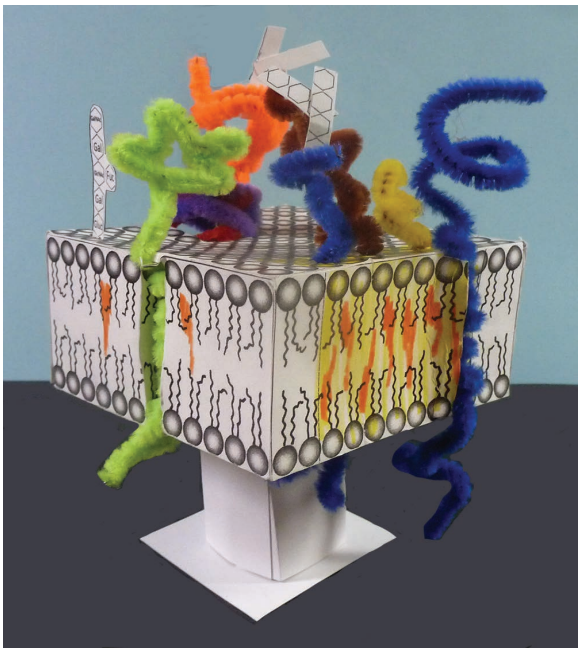
<u>ACTIVITY IDEA 2E</u>: A PAPER MEMBRANE MODEL
Note: This activity can be used after chapter 3 if you are out of activity time for chapter 2.



You will need:

- the following pattern page printed onto card stock
- scissors
- really good white glue (I order PVC glue from Amazon.co.uk. You might also try a white craft glue, such as Elmer's Craft Bond (not regular Elmer's white glue), or Alene's Tacky Glue.)
- a tool for cutting the chenille stems (Scissors will cut them, but be aware that they will dull scissor blades.)
- a sharp craft knife (such as an X-Acto knife)
- a pencil
- colored pencils or markers, especially in yellow or orange (for cholesterol molecules)
- a ruler or straight edge
- a pointed object for scoring fold lines (compass point, nail, very large needle, etc.)

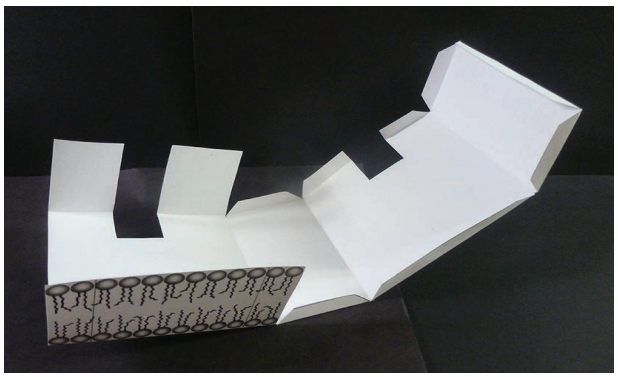
What to tell the students:

In this activity, you will make a paper module showing a tiny piece of a phospholipid membrane. You will add some protein structures to the membrane, both peripheral proteins and transmembrane proteins. One of these will be a real protein called MHC 1. It is the little flag that identifies the cell as part of the body. The other proteins will be examples of general types of proteins but won't be identifiable as any particular protein. For example, you will be putting in a channel that controls the flow of some type of molecule in or out of the cell but it won't be modeled after any particular channel. Also, you will add a number of receptors and "switches" but you can create your own squiggly patterns with the chenille stems. There so many protein shapes in a membrane, that whatever you create will probably look similar to one of them. There are still membrane proteins that scientists have not yet discovered!

What to do:

1) Before cutting out the pattern, score along fold lines. This step always seems like an extra bother, but it will make all the difference when you do the folds. The folds will be crisp and straight and the model will almost snap into place automatically. Use a ruler and something that will lightly scratch the paper without cutting it, such as the point of a compass, a nail, a large needle, or even a "dead" ballpoint pen. Scissors might be used successfully by an adult (I have done this) but can be tricky for many students. **If you are working with a younger group, you might want to consider doing this step ahead of time and give the students a pre-scored pattern page to cut out.**

