***Photosynthesis and Respiration***

**Introduction:**  All living things have some means of obtaining energy to carry out their life functions. Just being alive requires energy – energy to move, energy to grow and repair damage, energy to reproduce, and energy to maintain homeostasis. We have learned of two basic types of organisms in the world, producers and consumers (autotrophs and heterotrophs). Plants, algae, and many microorganisms are producers, while animals, fungi, and many other microorganisms are consumers. Consumers, like us, have to get food from the environment by consuming (ingesting, digesting) other organisms or the products of other organisms. Producers “produce” their own food. Plants are the most obvious examples of producers and form an important part of our (human) food consumption. Let’s think for a minute about what it means to be a producer and use plants as an example.

Plants take in carbon dioxide (CO2) from the atmosphere through their leaves and they take in water from the soil through their roots. The water travels up the roots and stems and into the leaves where it “joins with” CO2 in a complex process called ***photosynthesis*** to produce sugar. The chemical equation below summarizes this process:

*Sunlight*

**CO2 + H2O → C6H12O6 + O2**

(Sunlight is the energy source that allows this process to take place.)

So plants produce sugar. Why? Well, not to make us happy but to supply their own energy needs. Imagine the following: You go out to buy ice cream, put it your freezer so that later it will be a reward for doing your homework. While you are studying one of your siblings sneaks your ice cream and eats it. There was a note saying “sorry I ate your ice cream – will replace”. You are not happy. And when will the ice cream be replaced? To be prepared, the next day you buy more ice cream as a reward for yourself when you have finished your homework. After finishing your biology homework you rush to have ice cream. The ice cream is gone. There is another note saying “sorry I ate your ice cream – will replace”. This rude pattern continues and the ice cream is never replaced!

A friend you study with observes this process and concludes that you are a very nice person who buys ice cream so that someone else in the house can eat it. Obviously you are not very smart, are you? OK. When you suggest that plants make food so that we (animals) will have something to eat, you are saying the same thing as the study partner watching you and the thieves. Plants make food for their own needs, and we come along and steal it. In some instances, such as fruits, the plants are actually taking advantage of out “thievery” and using us to help them spread their seeds around. This is a symbiotic relationship called mutualism. Fruit is used to lure animals to carry away their seeds so that the seeds might have a better chance of finding a good place to take root and grow.

What do plants do with this sugar that they produce? The same thing that we do with it. They break down the sugar, through a process called respiration, to obtain energy for cellular activities. Respiration is essentially the reverse of photosynthesis and is summarized in the equation below:

**C6H12O6 + O2 → CO2 + H2O + *ATP/Energy***

(In respiration, energy is released in the form of a molecule called ATP.)

What is most interesting here is that photosynthesis is essentially a means of storing energy (from the sun) to be enjoyed later. While respiration is a means of releasing or using that energy to do work. Think of a wind up car. Winding up the car is analogous to photosynthesis (you are storing energy in a spring). Releasing the car so that it moves is analogous to respiration (the energy invested in the spring does ***work***: it moves the car as it unwinds).

You will now analyze two experiments from years past that attempted to study the process of photosynthesis and respiration.

The first experiment took 5 years to complete. This is the famous “von Helmont’s Willow Experiment” where he tries to determine where does the mass of a tree originate?

The second experiment is an analysis of confined mice, temperature, carbon dioxide and how they relate to each other.

Thanks to the following:

M. Gatton, Professional Performing Arts School, New York, NY

Adapted from: Lisa Weise, The American Biology Teacher, Vol. 68 No. 5, May 2006

An introduction to the photosynthetic and respiration process.

Plus, thanks to my six housemates whom stole my ice cream at UCSC.