

MHC Activity Instructions

Your group of four has received a bag containing:

- numbered index cards;
- four arrays of MHC, each containing 3 molecules;
- and 11 peptides.

1. Choose one person to be the reporter. The reporter will be in charge of periodically holding up one of the numbered index cards to share your group's results.
2. Distribute the MHC arrays so that each person has one.
3. Use the table below to note which MHC molecules are present in your array by circling the MHC molecule that is present in each position.
4. Compare your results to your groupmates'. Are all of your MHC molecules the same? Are they all different?

Table 1: Individual MHC haplotype.

MHC #1: Red Circle Blue Sphere	MHC #2: Yellow Hexagon Green Pentagon White 3D Hexagon Black 3D Pentagon	MHC #3: Periwinkle Triangle Purple 6-pointed star Blue 8-pointed star Pink 9-pointed star Orange Square
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5. The reporter should now fill in Table 1 on the Group Haplotype Sheet.

Stop here to allow your instructor to gather data from the class.

6. Based on the class data, which is the most common MHC molecule in the population?

7. Which is the least common?

8. How many different types of MHC molecules are present in the population?

9. How many different peptides do you think could be presented by the MHC molecules present in this population?

10. Next, test the ability of each of the 11 peptides in your bag to bind to each of your 3 MHC molecules. If a peptide is able to bind, place a check mark in the appropriate cell of the table. This most efficient way to do this is an “assembly line” approach: person #1 tries the red circle, and then passes the red circle to person #2 while moving on to the green and black 3D pentagon, etc. Be sure to try each peptide in each of your three MHCs.

Table 2: Individual antigen binding.

	MHC #1 shape:	MHC #2 shape:	MHC #3 shape:
Red circle			
Green and black 3D pentagon			
Blue 8-pointed star			
Multicolored triangle			
Orange square			
Purple 6-pointed star			
Yellow and white 3D hexagon			
Yellow hexagon			
Pink 9-pointed star			
Green pentagon			
Blue sphere			

11. Compare your completed table to the tables of your groupmates. Based on your observations, did your answer to question 9 change or stay the same? Why?

12. Do you think the composition of the MHC haplotype of the entire population -- that is the frequency of each different type of MHC molecule within the population -- is constant, or will it change over time?

Stop here for class discussion.

Unfortunately, everyone in this population is completely unvaccinated, and we have no antibiotics, antivirals, or other drugs available to us.

13. A smallpox epidemic has occurred. Smallpox is caused by a virus -- an intracellular pathogen. Will peptides derived from smallpox be presented by MHC I or MHC II?

14. One of the peptides derived from smallpox is the multicolored triangle found in your bag. Can any of your MHC molecules present this peptide?

15. Will you be able to mount an adaptive immune response against smallpox?

16. Considering your answer to question 15, predict your fate: will you live or die?

Stop here for class discussion.

17. Help your group's reporter to fill in Table 2 on the Group Haplotype Sheet. The reporter will then share this information with the class as directed.

Stop here for class discussion.

18. Based on the data reported by the class, how does the composition of the MHC haplotype of the entire population after the smallpox outbreak compare to the haplotype before the outbreak?

Stop here for class discussion.

19. Another epidemic has occurred -- this time, it's Ebola. If you survived the smallpox epidemic, you'll now need to determine whether you have what it takes to survive Ebola.

20. Once the Ebola virus infects your cells, its proteins can be processed into two different peptides for presentation by MHC I: the pink 9-pointed star, and the green and black 3D pentagon. Only if you are still alive after smallpox, test the ability of your MHC molecules to present these peptides. If you are already dead, observe the rest of your group.

21. What will be your fate if you can present one of these antigens? If you can present both? If you can present neither?

Stop here for class discussion.

22. Help your group's reporter to fill in Table 3 on the Group Haplotype Sheet. The reporter will then share this information with the class as directed.

Stop here for class discussion.

23. There aren't that many of you left, but now there has been an epidemic of *Mycobacterium tuberculosis*. One of the peptides derived from Mtb is the purple 6-pointed star. Only if you are still alive after both smallpox and ebola, test the ability of your MHC molecules to present this peptide. If you are already dead, observe the rest of your group.

24. Will you live or die?

25. Help your group's reporter to fill in Table 4 on the Group Haplotype Sheet. The reporter will then share this information with the class as directed.