Teaching Science with Toys and Telephones

When you want to explain abstract concepts, a physical model or demonstration can often be worth thousands of words. The demonstrations need not be elaborate; sometimes, even conjuring up a familiar mental image can clarify a difficult concept. Toys and common household appliances make great demonstration tools. Here are a few of my favorites:

1. Biological molecules are constructed of monomers (single units), which are chemically joined to form polymers (many units). This single concept is true of a variety of different types of molecules: nucleotides are joined together to form nucleic acids, and amino acids are joined together to form proteins.

The order of these monomers determines the type of nucleic acid or protein that is formed. The different chains, as represented by their chemical formulas, can look overwhelmingly similar to students. But when you demonstrate them with giant, brightly colored snap-lock beads, the concept becomes clear. Different colored beads are easily distinguishable and can represent different types of nucleotides or amino acids.

2. Proteins are chains of amino acids (polypeptides) that are folded precisely; the final folding of the structure is essential for it to function properly. There are four "levels" of protein folding, referred to as primary, secondary, tertiary, and quaternary structure.

Using props dramatically simplifies the explanation of protein structure. Imagine: Primary structure is represented as our chain of snap-lock beads. Students can then easily make the transition to viewing a straight phone cord (the kind that connects the wall to the phone) as a chain of several hundred amino acids. Secondary structure is then presented as a curling phone cord (that connects the phone to the mouthpiece). It is easy to demonstrate, by stretching and releasing the cord, how secondary structure can "compress" the polypeptide chain.

Next, to demonstrate tertiary structure, I simply fold regions of the phone cord that are far apart and clip them together. A few strategic folds turn the phone cord into a little ball that sits in my hand. I then demonstrate quaternary structure by taking two or more phone cord "balls" of different colors and joining them together.

3. Sometimes a mental image works as well as a physical demonstration. For example, nerve cells transmit electrical impulses to other cells. After each impulse, the cell has a "refractory period," in which it cannot send another impulse. Comparison with a toilet, which has a refractory period after being flushed, usually

brings a laugh and cements this concept in place. In summary, using toys and everyday objects to illustrate complex ideas makes those concepts more tangible, and therefore more accessible, to students. You can put flowers in food coloring to illustrate capillary action, toss tennis balls around the classroom to mimic the random jumps of an excited electron in a photosystem, and compare cleaning out refrigerators to explain the functioning of a kidney.

Everyday examples provide the students with a break from the fast pace of demanding content, and allow them to visualize or manipulate the concepts in a different way, which, in turn, promotes more effective learning.

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