynthesis, be sure to include the **products** of the light-dependent reaction:



4. Describe the Calvin Cycle and explain what carbon fixation is:

**Reflect and Review** Correct your work. If you had any difficulty with the questions above, indicate the topics you want to review in the box below. This exercise focused on your **understanding** of the chapter content. Activities you can do to improve this level of knowledge include: making concept maps, writing about the different topics in your own words without referring to your notes, creating a study guide, and finding a friend to talk about the chapter with.

	Plan when you'll do the next exercise:
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**RETRIEVAL ACTIVITY #3** Before beginning this activity, make sure you have filled any gaps in your knowledge that were revealed by the previous two retrieval activities. This activity focuses on your ability to **apply** what you have learned. An excellent way to prepare for this third activity is to pretend you are going to be teaching this chapter to a class or your study group partners. Review examples provided and try to come up with some of your own.

1. Every day you eat a variety of foods. Explain how photosynthesis supports the growth and development of all the foods you eat, both plants and animals.

2. Historically, naturalists (early scientists) hypothesized that the growth and development of new plant mass came directly from soil components. To test this hypothesis, Belgian physician Jan van Helmont carefully weighed a seedling and dry soil, which were then placed in a pot. After five years, no new soil was added, yet the seedling, which was now a tree had grown by 75 kg.

a) Does this result support the original hypothesis? Why or why not?

b) Propose an alternative hypothesis and experiment to test it.

3. Due to a complex array of economic and agricultural demands, the world's largest rainforest, the Amazon, is shrinking and may be shifting from rainforest to savannah. Use your knowledge of photosynthesis to explain the impact that the loss of those trees will have on atmospheric carbon dioxide and oxygen levels.

4. You discover a new plant and want to determine if it is a C3, C4, or CAM plant. Propose an experiment that would test the type of plant you have discovered.

**Reflect and Review** Congratulations! You have finished the last and most difficult of the retrieval exercises. Now your task is to correct your work. You may not be able to find all of the exact answers in the book or your notes. An excellent way to work through this last activity is to get together with a group from your class and discuss your answers. Explain to each other why you think your answer is correct. At the end, if you have any that you are uncertain about or have more questions, write them in the box below and bring them to class, office hours, or your campus tutoring center.

Questions you still have:

**Reflection** Think about your experience with chapter 5, are you happy with your level of understanding of the material? Have you found anything that is of particular interest to you or that you'd like to know more about?

**Make a Plan** In the box plan when you are going to work in time to start chapter 6 and continue to review previous chapters. One of the keys to success on exams is to practice regularly and to keep looking over past material. That will make studying for your exams much easier since you won't be relearning the material.

