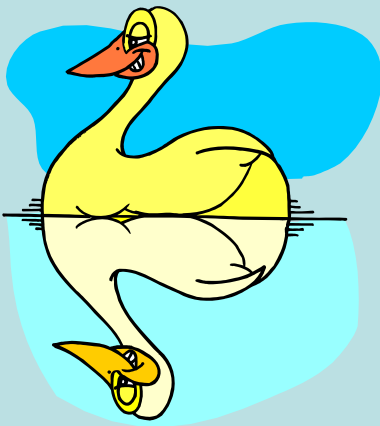


4.4 Transformations with Matrices

2. Reflections and Rotations



2) Reflections

A **reflection**, or flip, is a transformation that creates symmetry.

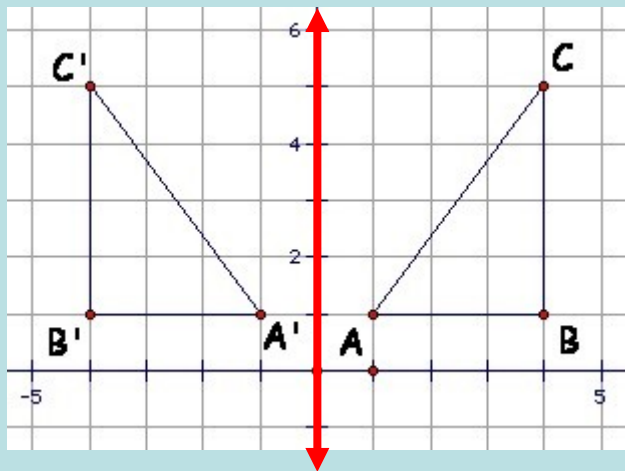
You can use matrix multiplication to graph reflections in the coordinate plane.

There are **four reflection** matrices you are responsible for knowing.

2) Reflections

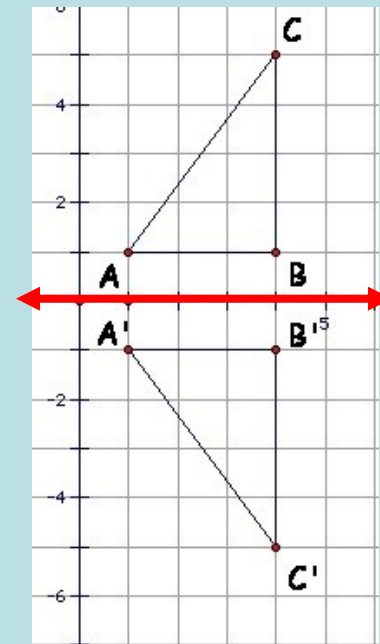
Reflection in the y -axis
the x -axis

$$\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$$



Reflection in

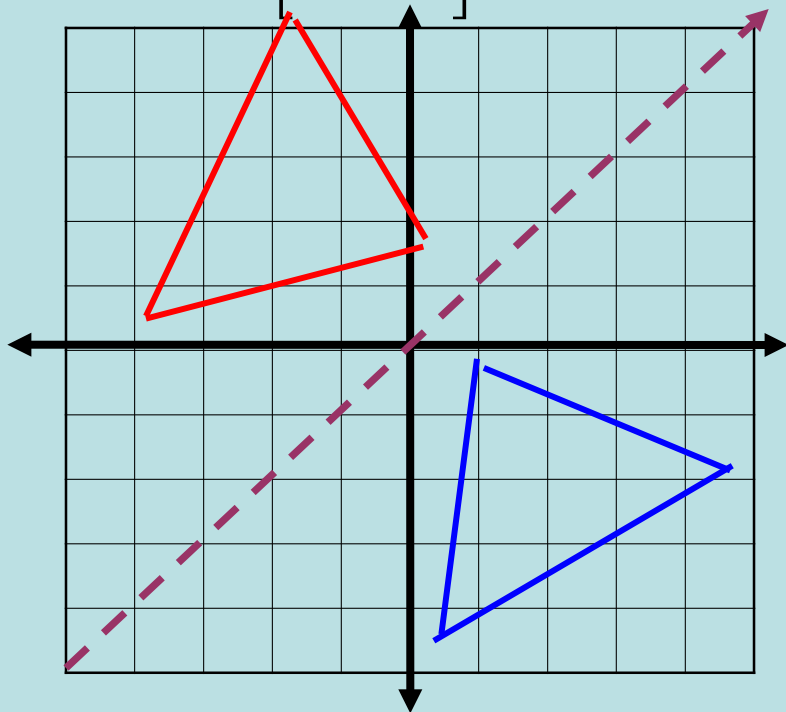
$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$



