Understanding the arrangement of atoms within nutrient molecules often helps explain their chemical behavior, health attributes and role in weight balance. Although atomic representations do not accurately represent electron configurations, they can be used to show the arrangement of nuclei and bond type. In the following activities, you'll construct several different molecular models that represent substances that play an essential role in our nutritional needs.

**A. Carbohydrates**
Carbohydrates are a group of nutrients that include sugars and starches. Perhaps, the most familiar carbohydrate building block is glucose. **Glucose** is a monosaccharide, which means that it contains one sugar unit. Monosaccharides can be joined together to produce larger chains of carbohydrates. Starch is an example of a long chain of sugar molecules that are linked together. In this set of activities, you'll construct a single sugar (glucose) and observe the effects of a dehydration synthesis reaction.

**Glucose Model**

1. Examine the study of gumdrops that you will be using to assemble your molecular models. Now, consider the formula of glucose, $C_6H_{12}O_6$. Based on this formula, how should you assign specific colors to the component atoms? (The most common color should be assigned to hydrogen, since hydrogen atoms are the most numerous.)

2. To build the ring version of glucose, let's construct a closed ring formed by five carbon atoms and one oxygen atom.

3. Now, let's add the sixth carbon atom. It is attached to the ring carbon that is immediately to the left of the oxygen atom.
4. The remaining five oxygen atoms are part of hydroxyl (OH) groups. They are added as shown here.

5. Finish the model by adding the remaining seven hydrogen atoms so that each carbon atom forms four bonds. Draw a simple diagram of glucose in your notebook, with color-coded elements.

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Modeling Dehydration Synthesis
To produce larger carbohydrate molecules, glucose is linked to other sugar molecules. During this bonding process, two atoms of hydrogen and one atom of oxygen are removed from the linking sugars. These atoms join together to produce a molecule of water. Hence, this type of sugar bonding is called dehydration synthesis.

1. Construct a second model of the glucose model.
2. Place both models side-by-side. Remove the two hydrogen atoms and one oxygen atom that are associated with dehydration synthesis (identified by the dashed line).

3. Join the free bond of the ring oxygen atom to the free bond of the carbon atom. Join the three removed atoms together to form a molecule of water.

Carbohydrate Questions
1. What are the three major elements found in every carbohydrate?
2. What functions do carbohydrates serve in living organisms?
3. Four important carbohydrates are starch, glycogen, chitin, and cellulose. Describe their roles in the organisms in which they are found.
4. How is glucose related to carbohydrates?
5. What type of molecule is removed during dehydration synthesis?
6. What might happen if you added water to a starch molecule?
B. Proteins

Proteins are macromolecules that are found in every living cell. Like carbohydrates, they form a critical part of our diet. They are also the profiled nutrient in the Atkins diet. The basic building block of a protein molecule is an amino acid. All amino acids have the following parts:

- Amine (NH$_2$) group
- Carboxyl (COOH) group
- “R” group (different for each of the 20 amino acids)

Amino Acid Model

1. Glycine is the simplest structural amino acid. Like all amino acids, it has an amine (NH$_2$) group. Use gumdrops to construct this functional group.

2. Like all amino acids, glycine also has a carboxyl (COOH) group. Use gumdrops to construct this functional group. Remember to retain consistency in your assignment of gumdrop colors.

3. The amine and acid group are both attached to a central carbon atom. The remaining two bonds of this backbone carbon are saturated with hydrogen. Your finished glycine model should resemble this image. Draw a simple diagram of this amino acid in your notebook, with color-coded elements.

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Protein Questions
1. What major elements are found in every amino acid?
2. What functions do proteins serve in living organisms?
3. How are amino acids related to proteins? Also discuss 3-D protein structure from pg. 170.
4. From what you can observe in the molecular structure, can dehydration synthesis also produce long chains of amino acids? Explain.
C. Lipids (Saturated and Unsaturated Fats)
Although you may not know what they are, chances are you've heard of saturated and unsaturated fats. Fats are long molecules that can have more than 20 carbon atoms in their backbone. A saturated fat has only single bonds in its carbon backbone. An unsaturated fat has one or more double bonds.

1. Construct a chain of four carbon atoms.
2. Add two hydrogen atoms to each carbon atom. Place a toothpick at both ends of the chain to represent the bond that connects this section to the rest of the fat molecule.
3. Now construct a version of this carbon backbone that contains an unsaturated carbon.
4. Draw and label of sketch of both types of fats in your notebook.

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Questions

1. What major elements are found in every lipid?
2. What functions do lipids serve in living organisms?
3. When saturated, to how many different atoms can a carbon bond?
4. What must be added to an unsaturated chain, in order to make it saturated?
5. Infer the structural feature of a "polyunsaturated fat."
6. Describe the structure of a “phospholipid.”