Using a Jack to Visualize the Right Hand Rule for Cross Products
Class Handout

1. Compute the following cross products by finding the determinant of the corresponding 3×3 matrix for each: $\vec{j} \times \vec{k}$, $\vec{k} \times \vec{j}$, and $-\vec{i} \times \vec{j}$.

2. Repeat the demonstration from class to make sure you understand how to use the jack to compute $\vec{i} \times \vec{j}$. Start by holding the jack in your left hand. Then hold up the palm of your right hand near $\vec{i}$ and wrap your fingers toward the $\vec{j}$ direction using the most direct route possible. Look at which direction your thumb is pointing to obtain the answer; in this example, your thumb should be pointing in the $\vec{k}$ direction. Now, use the right hand rule to compute the following cross products: $\vec{j} \times \vec{k}$, $\vec{k} \times \vec{j}$, and $-\vec{i} \times \vec{j}$. Did you obtain the same answers as you did in the first problem? Should you?

3. When you used the right hand rule to compute $\vec{j} \times \vec{k}$ and $\vec{k} \times \vec{j}$, what was different about the way your hand was placed? How are the two answers related to each other? Will this always happen when you change the order in which you take a cross product?

4. Pick any two vectors represented on the jack, and denote the plane containing those two vectors by P.

   (a) Take the cross product of the two vectors. How is the cross product related to P?

   (b) Imagine taking any two vectors from P, even if they are not represented by a vector on the jack. By using the right hand rule, what can you say about how the cross product is related to P geometrically?

5. Does it matter that you are using your right hand? That is, if you held the jack in your right hand and used your left hand to compute $\vec{i} \times \vec{j}$, do you get $\vec{k}$? Why or why not? Be sure to run a few experiments to support your answer.