2) Reflections

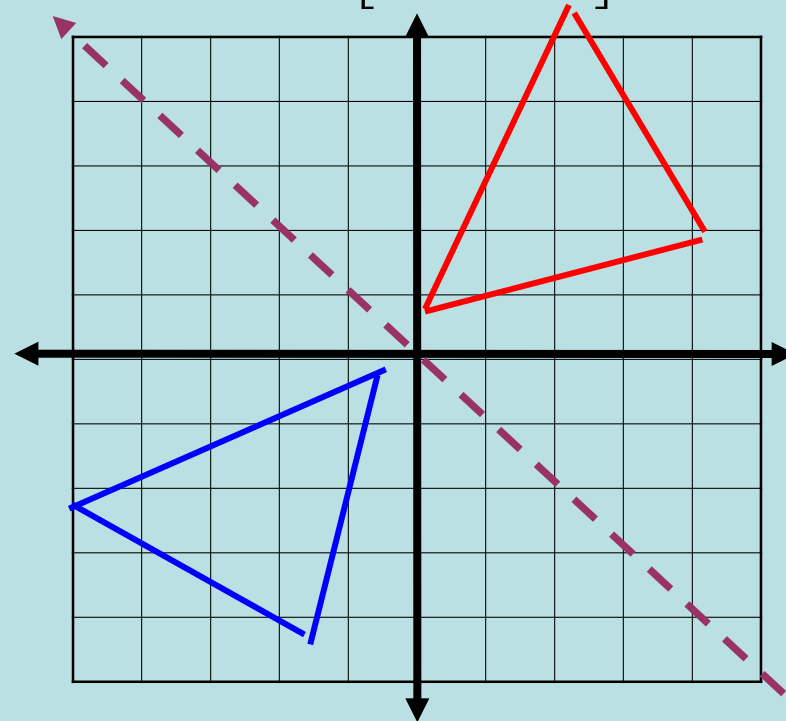
Reflection in the line $y = x$
the line $y = -x$

$$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$



Reflection in

$$\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$$



2) Reflections

Example 1: Given triangle ABC with $A (-4, 1)$, $B (-2, 5)$ and $C (0, 2)$, reflect the triangle across the y -axis. Then, sketch the image.

$$\begin{bmatrix} -4 & -2 & 0 \\ 1 & 5 & 2 \end{bmatrix}$$

2) Reflections

Example 1: Given triangle ABC with $A (-4, 1)$, $B (-2, 5)$ and $C (0, 2)$, reflect the triangle across the y -axis. Then, sketch the image.

$$\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} \bullet \begin{bmatrix} -4 & -2 & 0 \\ 1 & 5 & 2 \end{bmatrix}$$