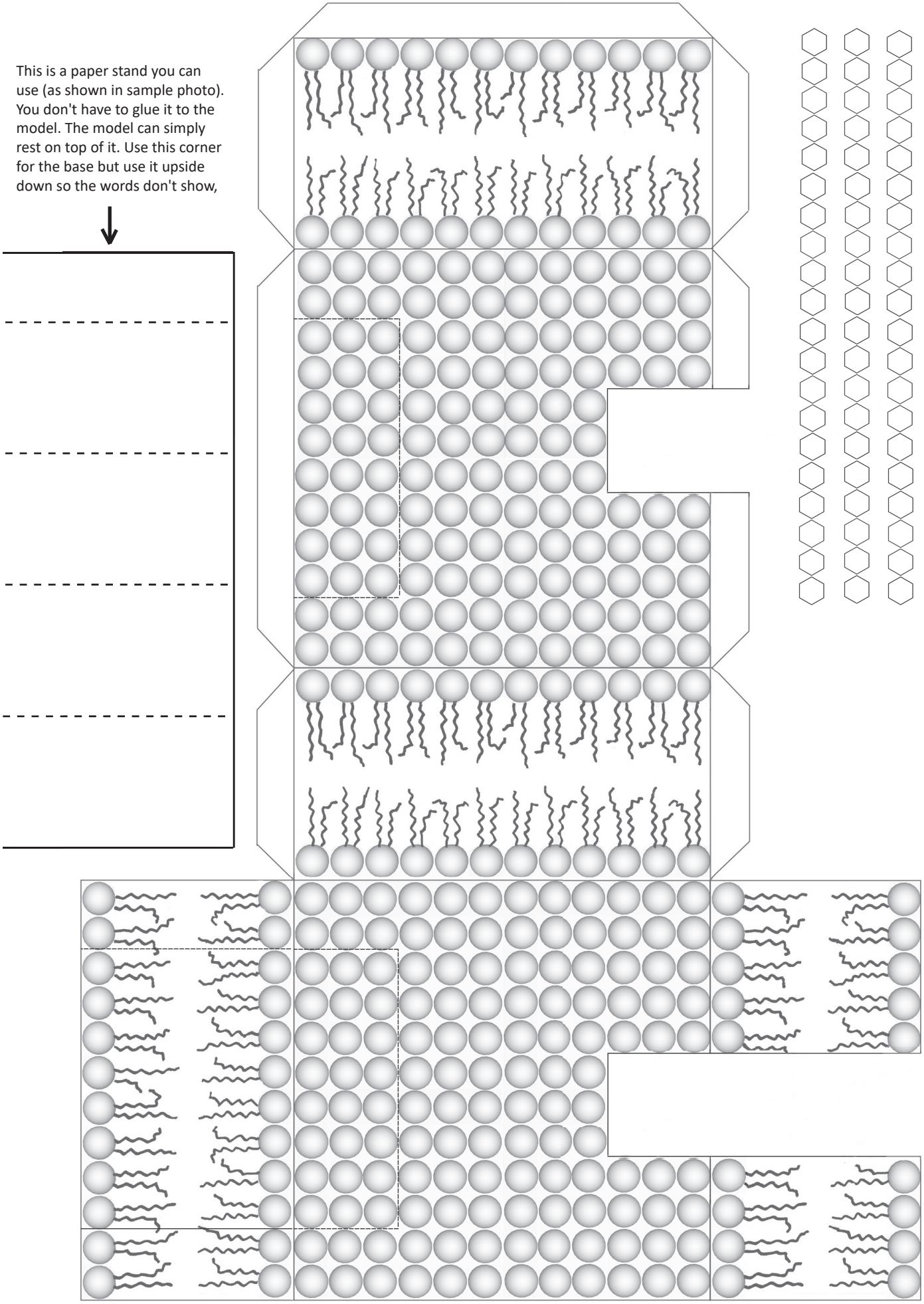
2) Locate the lipid raft section (indicated by thin dotted lines). Add cholesterol molecules between the phospholipid tails in the lipid raft region. You can also add one or two cholesterols on other sections, if you find those few places that have more straight tails.
Student might also want to add some light yellow to the phospholipid heads that belong to the lipid raft region, to make it more visible.



3) Cut around the edges of the paper pattern. Work carefully. Slopping cutting will make the assembly process much harder.

4) Fold on all the fold lines. After this step your project should similar to the one shown here.

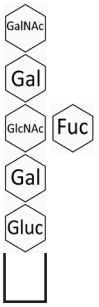
This is a paper stand you can use (as shown in sample photo). You don't have to glue it to the model. The model can simply rest on top of it. Use this corner for the base but use it upside down so the words don't show,



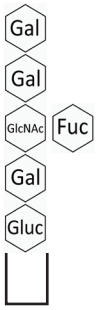
Optional:

ABO Blood antigens (made of sugars)

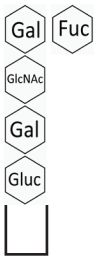
Type A



Type B



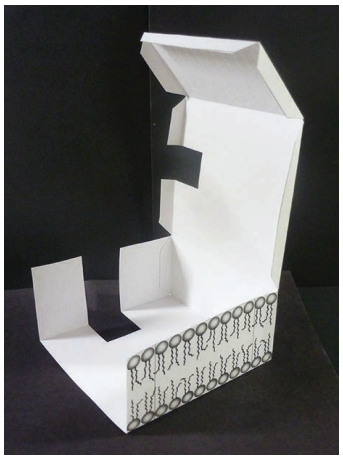
Type O

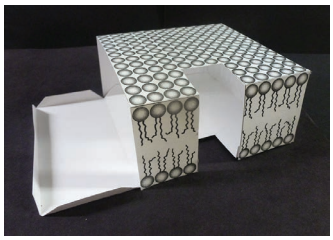


For type AB, use both A and B.

