**Activity 8.1.2 Matrix Terminology and Laws for Matrix Operations**

Think about how you added matrices in the previous activity.

1. What do matrices need to have in common in order to add and subtract them?

In mathematics, *closure under an operation* means that when we perform the operation we will get always get back another object like the ones we started with. Example: the integers are closed under multiplication because if we multiply two integers we always get an integer. The integers are not closed division.

1. Are matrices closed under addition and subtraction?
2. If we add two given integers, but in a different order do we get the same result?

When an operation has this property it is called commutative. We might ask if adding matrices commutative.

1. To examine this, choose some numbers for entries into these two blank matrices of the same size below. Include positive and negative numbers, decimals and rational and irrational numbers.

$R=\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]$ $S=\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]$

1. Check to see if the sum $R+S$ and $S+R$ are the same.

$R+S=\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]$ $S+R=\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]$

1. Write several sentences about why you think that addition of matrices is or isn’t commutative.

This is the data for collections of reusable items during the first week of our project:

$$A=\left[\begin{matrix}92&36&14&88\\46&87&34&73\\57&44&37&44\end{matrix}\right]$$

You have seen subscripts used before in different settings. For matrices, subscripts are used to identify the row and column of an entry. For example the entry in the first row, third column of matrix *A* is $a\_{13}$ , so $a\_{13}=14$ .

1. What is the physical meaning of $a\_{13}=14?$

(Hint: The number of pairs of shoes collected at site number \_\_\_\_ during the first week was 14.)

We use *m* for the number of rows and *n* for the number of columns in a matrix. So an *m* × *n* matrix has *m* rows and *n* columns. Matrix *A* is 3 × 4 matrix. This is a 3 × 4 matrix with the entries labeled using subscripts:

$$A=\left[\begin{matrix}a\_{11}&a\_{12}&a\_{13}&a\_{14}\\a\_{21}&a\_{22}&a\_{23}&a\_{24}\\a\_{31}&a\_{32}&a\_{33}&a\_{34}\end{matrix}\right]$$

1. For matrix *A* , what is the numerical value of entry $a\_{31}$? ­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_ Describe this entry in terms of the collection data from the project.

Matrices can have various sizes and they do not need to be square. When writing the size of a matrix, write the number of rows first, then the number of columns. A 4×3 matrix has four rows and three columns as shown in the blank matrix below:

$$\left[\begin{matrix}&&\\&&\\&&\\&&\end{matrix}\right]$$

Here are two matrices and matrix addition illustrated:

*A* = $\left[\begin{matrix}a\_{11}&a\_{12}&a\_{13}&a\_{14}\\a\_{21}&a\_{22}&a\_{23}&a\_{24}\\a\_{31}&a\_{32}&a\_{33}&a\_{34}\end{matrix}\right]$ *B* = $\left[\begin{matrix}b\_{11}&b\_{12}&b\_{13}&b\_{14}\\b\_{21}&b\_{22}&b\_{23}&b\_{24}\\b\_{31}&b\_{32}&b\_{33}&b\_{34}\end{matrix}\right]$

*A* + *B* = $\left[\begin{matrix}a\_{11}+b\_{11}&a\_{12}+b\_{12}&a\_{13}+b\_{13}&a\_{14}+b\_{14}\\a\_{21}+b\_{21}&a\_{22}+b\_{22}&a\_{23}+b\_{23}&a\_{24}+b\_{24}\\a\_{31}+b\_{31}&a\_{32}+b\_{32}&a\_{33}+b\_{33}&a\_{34}+b\_{34}\end{matrix}\right]$

1. Look at the matrix addition illustrated above. What property of real numbers is involved with why matrix addition is commutative? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Suppose the matric C for week 3 collections is said to equal 3A where A is the matrix for the first week of collections as defined above. What do you think would be the entries in matrix C?

Look back at the matrix *R* that you created above at the start of this activity. You multiply a matrix by a real number by multiplying every entry by that number.

1. Find $(-1)R=\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]$
2. Now add: $\left(-1\right)R+R$

$$\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]+\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]=\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]$$

1. (-1)R + R = \_\_\_\_\_\_\_\_\_\_\_
2. Suppose that all of the collection centers were closed for a week. Use the blank matrix below to write a matrix that would represent the collections during that week. Remember, the four columns are general clothing articles, outerwear, shoes, and rags. The three rows are the three collection sites.

$$\left[\begin{matrix}&&&\\&&&\\&&&\end{matrix}\right]$$

1. Suggest a name for this matrix. \_\_\_\_\_\_\_\_\_\_\_\_
2. Complete the following:$ a. A+0=$ \_\_\_\_\_

b. $0+A=$ \_\_\_\_\_\_\_\_\_

1. Looking at the result above, and complete the equation$: A+0=0+A=\\_\\_\\_\\_\\_\\_\\_$

So we have defined the Zero matrix, **0** and that this is a matrix with entries that are all zeros. Not all zero matrices are the same because they have different sizes.

1. Make up three 2X2 matrices and add them in two orders (A + B) first and then add C so (A + B) + C. Then (B + C) and finally A + (B +C) and to see if there is an associative property for addition. Compare results with your class.