y-axis
reflection
matrix

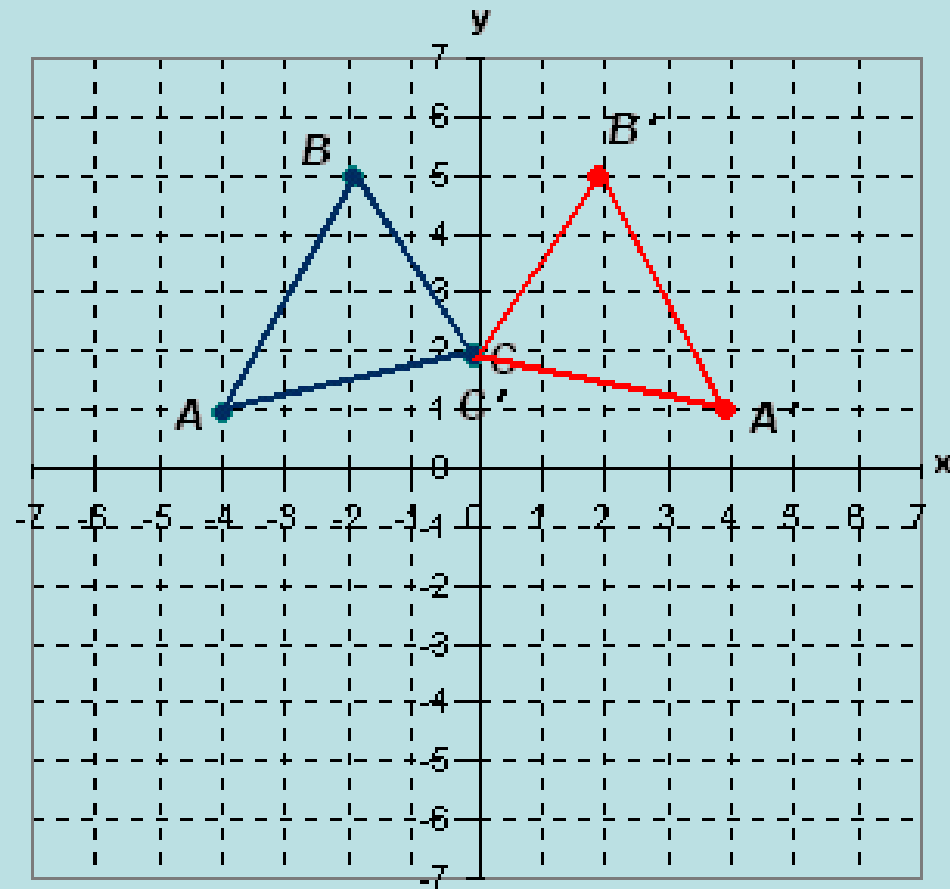
2) Reflections

Example 1: Given triangle ABC with $A (-4, 1)$, $B (-2, 5)$ and $C (0, 2)$, reflect the triangle across the y -axis. Then, sketch the image.

$$\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} \bullet \begin{bmatrix} -4 & -2 & 0 \\ 1 & 5 & 2 \end{bmatrix} = \begin{bmatrix} 4 & 2 & 0 \\ 1 & 5 & 2 \end{bmatrix}$$


y-axis
reflection
matrix

2) Reflections



2) Reflections

Example 2: Given triangle ABC where A $(-4, 1)$, B $(-2, 5)$ and C $(0, 2)$, reflect the triangle across the x -axis. Then, sketch the image.

2) Reflections

Example 2: Given triangle ABC where A $(-4, 1)$, B $(-2, 5)$ and C $(0, 2)$, reflect the triangle across the x -axis. Then, sketch the image.

$$\begin{array}{ccc} A & B & C \\ \left[\begin{array}{ccc} -4 & -2 & 0 \\ 1 & 5 & 2 \end{array} \right] \end{array}$$

2) Reflections

Example 2: Given triangle ABC where A $(-4, 1)$, B $(-2, 5)$ and C $(0, 2)$, reflect the triangle across the x -axis. Then, sketch the image.

$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \bullet \begin{array}{ccc} \textcolor{blue}{A} & \textcolor{blue}{B} & \textcolor{blue}{C} \\ \begin{bmatrix} -4 & -2 & 0 \\ 1 & 5 & 2 \end{bmatrix} \end{array}$$



