FOLLOWING THE ENERGY

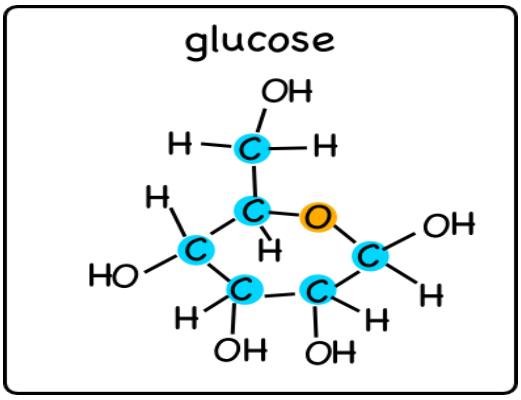
As an exercise to transition from ecology to biochemistry in Biology class, I had students follow the energy from the Sun to humans via potatoes. After all, we've been putting together food webs, following energy through the food chain, and now I want to start talking about the short and long chained biochemical molecules like glucose and starch, at least at a general level.

Leaves in the forest canopy capturing sunlight. Photosynthesis in action. Because of all the captured (and reflected) sunlight the floor of the forest beneath the canopy is dark with very little undergrowth. Note: these are not potato trees, potatoes tend to grow under the ground, and potato plants are short, bushy herbs.

So, we start with **photosynthesis**. The leaves of the potato plant capture sunlight and combine water and carbon dioxide to produce **glucose** with oxygen as a by-product.

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

This reaction takes *radiative energy* from the Sun, and stores it as *chemical energy* in the bonds of the glucose molecule.

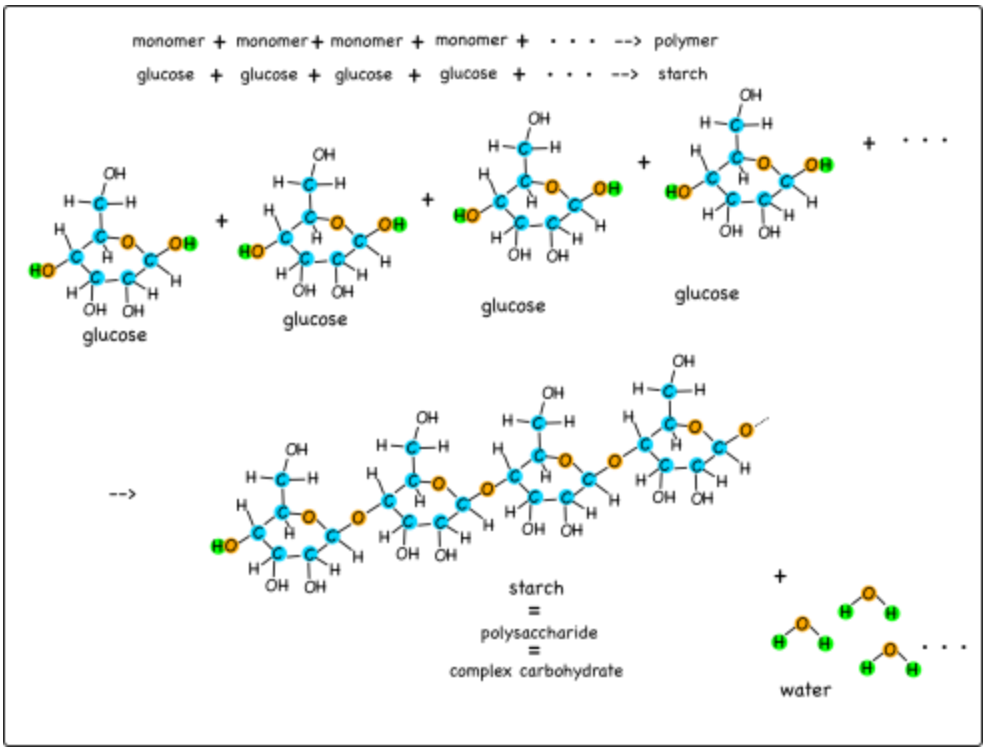


A glucose molecule that stores the energy from photosynthesis. The carbon and oxygen atoms in the ring are highlighted.

Glucose is a simple sugar, one of the basic *carbohydrate* molecules (my bio class has not done the testing for carbohydrates yet, but we will soon). Simple carbohydrates are *monomers* that can be chained together to produce more complex molecules.

Sizable packets of solar energy stored in the chemical bonds of the carbs.

The potato plant chains together a series of glucose molecules it produces by photosynthesis into long chained *polymers* called *starches*. Starches are good for long-term storage of the energy because, for one thing, they don't dissolve in water the way glucose does. (A good metaphor for this might be to have students carry a handful of beads to represent a bunch of glucose molecules versus carrying a string of beads to represent the starch).



Starch molecules form by chaining together glucose molecules. Water is a byproduct.

The large stash of energy consolidated into the starch is an inviting target for animals like humans. We eat things like potatoes to get the starches, only we usually refer to them by their other name, **carbs**. Carbs are short for *complex carbohydrates*: since glucose is a simple carbohydrate, a chain of glucoses is called a complex carbohydrate. This is why people on low-carb diets try to avoid foods like potatoes.

For those of us who do eat potatoes, however, we need to break the starches down into their constituent glucose molecules to get the energy. When we eat potatoes, we chew (*masticate*) them to break down the cell walls and expose the starches to the *enzymes*, like amylase in our *saliva*, that breaks apart the long carbohydrate chains into simple glucose molecules. Enzymes, like amylase, are catalysts.

Catalysts are substances that accelerate a chemical reaction, but are not used up in the process.

The body extracts these glucose molecules from the digested food in the *small intestines*. The glucose is absorbed through the small, finger-like, *capillary*-filled *villi* that line the small intestines, and gets into the *blood plasma*.

The *circulatory system* transports the glucose in the plasma to cells throughout the body.

Cells use the glucose for energy by reversing the photosynthesis reaction, in a reaction called **respiration**:

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

So the cells use respiration to liberate the energy the potato plant captured from the Sun.

Source: http://montessorimuddle.org/2013/11/11/following-the-energy/