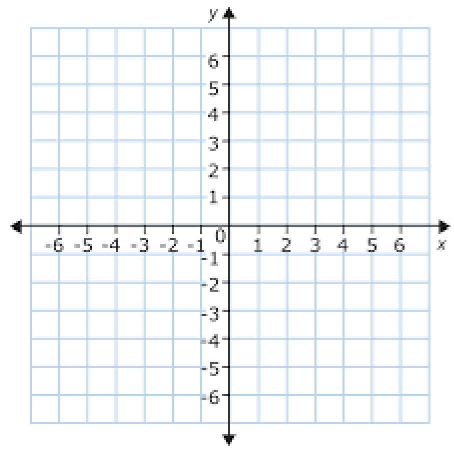
Computer Animation through Matrix Transformations

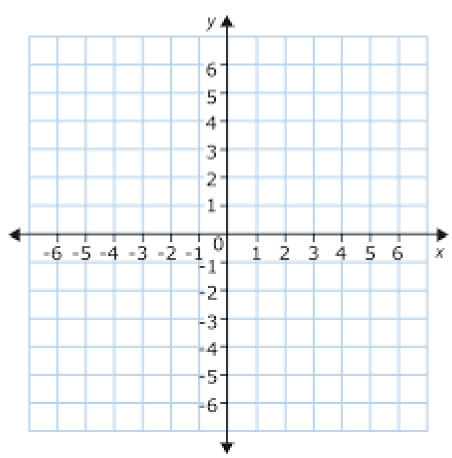
1. Create your own picture to be animated. Draw the basic image on the graph below. Have 6-8 coordinate points identified on the graph.



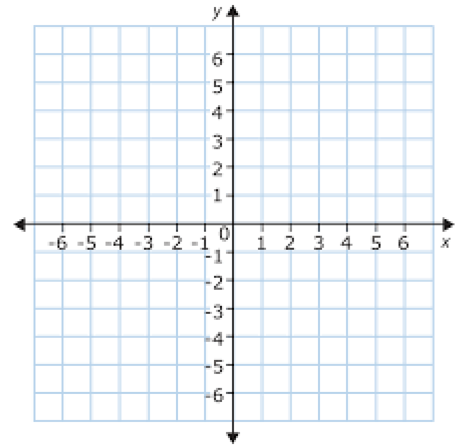
2. The first step in computer animation is for the animator to create a simplified representation of a character's anatomy. **Enter key points in your image in a 2×n matrix**, where the x-coordinate of a point is in the top row, and the y-coordinate of the point is in the bottom row. There will be one column for each point you identified in the previous question. **Call this matrix S** (for "skeleton").

3. Write the matrix for each product below, then graph the shape that results. Below each matrix, write a brief description of how the shape is "transformed" by the matrix multiplication. Use geometric terms such as reflection, rotation, stretching, translation. Be as precise as you can, telling where the line of reflection is, or in which direction the rotation occurs and how many degrees.

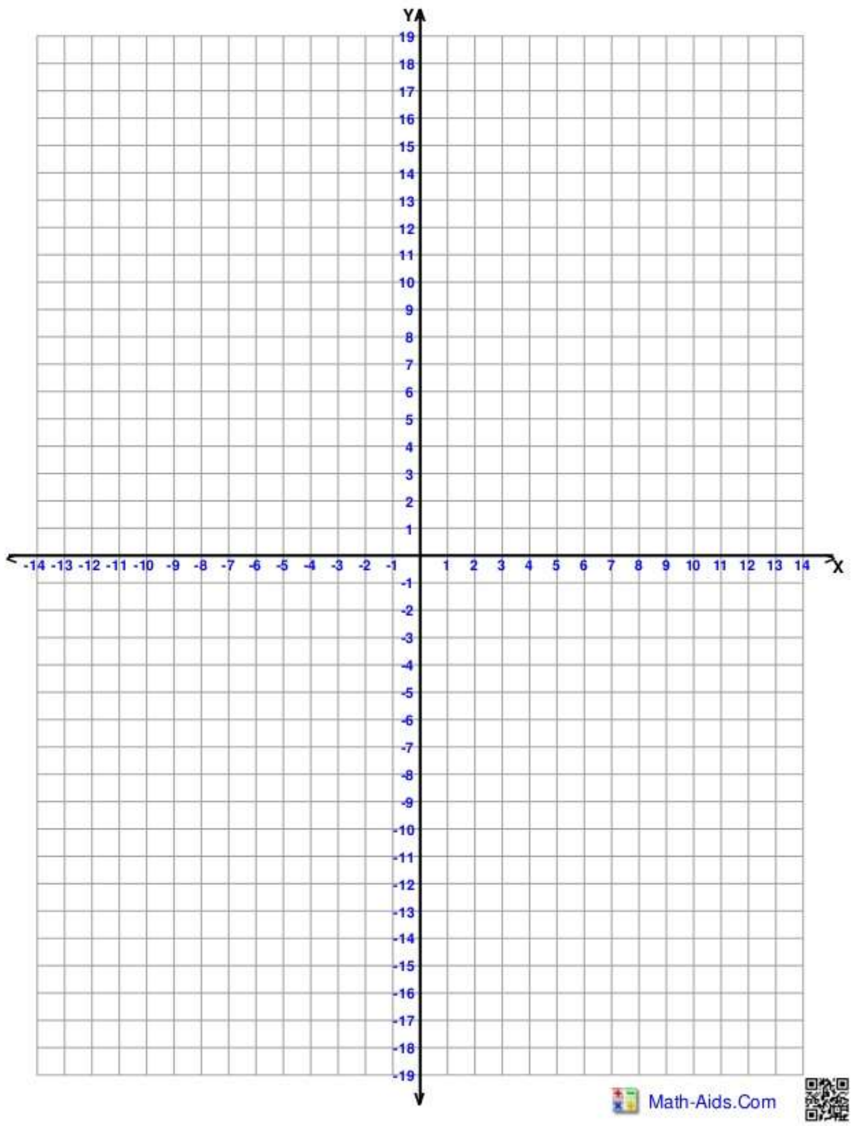
A. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \cdot S$