x-axis
reflection
matrix

2) Reflections

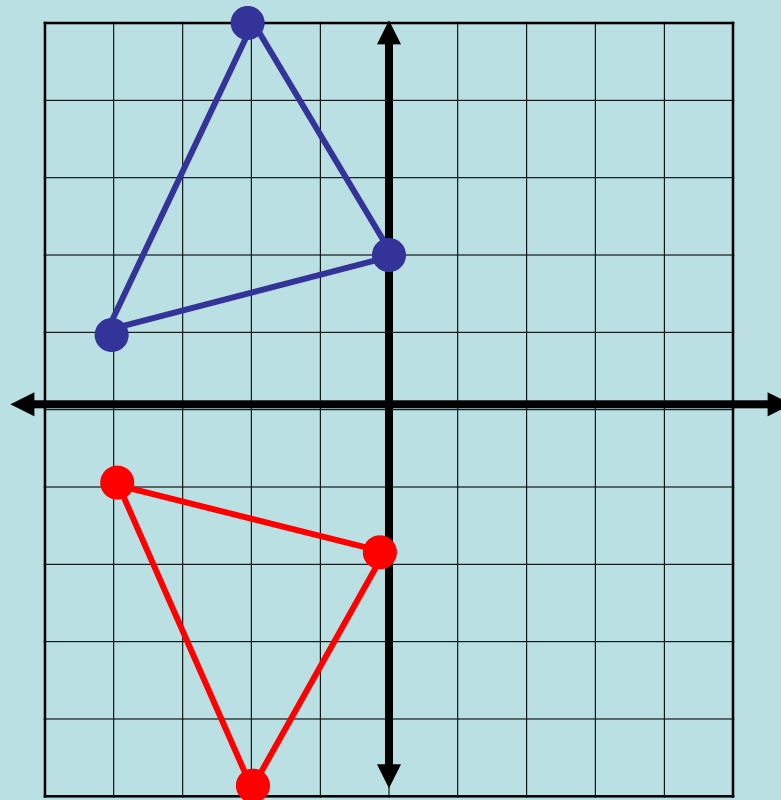
Example 2: Given triangle ABC where A $(-4, 1)$, B $(-2, 5)$ and C $(0, 2)$, reflect the triangle across the x -axis. Then, sketch the image.

$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \bullet \begin{matrix} A & B & C \\ \begin{bmatrix} -4 & -2 & 0 \\ 1 & 5 & 2 \end{bmatrix} \end{matrix} = \begin{matrix} A' & B' & C' \\ \begin{bmatrix} -4 & -2 & 0 \\ -1 & -5 & -2 \end{bmatrix} \end{matrix}$$



x-axis
reflection
matrix

2) Reflections



$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \bullet \begin{bmatrix} -4 & -2 & 0 \\ 1 & 5 & 2 \end{bmatrix} = \begin{bmatrix} -4 & -2 & 0 \\ -1 & -5 & -2 \end{bmatrix}$$

2) Rotations

A **rotation** is a transformation that turns a figure about a fixed point called a **center of rotation**.

You can rotate a figure as much as 360° .

In this text, all rotations are counterclockwise about the origin.

2) Rotations

Rotation of 90°
of 360°

$$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

Rotation

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Rotation of 180°
of 270°

$$\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

Rotation

$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

2) Rotations

Example 1: Given triangle ABC where $A (-4, 1)$, $B (-2, 5)$ and $C (0, 2)$, rotate the triangle 270° . Then, sketch the image.

2) Rotations

Example 1: Given triangle ABC where $A (-4, 1)$, $B (-2, 5)$ and $C (0, 2)$, rotate the triangle 270° . Then, sketch the image.

$$\begin{array}{ccc} A & B & C \\ \left[\begin{array}{ccc} -4 & -2 & 0 \\ 1 & 5 & 2 \end{array} \right] \end{array}$$

2) Rotations

Example 1: Given triangle ABC where $A (-4, 1)$, $B (-2, 5)$ and $C (0, 2)$, rotate the triangle 270° . Then, sketch the image.

$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \bullet \begin{matrix} A & B & C \\ \begin{bmatrix} -4 & -2 & 0 \\ 1 & 5 & 2 \end{bmatrix} \end{matrix}$$



