**3D Carbon Compound Model Project**

*Project Due Date:* Friday, December 1, 2017

**Objective:** Create a detailed 3-dimensional molecular model of one of the four carbon compounds (carbohydrate, lipid, protein, or nucleic acid) with accompanying key.

**This project will count as a MAJOR grade of 100pts.**

**Polymer --- Monomer structure:**
monomers (nucleotides, amino acids, monosaccharides, etc) should be described or explained so the observer will better understand the polymer structure of larger molecules (DNA, RNA, Proteins, starch, cellulose, etc). Labels do not have to be in your model but you must explain/show it on your key.

Molecule examples (ideas):

**Nucleic Acid:** DNA, RNA; **Carbohydrates:** Glucose, Fructose, Sucrose, Lactose, α glucose “starch”, β glucose “cellulose”, glycogen; **Protein:** (quaternary) hemoglobin, collagen; **Lipid:** Saturated vs Unsaturated, Ω3 “omega 3” (gamma-linolenic acid), phospholipid, cholesterol, steroids

**Bond angles:**
The more detailed the model, the more points that will be awarded. For example, in a starch molecule, the glucose molecules shown as a simple hexagon will receive fewer points than the glucose molecules that show the C, H and O atoms in proper arrangement with proper bond angles. This is will truly make the models 3D.

**The model must be scientifically accurate.**

**Materials:** *(PREMADE KITS/MODELS WILL NOT BE ACCEPTED)*

*Do not feel you have to buy Styrofoam balls* to represent your atoms. Small pompoms work very well with pipe cleaners or toothpicks and are cheaper. Hot glue is essential.

Be creative. Some of the best “Meta” extra credit comes from using unique materials for the models.

**Possible Extra Credit (2 points: must be done on level 2 and higher molecules)**

Meta- *(from Greek: μετά = "after", "beyond", "with", "adjacent", "self"), is a prefix used in English (and other Greek-owing languages) to indicate a concept which is an abstraction from another concept, used to complete or add to the latter.

Ex: metacognition – thinking about thought

Show a “Meta” understanding of the purpose of the molecule. For example if the purpose of a molecule was responsible for humans being able to smell, then materials that have a scent could be used to make the molecule.

**DO NOT** use anything in the model that will decompose or rot quickly. **No models will be accepted that are made of any kind of food (this includes uncooked pasta).** This is done to keep the pest population in the school at a minimum.
**Rubric:** (Point values will vary based on level of model completed)

<table>
<thead>
<tr>
<th>Level of Project</th>
<th>Carbohydrate</th>
<th>Lipid</th>
<th>Protein</th>
<th>Nucleic Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
<td>Create a poster that is 11”x17”. The poster must include diagrams of all 4 carbon compounds. For the 4 carbon compounds, give diagrams and examples of the molecules that can be found in a cell and diagrams and examples of the molecules found at the organismal level. For carbohydrates, proteins and nucleic acids name the monomer and polymer structures. For lipids compare and contrast saturated and unsaturated fats. Also, draw and label the molecular structure of a phospholipid.</td>
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<tr>
<td><strong>Level 2</strong> (Simple molecule or Monomer)</td>
<td>monosaccharide</td>
<td>Simple hydrocarbon chain with at least 6 carbon atoms</td>
<td>1 amino acid modeled to the atomic level. Must be one of the 20 amino acids with a complete R group.</td>
<td>A single cysteine, thymine or uracil nucleotide modeled at the atomic level.</td>
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<tr>
<td>Maximum grade of 80, Must include the poster from Level 1</td>
<td>Disaccharide OR Simple polysaccharide (starch, cellulose, glycogen) No more than 3 complete monosaccharides are included</td>
<td>A single steroid molecule (testosterone, estrogen, cholesterol, etc) OR Build a saturated and an unsaturated model (at least 6 carbons each) to show differences, and explain how the bonding affects the shapes</td>
<td>3 complete amino acids at the atomic level connected in a polypeptide chain.</td>
<td>A single adenine or guanine nucleotide modeled at the atomic level</td>
</tr>
<tr>
<td><strong>Level 3</strong> (Dimer or Trimer)</td>
<td>Plant starch: a 6 glucose plant starch (ex: cellulose, amalose [starch], etc) OR Animal starch: show at least 1 proper branching of 6 glucose molecules in one glycogen molecule and explain the molecules purpose</td>
<td>Phospholipid showing all atoms/elements in head with two lipid tails containing carbon chains of at least 10 carbons OR Triglyceride (hydrocarbon chains with at least 10 carbons in each backbone) OR Using many simplified (ask instructor for a demo) phospholipid models, show and explain how &amp; why membranes are arranged in a bilayer</td>
<td>Build a model that shows the quaternary structure of a protein (hemoglobin, collagen molecules that make up hair, etc). Use a macro representation of an amino acid (ex: 1 pony bead as an amino acid) OR Using level 3 model, show the dehydration synthesis addition of at least one amino acid to a peptide chain (Must show at least 5 amino acids in dehydration synthesis, some connected and one or two in the process of being joined)</td>
<td>Build an atomic level model of at least 3 base pairs in proper DNA arrangement. Must show at least one of each nucleotide (A, T, G and C.)</td>
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<td>Maximum grade of 90, Must include a the poster from Level 1</td>
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<td><strong>Level 4</strong> (Polymer)</td>
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<td>Maximum of 100 Must include the poster from Level 1</td>
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</table>
Key/Poster: (max of 70 points) – must include both steps below

1) Create a presentable piece of documentation that explains and describes all 4 of the molecules’ functions. If the model rubric calls for labels or descriptions, place it here.

Create a poster that is 11”x17”. The poster must include diagrams of all 4 carbon compounds. For the 4 carbon compounds, give diagrams and examples of the molecules that can be found in a cell and diagrams and examples of the molecules found at the organismal level.

For carbohydrates, proteins and nucleic acids name the monomer and polymer structures. For lipids compare and contrast saturated and unsaturated fats. Also, draw and label the molecular structure of a phospholipid.

2) The documentation should include:
   a. A key for your level 2, 3 or 4 model if applicable.
   b. Printed or drawn diagrams of all of the biomolecules.
   c. A explanation of the purpose the molecule serves in biological systems.

3) Include on your documentation the descriptions and biological purposes of the other 3 carbon compounds, for which you DID NOT create a model.

The overall grade will be a combination of...
   1) At least the poster. (Everyone must do the poster)
   2) The model grade if you choose to do one (If you want a grade above 70, you have to make a level 2, 3 or 4 model to be included with your poster.)

Instructor has final say as to the grade value of all projects. You may have attempted a level 2, 3 or 4 project, but this DOES NOT guarantee that you will receive maximum points for that model level.

Please try to keep your model a reasonable size. I prefer the models not be larger than a 2ft x 2ft x 2ft space. There are over 150 students that will be turning this project in to the instructor. Also, do not make it so small that the instructor cannot see the required content.

If you are making a complex model make sure all of the pieces are very well attached to each other. DO NOT just rely on the model staying together by pressure against the materials. Gluing the pieces together will ensure that the model does not fall apart during transport to the classroom.

Another good idea is to attach the model to some display board/box. This will help moving the project around the classroom during grading.

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