B. $\begin{bmatrix} \frac{3}{5} & -\frac{4}{5} \\ \frac{4}{5} & \frac{3}{5} \end{bmatrix} \cdot S$



C. $\begin{bmatrix} 2 & 0 \\ 0 & 4 \end{bmatrix} \cdot S$



4. Find a 2×2 transformation matrix that will leave your image unchanged.

Do you think there is more than one matrix that would have this effect? **Explain your thinking**.

5. Find a 2×2 transformation matrix that will make your image shrink into a single dot.

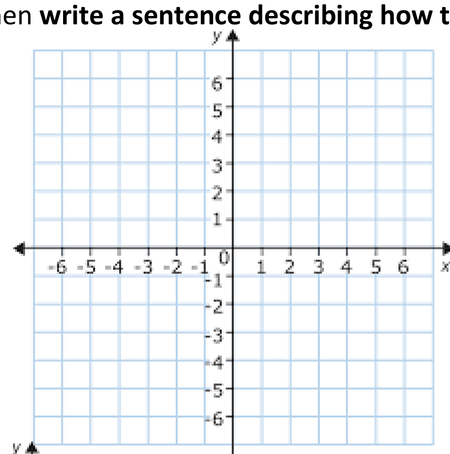
Do you think there is more than one matrix that would have this effect? **Explain your thinking**.

Can you find a matrix that will flatten your image into a horizontal (or vertical) line?

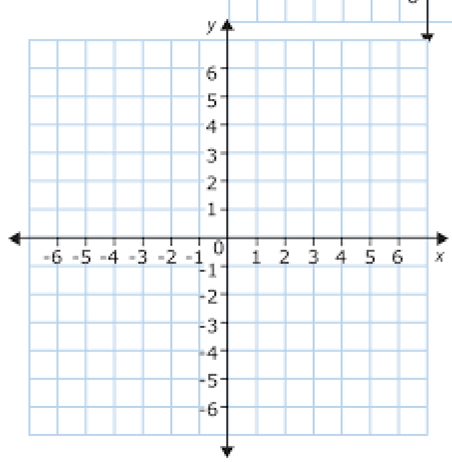
6. Represent your shape using a 3×n matrix adding a third row of all 1's to matrix S from Question 1. This extra row will allow for additional transformations, which you will explore below. **Call this matrix R.**

7. Write the product of each matrix below, and again graph the resulting shapes. Use the row of 1's for your calculation, but ignore it when you graph, inly using the first two rows to graph the coordinate points.. Write out the products, and then **write a sentence describing how the image has been transformed.**

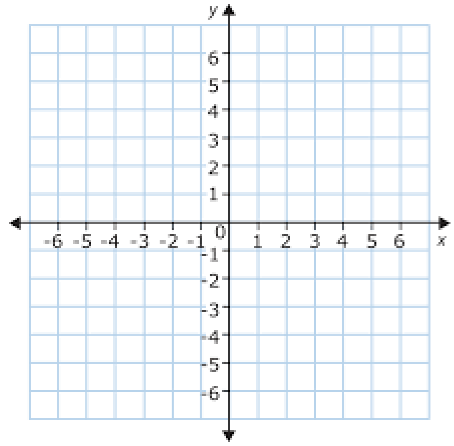
a. $\begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot R =$



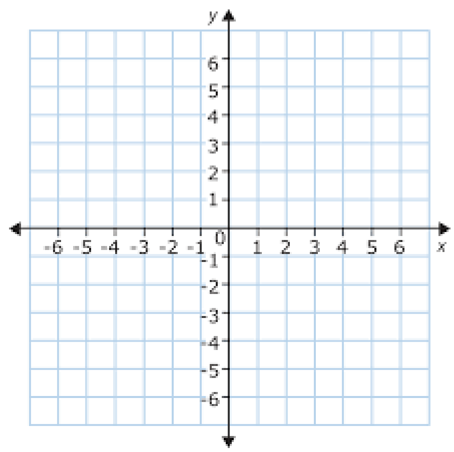
b. $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -3 \\ 0 & 0 & 1 \end{bmatrix} \cdot R$



c. $\begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & -3 \\ 0 & 0 & 1 \end{bmatrix} \cdot R =$



d. $\begin{bmatrix} 1 & 0 & 2 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot R =$



8. Create your own 3x3 transformation matrix. Before multiplying, predict what you think will happen to the original image. Then graph to check.