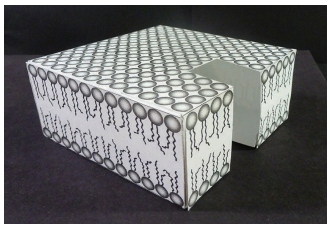
5) Begin gluing the glue tabs, perhaps in this order:

1

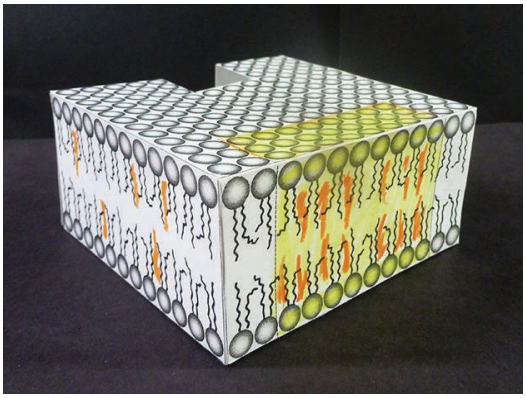




2

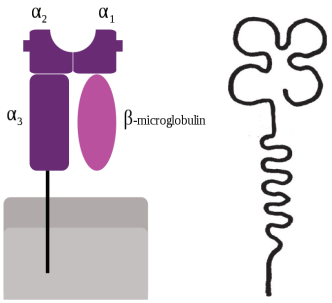


3

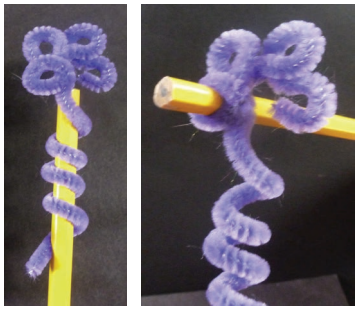


If you have colored the lipid raft area, your model will look something like this.

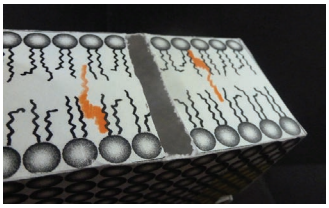
6) Use a chenille stem to make an "MHC 1" shape. (the ID flag)
You can use a pencil to create the round shapes.



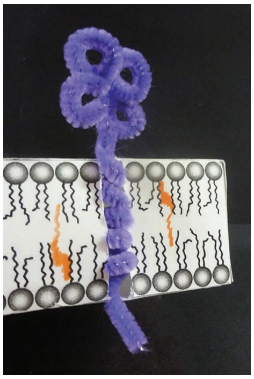
MHC 1 is shown many ways. Here are two typical diagrams. We'll imitate the one on the right.



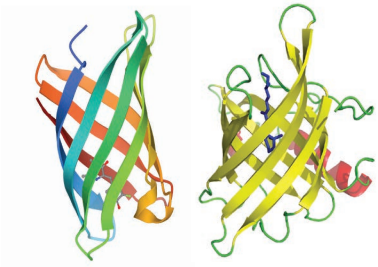
Your MHC 1 can be any color. My students found it helpful to use a pencil to make the curls.



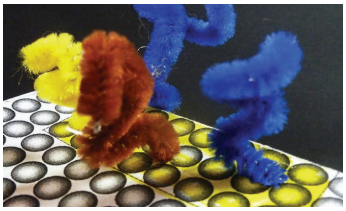
To insert MHC 1 (or any transmembrane protein) use a craft knife to cut out one phospholipid. Tuck in curled chenille. Add a tiny bit of glue to keep it in place.



7) The large opening is for a beta barrel. Beta barrels are made of folded proteins called beta sheets. Beta barrel diagrams often look like a braided structure. We are going to just use two or more chenille stems and curl them in opposite directions around a finger. Try to make your barrel large enough to fit into the space in your membrane. Some barrels have extra curls on the top or bottom.



8) Add some peripheral proteins and some transmembrane proteins. They can be any shape. For the peripheral proteins, you can make a tiny hole, put a small blob of glue on the end of the chenille and stick it in (and let it dry). For the transmembrane protein you will need to cut a slot in the side of the model. Make sure you put several proteins in the lipid raft area.



9) Add some glycan sugar strings to your model.

You have a number of options. You can add one of the famous "ABO" blood type markers, provided on the side of your pattern page. Only red blood cells will have these proteins on their surface, but we are not concerned with making this sample membrane accurate to any particular cell, so you can add these gylcans or leave them off, either way is fine. If you happen to know your blood type you can make your membrane match your own cells.