Visualizing Biopolymers and Their Building Blocks Lesson Plan

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Lesson Goals:

1. To improve students' understanding of the molecular structure of biopolymers and their building blocks.

2. To improve retention of molecular knowledge by providing problem solving opportunities in a unit dominated by rote memorization.

Prior knowledge required:

- Cells make a huge number of large molecules called polymers from a limited set of small molecules called monomers. When the monomers are identical, as with starch, we call it a homo-polymer. If there are two or more different monomer types, as with proteins, it is a hetero-polymer.

- Polymers are formed in a condensation reaction (dehydration synthesis) in which two monomers lose a water molecule and are joined covalently. Hydrolysis, the opposite of dehydration synthesis, is when the covalent bonds linking two monomers in the polymer are broken and water is gained.

- Biopolymers fall into four distinct classes: proteins, nucleic acids, lipids, and carbohydrates, which are made up of amino acids, nucleosides, fatty acids and monosaccharides.

Materials:

- A computer with VMD installed and an LCD projector for the instructor.

- A computer with VMD installed for each student group.

- Student handout

- Molecule files:

  a. Carbohydrates: glucose.pdb, fructose.pdb, sucrose.pdb, starch.pdb

  b. Lipids: palmitic.pdb, oleic.pdb, glycerol.pdb, popc.pdb, cholesterol.pdb

  c. Nucleic Acids: thymine.pdb, uracil.pdb, adenosine.pdb, dna.pdb

  d. Proteins: glycine.pdb, dipeptide.pdb, helix.pdb, betasheet.pdb

Protocol:

1-2 Days before

Prepare students for the activity by going over relevant terms and concepts in the "Prior Knowledge Required" section above.

Day 1

Lead students through the "Loading a Molecule in VMD" section of the handout using a molecule of your choice. Take the time to remind students of the CPK coloring conventions and to teach them the shortcuts for basic molecule manipulations in VMD. Lead the class through the first question in the chosen section ("Carbohydrates" if it is done in order). Students can complete the rest of the activity on their own or in groups of 2-3.

Days 2 - 4

Begin class by a brief refresher on how to load and manipulate molecules in VMD. Lead the class through the first question in the subsequent section. Students should finish one section each class period.

Note to the instructor:

One or more sections can be skipped if there is limited time. Each section requires one full class period. Ball and stick models are a very useful augmentation to these activities if they are available.

Grading/assessment:

If students work in teams, 12 points are given for teamwork and 22 points are equally divided among the questions in each section. If students work individually, 25 points are given per section. The extra credit in the "Lipids" section is worth is 5-10 points.