

7.340 Nano-life: Introduction to Virus Structure & Assembly

Assignment #1: Build a capsid model.

Due: Session 3

Approximate time to completion: 2 to 4 hours.

You have been given a hexagonal lattice of humanoid figures (a homuncu-lattice, if you will) representing capsid subunits printed onto 11" x 17" card stock. Your assignment is to cut out triangular faces of the lattice and construct an icosahedron representing a capsid shell of a T number of your choosing. *Pick one of these T numbers only: 7, 9, or 12.* The face sizes will be determined by your chosen T number. Hints are given below. After you have built the capsid, answer/do the following:

1. How many homunculi cover the surface of your capsid? How many are on each face? How many per asymmetric unit?
2. Using a colored pen, mark an asymmetric unit. Indicate each of the unique subunit positions.
3. Indicate examples of true two, three, and five fold symmetry axes with an ellipse, triangle, and pentagram (respectively).
4. Indicate examples of pseudo three-fold and six-fold symmetry axes with "3" and "6".
5. Extra: is your lattice *laevo* or *dextro*?

Hints:

1. To find the centers of a hexagonal homunculus ring, draw lines connecting the vertices (inner homunculi elbows) of the implied hexagon (I apologize for not putting a dot there to orient you better).
2. Once you have one face cut out and you are happy that it is fairly accurate, use it as a template to trace out further faces. Be careful not to mix up the "handedness" of your triangular faces.
3. When you have cut out 20 triangular faces, you can arrange them according to the triangular net shown in the figure below. Tape the seams with clear tape. "Roll" the faces up into an icosahedron. Close the structure with more tape. Tabs are optional.
4. Ruler and razor blade or box cutter (be careful!!!) are one way to make a nice clean edge.
5. Try to plan ahead and maximize the number of faces you can get out of each sheet before you go and start cutting it up. Mark with pencil and erase if necessary. I was able to get ten T=7 faces out of one sheet. Tiling your faces (marking them out so that they share common edges) saves space and reduces the number of cuts you need to make.
6. Closure is the most difficult part. Leave the last face "flappy" as a trap door so you can put a hand inside the model to help tape the closing edges.
7. It doesn't have to be perfect! Some edges will look better than others. Some partial subunits will not perfectly line up at edges.
8. Challenge yourself. If you are really, really stuck... Google.

Figure removed due to copyright reasons.

Please see:

<http://www.enchantedlearning.com/math/geometry/solids/Icosahedrontemp.shtml>