**Activity 8.3.2 Matrix Identity Crisis**

Look back at activity 8.3.1.

In the first matrix multiplication example, the two matrices were:

$H=\left[\begin{matrix}9&6&2\\6&8&3\\8&9&4\end{matrix}\right]$ and $M=\left[\begin{matrix}18&4&12\\16&3&12\\14&2&10\end{matrix}\right]$

1. You determined the meaning of the rows and columns of the product matrix $P=HM$ was:

After performing the procedure for the product matrix, you found that

$$HM=\left[\begin{matrix}286&58&200\\278&54&198\\344&67&244\end{matrix}\right]$$

1. Explain the meaning of the entry (198) in the second row, third column of matrix *HM*.
2. Based on the size of the two matrices, would it be possible to multiply the entries in matrix *H* by the entries in matrix *M* to find the product matrix *MH*?
3. If yes, use your graphing calculator to find the product and write the product below:
4. Try to explain the meaning of the entry in the second row, third column of matrix *MH* in terms of the original scenario.
5. Were the entries in the product matrices the same for matrix *MH* and matrix *HM*? No

Again, look back at activity 8.3.1.

In the second matrix multiplication example, the two matrices were:

$A=\left[\begin{matrix}92&36&14&88\\46&87&34&73\\57&44&37&44\end{matrix}\right]$ and $B=\left[\begin{matrix}.67&5.9\\1.2&14\\2.5&30\\.5&1.7\end{matrix}\right]$

1. You determined the meaning of the rows and columns of the product matrix *AB* was
2. The product matrix was:



1. Looking at matrix *A* and matrix *B*, will you be able to find the product matrix *BA* based on their size?
2. Use your graphing calculator to attempt to find the product matrix *BA*.

What result did you find?

When a mathematical operation gives the same result when performed in the opposite order, it is called “commutative.” We know that for real numbers, adding and multiplying are commutative, whereas subtracting and dividing are not commutative. For matrices we saw that adding is commutative and subtracting is not.

1. Is multiplication commutative? Explain using the examples above.

Even when an operation is not commutative, it may be commutative in some special cases.

The identity matrix is a square matrix with 1 entries on the main diagonal (diagonal from upper left to lower right corner) and zero entries elsewhere. For example, the identity matrix for 3×3 matrices, is shown below:

$$I\_{3}=\left[\begin{matrix}1&0&0\\0&1&0\\0&0&1\end{matrix}\right]$$

1. Find the product matrices below:

$$HI\_{3}=\left[\begin{matrix}9&6&2\\6&8&3\\8&9&4\end{matrix}\right]\left[\begin{matrix}1&0&0\\0&1&0\\0&0&1\end{matrix}\right]=$$

$$I\_{3}H=\left[\begin{matrix}1&0&0\\0&1&0\\0&0&1\end{matrix}\right]\left[\begin{matrix}9&6&2\\6&8&3\\8&9&4\end{matrix}\right]=$$

$$MI\_{3}=\left[\begin{matrix}18&4&12\\16&3&12\\14&2&10\end{matrix}\right]\left[\begin{matrix}1&0&0\\0&1&0\\0&0&1\end{matrix}\right]= $$

$$I\_{3}M=\left[\begin{matrix}1&0&0\\0&1&0\\0&0&1\end{matrix}\right]\left[\begin{matrix}18&4&12\\16&3&12\\14&2&10\end{matrix}\right]=$$

1. What do these examples lead you to conclude about the identity matrix and multiplication?
2. Why do you think it is called the identity matrix?
3. Write the identity matrix $I\_{2}$