Lab activity: dissecting owl pellets
Learning Objectives:

- Construct food web diagrams
- Illustrate how organisms in a community interact.
- Explain why removal of one organism can effect an entire community, and predict which species removal will have the greatest impact.

## Lab: Food Webs and Trophic Levels – Owl Pellets

"What's eating you?" said Pumbaa.
"Nothing, he's at the top of the food chain" said Timon in the Lion King...
"Everything you see exists together in a delicate balance. As king, you need to understand that balance and respect all the creatures, from the crawling ant to the leaping antelope" said Mufasa.
"But, Dad, don't we eat the antelope?" said Young Simba.
"Yes, Simba, but let me explain. When we die, our bodies become the grass, and the antelope eat the grass. And so we are all connected in the great Circle of Life" said Mufasa.

The circle of life, as described by the king of Pride rock, depicts how nutrients and energy are passed from one organism to the next. This unidirectional flow within an ecological system is called a **food chain**. Organisms in these feeding relationships are part of a **community**, consisting of all the organisms living together in a particular habitat. For example, a forest of trees and plants, inhabited by animals, with soil containing bacteria and fungi, constitutes a community. The complex linkages among organisms in a community comprise a **food web** which is made up of multiple **food chains**. As with a spider's web, any disruption in one strand of the web of life is felt by other portions of the web.

A common example of a food web disruption is the introduction of an invasive species. Often changing one species in a community will create a myriad of new or altered interactions within the community. For example, following the introduction of the spiny water flea (a type of zooplankton or a small aquatic animal) into the Great Lakes, there was a change in food available for fish. Because spiny water fleas will eat smaller native zooplankton, this decreases the total number of zooplankton available for small fish to feed on. Small fish cannot eat spiny water fleas because they have a long sharp tail, which causes fish to choke and spit them out. Thus, the introduction of the spiny water flea altered the amount of food available near the bottom of the food chain, which lead to changes in species populations that work their way up to the top of the food chain. Since there will be fewer small fish that can be supported by the food supply, larger fish, like walleye, will have nothing to eat and their populations will get smaller. If you enjoy fishing or eating lake fish, the introduction of this tiny invasive species should concern you.

Food webs can be divided into levels called **trophic levels**, which represent the amount of energy present. Because the bottom trophic levels have more energy and organisms than the top levels, a community's trophic structure can be represented by a pyramid. Forming the base of the pyramid, the lowest trophic level consists of the **primary producers** (plants) that form the basis of every ecosystem. Herbivores are the **primary consumers** that feed on plants and comprise the second trophic level. The third level consists of **secondary consumers**, organisms that eat primary consumers. At the top of the pyramid are the **top predators**, of which there are typically very few.

**Lab activity:**

- Let Elodea leaves photosynthesize in the light and dark and compare rates of CO2 consumption.
- Create stomatal peels from the top and bottom of Zebrina leaves.

**Learning Objectives:**

- Identify the inputs and outputs of photosynthesis.
- Compare photosynthetic rates under different conditions.
    - Understand that plants conduct photosynthesis and cellular respiration.
- Explain why it is advantageous for plants to have more stomata on the bottoms of their leaves.

# Photosynthesis Lab

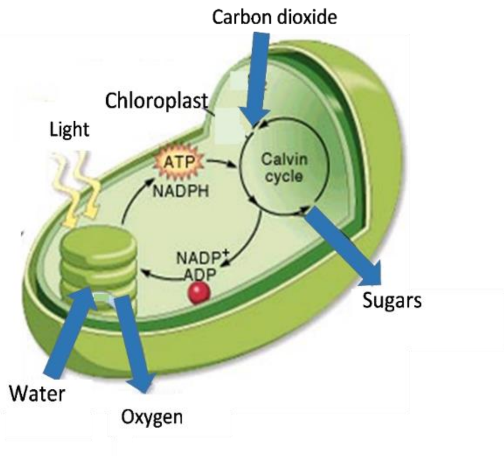
All living things require energy to survive. In humans, this energy is created through cellular respiration where oxygen and sugars are broken down to create ATP. In this case, humans can consume sugars that they use. Plants, on the other hand, do not usually take in sugars, instead they create them. Plants create sugars through **photosynthesis**. During this process, energy from sunlight is used to drive the synthesis of sugars.

Photosynthesis occurs in the **chloroplasts** of plant cells and has two parts. In the first step, the **light-dependent reactions**, the energy from light splits water molecules ($H_2O$) into oxygen and hydrogen. This process also generates a little bit of energy (ATP). This happens in the **thylakoid membrane** (the green disks in the diagram below). The next step, the **Calvin cycle**, uses the ATP from the previous step to convert carbon dioxide into sugars. This step happens inside the **stroma**, or the cytoplasm of the chloroplast.

Even though this process requires light, plants can still make sugars at night. If the plants store enough ATP in their cells, they can take in carbon dioxide and use that ATP to only go through the Calvin cycle, skipping the light-dependent reactions.

$$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$$

**carbon dioxide    water    glucose    oxygen**




Photosynthesis and cellular respiration have an important connection. To understand why, let's look at the chemical equations for these two processes.

Photosynthesis: $6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$ (requires light)
Cellular Respiration: $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$ (plants respire some at night)

The products of cellular respiration are the reactants in photosynthesis, and vice versa. Photosynthesis creates **glucose** and **oxygen**, which are then used in cellular respiration to create **carbon dioxide** and **water**. The carbon dioxide and water is used again in photosynthesis, and the process continues. Although photosynthesis and cellular respiration exist in separate organisms, the relationship between these two processes allow life as we know it to exist.