School Name _____

Student #1 _____
Student #2 _____
Student #3 _____

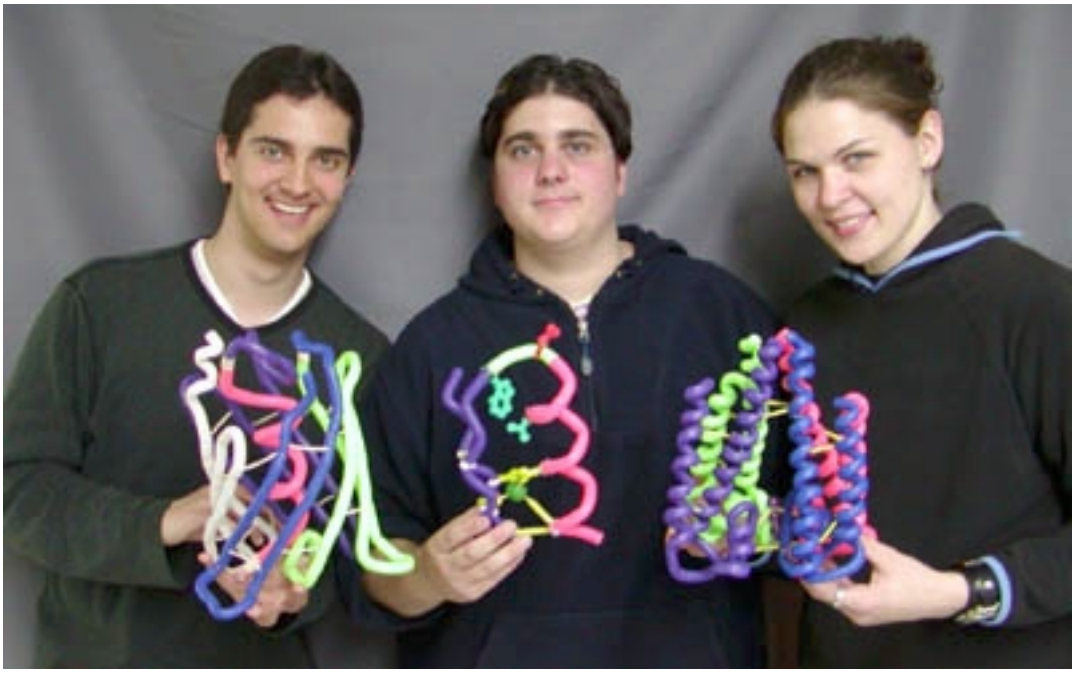
Center for BioMolecular Modeling
...where teachers come first.

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

Wisconsin Science Olympiad

Wisconsin Science Olympiad
State Competition
2 April 2005

Protein Modeling Event



This event is co-sponsored by the **MSOE Center for BioMolecular Modeling** (CBM) and **3D Molecular Designs**. To learn more about the science education programs of the CBM, or the innovative products of 3D Molecular Designs, visit the following web sites:

www.rpc.msoe.edu/cbm

www.3dmoleculardesigns.com

Center for BioMolecular Modeling
...where teachers come first.

Wisconsin Science Olympiad
State Competition

Protein Modeling Event

Part I: Potassium Channel

Potassium channel is to be impounded at 9am the morning of the competition and then scored. This will be 40% of your final score.

Center for BioMolecular Modeling

...where teachers come first.

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

Wisconsin Science Olympiad

Wisconsin Science Olympiad State Competition

Protein Modeling Event

Part II: On-Site Modeling Challenge

Materials Provided at each workstation:

- 49.5 inch yellow toober
- 5 crosslinkers
- 4 plaster amino acid sidechains
- 1 Blue End Cap
- 1 Red End Cap
- 1 meter stick
- 1 marker
- Folder on computer labeled "Protein Modeling" which has RasMol and the pdb file
- 3-ring binder with Molecule of the Month, abstract and structure summary pages
- RasMol Quick Reference Card

Instructions:

1. Using the 49.5 in yellow toober provided, construct a model of **chain B** of the pdb file **1HSA**.

   The **scale** should be **½ inch per amino acid**. A meter stick has been provided for you. **Please note** that at this scale, the precise folding of secondary structures will not be possible (for example, the "crimping" associated with beta sheets will not be possible) and therefore, will not be scored.

2. Your toober model of Chain B of 1HSA.pdb should include the following:

   (A) two **Tryptophan** (Trp) sidechains

   (B) the two amino acid sidechains involved in the **disulfide bond** within Chain B

   (C) the Blue End Cap, indicating the **amino terminus** (N-terminal end) of Chain B

   (D) the Red End Cap, indicating the **carboxy terminus** (C-terminal end) of Chain B

Center for BioMolecular Modeling
...where teachers come first.