270° rotation
matrix

2) Rotations

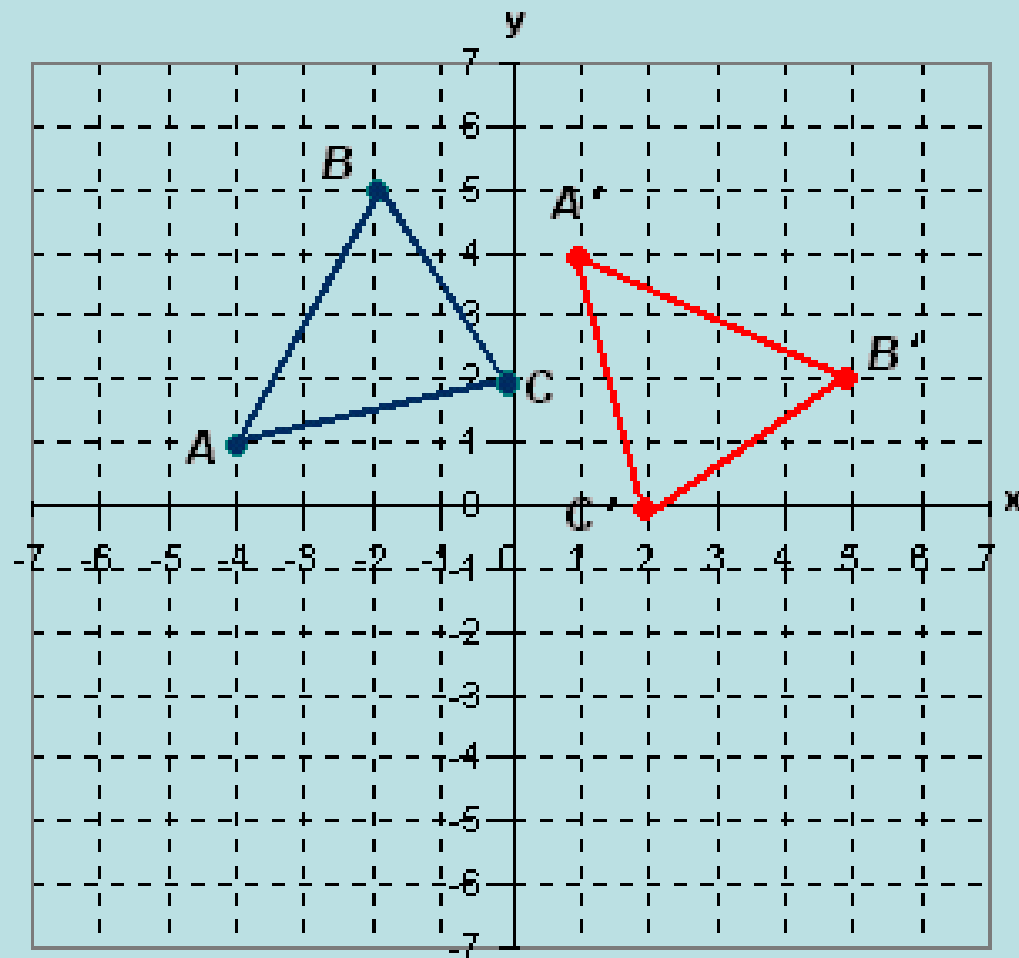
Example 1: Given triangle ABC where $A (-4, 1)$, $B (-2, 5)$ and $C (0, 2)$, rotate the triangle 270° . Then, sketch the image.

$$\begin{array}{ccccccc} & A & B & C & A' & B' & C' \\ \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} & \bullet & \begin{bmatrix} -4 & -2 & 0 \\ 1 & 5 & 2 \end{bmatrix} & = & \begin{bmatrix} 1 & 5 & 2 \\ 4 & 2 & 0 \end{bmatrix} \end{array}$$



270° rotation
matrix

2) Rotations



2) Rotations

Example 2: The matrix below represents the vertices of a polygon. Write a matrix to represent the vertices after a rotation of 90° .

<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
3	4.5	5	3.5
3	1.5	2	4

2) Rotations

Example 2: The matrix below represents the vertices of a polygon. Write a matrix to represent the vertices after a rotation of 90° .

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \bullet$	3	4.5	5	3.5
	3	1.5	2	4



90° rotation
matrix

2) Rotations

Example 2: The matrix below represents the vertices of a polygon. Write a matrix to represent the vertices after a rotation of 90° .

$$\begin{array}{cccc} & \mathbf{A} & \mathbf{B} & \mathbf{C} & \mathbf{D} & & \mathbf{A'} & \mathbf{B'} & \mathbf{C'} & \mathbf{D'}} \\ \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \bullet \begin{bmatrix} 3 & 4.5 & 5 & 3.5 \\ 3 & 1.5 & 2 & 4 \end{bmatrix} = \begin{bmatrix} -3 & -1.5 & -2 & -4 \\ 3 & 4.5 & 5 & 3.5 \end{bmatrix} \end{array}$$



90° rotation
matrix