Dear Parents,

In this unit students will:

- represent and manipulate data using matrices
- define the order of a matrix as the number of rows by the number of columns
- add and subtract matrices and know these operations are possible only when the dimensions are equal
- recognize that matrix addition and subtraction are commutative
- multiply matrices by a scalar and understand the distributive and associative properties apply to matrices
- multiply matrices and know when the operation is defined
- recognize that matrix multiplication is not commutative
- understand and apply the properties of a zero matrix
- understand and apply the properties of an identity matrix
- find the determinant of a square matrix and understand that it is a nonzero value if and only if the matrix has an inverse
- use 2 X 2 matrices as transformations of a plane and determine the area of the plane using the determinant
- write a system of linear equations as a matrix equation and use the inverse of the coefficient matrix to solve the system
- write and use vertex-edge graphs to solve problems

Concepts Students will Use & Understand

- Commutative Property
- Associative Property
- Distributive Property
- Identity Properties of Addition and Multiplication
- Inverse Properties of Addition and Multiplication
- Solving Systems of Equations Graphically and Algebraically

Vocabulary

- **Determinant**: the product of the elements on the main diagonal minus the product of the elements off the main diagonal
- **Dimensions or Order of a Matrix**: the number of rows by the number of columns
- **Identity Matrix**: the matrix that has 1’s on the main diagonal and 0’s elsewhere
- **Inverse Matrices**: matrices whose product (in both orders) is the Identity matrix
- **Matrix**: a rectangular arrangement of numbers into rows and columns
- **Scalar**: in matrix algebra, a real number is called a scalar
- **Square Matrix**: a matrix with the same number of rows and columns
- **Zero Matrix**: a matrix whose entries are all zeros

For further help:

http://intermath.coe.uga.edu/dictnary/homepg.asp
http://www.amathsdictionaryforkids.com/
Properties

Let \( a, b, \) and \( c \) be real numbers

<table>
<thead>
<tr>
<th></th>
<th>ADDITION PROPERTIES</th>
<th>MULTIPLICATION PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMMUTATIVE</td>
<td>( a + b = b + a )</td>
<td>( ab = ba )</td>
</tr>
<tr>
<td>ASSOCIATIVE</td>
<td>((a + b) + c = a + (b + c))</td>
<td>((ab)c = a(bc))</td>
</tr>
<tr>
<td>IDENTITY</td>
<td>There exists a unique real number zero, 0, such that ( a + 0 = a )</td>
<td>There exists a unique real number one, 1, such that ( a + 1 = 1 + a = a )</td>
</tr>
</tbody>
</table>
| INVERSE        | For each real number \( a \), there is a unique real number \( -a \) such that \( a + (-a) = 0 \) | For each nonzero real number \( a \), there is a unique real number \( \frac{1}{a} \) such that \( a \cdot \frac{1}{a} = 1 \)

Sample Problems

1. Find the dimensions:
   
   \[
   \begin{bmatrix}
   -3 & 5 \\
   4 & 1/4 \\
   -\pi & 0
   \end{bmatrix}
   \]
   
   3 rows, 2 columns; Dimensions: 3 x 2

2. Two stores carry small, medium, and large sweatshirts. The table shows the inventory at the stores. Arrange the data in a matrix. Give the dimensions of the matrix.

<table>
<thead>
<tr>
<th>Sweatshirt Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
</tr>
<tr>
<td>Store A</td>
</tr>
<tr>
<td>Store B</td>
</tr>
</tbody>
</table>
   
   \[
   \begin{bmatrix}
   6 & 21 & 13 \\
   16 & 32 & 28
   \end{bmatrix}
   \]
   The dimensions are 2 x 3

3. Multiply the following matrix:
   
   \[
   \begin{bmatrix}
   1 & 2 & 3 \\
   4 & 5 & 6
   \end{bmatrix}
   \times
   \begin{bmatrix}
   7 & 8 \\
   9 & 10 \\
   11 & 12
   \end{bmatrix}
   \]
   
   \[
   \begin{bmatrix}
   58 & 64 \\
   139 & 154
   \end{bmatrix}
   \]

4. Find the inverse of the following matrix:
   
   \[
   \begin{bmatrix}
   1 & 0 & 1 \\
   1 & 1 & 9 \\
   0 & 1 & 9
   \end{bmatrix}
   \]
   
   \[
   \begin{bmatrix}
   0 & 1 & -1 \\
   -1 & 9 & -8 \\
   1 & -1 & 1
   \end{bmatrix}
   \]
   The inverse exists!

5. What system of equations is represented by the matrix equation?
   
   \[
   \begin{bmatrix}
   -41 & 1 & 0 \\
   1 & 50 & 1 \\
   67 & 4 & 0
   \end{bmatrix}
   \begin{bmatrix}
   x \\
   y \\
   z
   \end{bmatrix}
   =
   \begin{bmatrix}
   1 \\
   7 \\
   -29
   \end{bmatrix}
   \]
   
   \[
   \begin{align*}
   -41x + y &= 1 \\
   x + 50y + z &= 7 \\
   67x + 4y &= -29
   \end{align*}
   \]