Wisconsin Science Olympiad State Competition

Protein Modeling Event

Part III: On-Site Test Questions
(15 questions x 2 pts. Each)

School Name _____

Student #1 _____
Student #2 _____
Student #3 _____

Directions:
There are 15 questions in this section, each worth 2 points. Clearly print the letter of the one BEST answer to each question in the blank provided for that question. Illegibly answers will be incorrect.

_____1. What role do the MHC molecules play in our bodies?
A. They recognize viruses and immediately destroy them.
B. They display peptide fragments so the immune system can see them.
C. They form a barrier to block antigens from getting into the blood.
D. They provide the energy for antibodies to destroy antigens.

_____2. When was the pdb file 1HSA released to the public?
A. 11-AUG-92
B. 15-OCT-92
C. 21-SEP-91
D. 19-NOV-90

_____3. What is the major difference between the Class I and Class II MHC molecules?
A. Class I MHC molecules are found tethered to cell surfaces and Class II MHC molecules are not.
B. Class II MHC molecules have a pocket that displays small peptides and Class I MHC molecules do not.
C. Class I MHC molecules are found on all types of cells and Class II MHC molecules are only found on specialized antigen-presenting cells.
D. Class I MHC molecules have two chains that cross the cell membrane and bind them and Class II MHC molecules have only one chain that crosses cell membranes and bind them.

_____4. Human MHC molecules are often named
A. interferons
B. platelets
C. human leucocyte antigens
D. phagocytes

_____5. What is the resolution at which the HMC molecule was solved in pdb file 1HSA?
A. 1.20 angstroms
B. 3.05 millimeters
C. 2.65 microns
D. 2.10 angstroms

_____6. What is chain B in the 1HSA pdb file?
A. HLA
B. beta 2-microglobulin
C. model peptide
D. symmetric residues

_____7. What is the best description of the immunoglobulin fold that is found in MHC molecules (and other proteins in the immune system)?
A. A sandwich of beta sheets locked together by a disulfide bridge between two cysteine amino acids.
B. A sandwich of two alpha helices locked together by an attraction between a positively charged lysine amino acid and a negatively charged glutamate amino acid.
C. A sandwich of beta sheets locked together by an attraction between a positively charged lysine amino acid and a negatively charged glutamate amino acid.
D. A sandwich of two alpha helices locked together by a disulfide bridge between two cysteine amino acids.

_____8. If in modeling the MHC molecule you wanted to select amino acid #4 and amino acid #8 to color them so as to make them stand out from the rest of chain A, what command would you use in RasMol?
A. RasMol>select *a and (4 or 8)
B. RasMol>restrict *a and (4 and 8)
C. RasMol>select *a and (4 and 8)
D. RasMol>select *a and (4 and 8) and (4 or 8)

_____9. Which display feature in RasMol most closely resembles the mini-toobers you use to model proteins?
A. hydrophobic sidechains
B. hydrogen bonds
C. alpha carbon backbone
D. spacefill alpha helices and beta sheets

_____10. Who is the usual author of the "Molecule of the Month" on the Protein Data Bank website?
A. Tim Herman
B. David Goodsell
C. Jennifer Morris
D. Shannon Colton

_____11. How many disulfide bonds (bridges) stabilize Chain A and B MHC molecule in the 1HSA pdb file?
A. 2
B. 3
C. 6
D. 8

_____12. In which scientific journal was the primary citation for the pdb file 1HSA published?
A. Nature
B. Cell
C. Science
D. Human Immunology

_____13. Who is the first author of the pdb file 1HSA?
A. D.C. Wiley
B. D.R. Madden
C. J.C. Gorga
D. J.L. Strominger

_____14. From which organism was the MHC molecule in pdb file 1HSA isolated?
A. ape
B. cow
C. man
D. mouse

_____15. What is most likely to cause tissue rejection following a transplant operation?
A. A transplant recipient having the same 4 types of MHC molecules as the donor.
B. A transplant recipient having most of the hundreds of MHC molecule types.
C. A transplant donor having most of the hundreds of MHC molecule types.
D. A transplant recipient having 4 different MHC molecule types than the donor's 4 types.

☐

Tiebreaker Questions:

1. There is a picture on the cover page of three MSOE CBM representatives holding three mini-toober molecular models. List the names of these three molecules from left to right:

   _____ _____ _____

2. Offer an explanation as to why Tryptophan 60, a hydrophobic amino acid, on chain B of the MHC molecule is located on the surface of the protein.