Building Proteins using Blocks

Objective: Students will build a small protein using Duplo™ or Lego® blocks, simulating secondary protein structure.

Using the amino acid sequence created by the previous activity, students will create a protein with Duplo or Lego blocks.

Teacher notes: Duplo blocks work best for this activity, but Legos will also work.

The model that results from this activity is very simplistic, but shows the three-dimensional structure of proteins. Depending on the level of the students, the exact chemical properties of the amino acids may be discussed (hydrophobic and hydrophilic, polar and nonpolar).

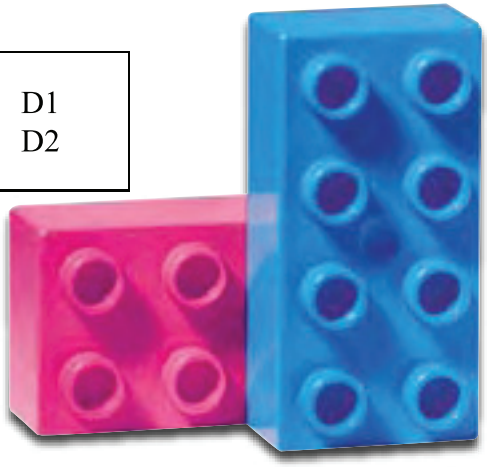
Because amino acids are rigidly bonded between certain parts of the amino acid itself, there is some freedom of movement among the rest of the molecule. This results in the three-dimensional structure of proteins, also called secondary structure. Secondary structures are repetitive patterns found in proteins and usually give a clue about the function of the protein. In this activity, students are making alpha-helix structures which are rod-like shapes around a rotational axis.

Materials: Each student will need several Duplos 4 x 2 or 3 x 2, or Legos either 4 x 2 or 3 x 2.

Procedure: Students will build a protein by linking the blocks in the following way:

A1	B1	C1	D1
A2	B2	C2	D2

A1	B1	C1
A2	B2	C2



Connect the first block to the second by placing A1 on top of D2, making a V-shape. This allows the block to swing freely. Continue adding new blocks in this fashion until all 7 are connected. This model will be very unstable. If students have problems holding the pieces together while trying to build, the same effect can be achieved (without the swinging motion) by connecting the second block securely on top of the first A1, B1 and A2, B2, on the upper block to C1, D1 and C2, D2 on the lower block. Continue adding blocks in this way, turning each at right angles until a tower that rotates around a center axis is formed. This model will be more stable.

Another structure of proteins is the beta sheet. This is a grid-like structure that is held together in a more linear fashion. Students could create a grid by hooking A1, A2, and B1, B2 to C1, C2, and D1, D2 in a horizontal direction, then at a direction from an amino acid in the sequence (proline, for example), the horizontal would turn 90 degrees to the left to form a right angle, then with another proline, 90 degrees to the left again to begin a horizontal in the opposite direction. (Serine turns right for the other end.) Students would complete the protein following this back-and-forth pattern, depending on the number of amino acids in the protein.

ANSWER KEY
What do you know?
1. B 2. E 3. B 4. D 5. D 6. C

Evaluate these statements:

"…biotechnology techniques have the potential to be useful in enhancing the quality, nutritional value, and variety of food available for human consumption and in increasing the efficiency of food production, food processing, food distribution and waste management."
The American Dietetic Association

"Responsible biotechnology is not the enemy; starvation is. Without adequate food supplies at affordable prices, we cannot expect world health or peace."
Jimmy Carter, former President of the U.S.

"As we have evaluated the results of the seeds or crops created using biotechnology techniques, we have seen no evidence that the bioengineered foods now on the market pose any human health concerns or that they are in any way less safe than crops produced through traditional breeding."
Dr. Jane Henney, Commissioner of the U.S. Food and Drug Administration

"Food dictators won't feed the world—they are part of the problem."
Greenpeace: World Food Summit