3-D Molecular Designs
. . . where molecules become real ™

Amino Acid Starter Kit

Additional Activities

There are many variations to the basic mini toober folding exercise described in Student Handout 1. Examples of variations are described below.

Reversible Denaturation

Many proteins undergo reversible denaturation, by re-folding into their original shape (native structure) following their complete unfolding (denaturation) by heating.

1. Have each student document the native shape of their folded protein with a digital photo.
2. Ask the students to unfold their protein and then re-fold it.
3. Check the refolded protein against the photo of the native structure.

Reverse Engineering

Some students will randomly generate a sequence of side chains that is very difficult to fold into a shape that simultaneously satisfies all the 4 principles of chemistry. This is a good teaching moment in that the teacher can use these examples to emphasize that such proteins would not be selected from the enormous pool of possible protein sequences.

How can students arrive at a perfectly optimized sequence of amino acids that have been selected over evolutionary time to always fold into the same globular shape? *They can reverse engineer the sequence.*

1. Have each group of students fold their toober into a compact globular shape without any side chains.
2. Have each group of students then add the side chains to the pre-folded toober, positioning them such that all of the "laws of chemistry" are satisfied in the folded structure.
3. Unfold the toober and document the sequence of amino acids.
4. Have the students then re-fold the sequence into the original shape (see reversible denaturation, above).

The Effects of Mutations

Some mutations inactivate a protein by destabilizing its native shape.

1. Starting with the "reverse engineered" sequence of amino acids as described above, mutate one of the hydrophobic amino acids (yellow side chain) to a positively charged amino acid (blue side chain).

Share your variations. Let us know what other variations you use with your students.

For more information go to: *cbm.msoe.edu/teachRes/library/index.html*.
You may also like to consider attending a MSOE Center for BioMolecular Modeling workshop: *cbm.msoe.edu/teacherWorkshops.php*.