Activity 5.3: More about Chemical Energy

What is chemical energy? Every atom has a small nucleus, made of protons and neutrons, and *electrons* that circulate outside the nucleus. Electrons are like other particles because they move naturally toward low-energy places or states close to the nucleus, like balls that roll downhill.

Molecules and chemical energy exist because many atoms have either too many or too few electrons. Carbon and hydrogen have extra electrons; they could be more stable if they could get rid of or share some of their extra electrons. Oxygen, on the other hand, does not have enough electrons; oxygen atoms would be more stable if they could add some electrons.

Chemical bonds and molecules. Molecules exist because electrons can move to other atoms. When carbon and hydrogen share electrons, the shared extra electrons can move to lower-energy states. Oxygen atoms can also become more stable by gaining electrons to "fill their gaps." Atoms that share electrons stay close together, so those shared electrons are the *chemical bonds* that keep atoms together in molecules.

High-energy and low-energy bonds. Carbon and hydrogen atoms can lose a little energy (like a ball rolling a little way downhill) if they share electrons with other carbon and hydrogen atoms. But they still have their basic problem—extra electrons—so we say that C-C and C-H bonds are relatively weak *high-energy bonds*.

BUT if carbon and hydrogen atoms can give their extra electrons to oxygen atoms (remember oxygen atoms have too few electrons), then they can lose a lot more energy (like a ball rolling farther downhill). So we say that C-O and H-O bonds are stronger *low energy bonds.*

Keeping track of chemical energy. There are several methods of keeping track of how much energy is transformed during a chemical reaction. Chemists can make accurate calculations of the amount of energy by using Hess's Law. In this unit we won't try to be that accurate, though. Instead, we will be sure to notice whenever carbon atoms have *high-energy bonds that could be replaced by low-energy bonds.* We will use twist ties to identify high-energy C-C and C-H bonds. Those bonds have extra electrons that could lower their energy by getting close to oxygen atoms. If that actually happens—if the electrons move from C-C or C-H bonds to C-O or H-O bonds—then we can use the twist ties to remind us that energy was released in the process, and changed into some other form of energy such as heat, light, or motion.