

# FUNNY FACE

## Brief Description:

Participants sit in front of the camera and the machine takes 4 pictures in succession. The first picture is not altered. For each of the other three, the computer randomly picks one mathematical transformation from a built-in library, and shows the picture with that transformation. The user can adjust the slider on the screen to change the amount of distortion in the transformation, and see how that change affects the picture.

## Objectives:

Students will see how a mathematical equation can be used to distort an image. They will learn more about graphs and see firsthand the effect of some unusual transformations.

## Links to Websites:

<http://mathmidway.org/Training/face.php>

## Vocabulary:

Abscissa	Cartesian coordinates
Ordinate	Parameter
Pixel	Polar coordinates
Reflection	Rotation
Scale	Translation

## Before:

- ⊙ (Level 1, 2) Give groups of students a piece of silly putty to roll out flat on the table. Draw a picture of something and transfer it onto the silly putty. Now stretch the silly putty to distort your drawing.
- ⊙ (Level 1, 2, 3) Create rubber band secret messages by writing on a stretched rubber band and then letting it shrink.
- ⊙ (Level 1, 2, 3) Draw shapes on a balloon. Stretch the balloon and discuss the distortion.
- ⊙ (Level 2, 3) Activities like those listed above can also be done on a computer using any draw program (Illustrator, Intaglio, Concept Draw, etc.) or Photoshop. They all contain options to distort/transform an image.

## During:

- ⊙ (Level 1, 2, 3) Each student should take his/her photo and distort the image, as per instructions on the training video.
- ⊙ (Level 2, 3) Record the formula for the distortion.  
*How does the image change as a value (parameter) in the formula is increased or decreased?*

## After:

⊙ (Level 2, 3) Distorting a polygon:

1. On a sheet of graph paper, mark the origin and draw the  $x$ - and  $y$ -axis.
2. Draw a polygon whose vertices are at points on the Cartesian plane. Use any polygon you like. Pentagons work very well for this exercise.
3. Label each of the vertices with a letter and write the coordinates that correspond to the letter elsewhere on the paper, for example:  $A(1, 1)$ ,  $B(1, 3)$ ,  $C(2, 4)$ ,  $D(3, 3)$ , and  $E(3, 1)$
4. Transform this shape similarly to how Funny Face distorted your photo. The first transformation is this  $x' = x + y$  and  $y' = x - y$ . Figure out what each of the new coordinates for your shape would be. For the example shape listed above, they would be:  $A'(2, 0)$ ,  $B'(4, -2)$ ,  $C'(6, -2)$ ,  $D'(6, 0)$ , and  $E'(4, 2)$ .
5. Plot the new points on the graph paper. Use a different color ink or pencil to draw the new shape. *How has the shape changed?* (Has it been scaled, reflected, rotated, and/or translated.)
6. Try another distortion formula. This time try  $x'' = 2x + y$  and  $y'' = x + 2y$ . For this distortion on the original example coordinates, the new coordinates become:  $A''(3,3)$ ,  $B''(5,7)$ ,  $C''(8,10)$ ,  $D''(9,9)$ , and  $E''(7,5)$ .
7. Plot the new shape and describe how it looks now.
8. Have students make up their own distortion equations and plot them on graph paper.

Investigations: *What happens when you take your original shape, apply the first distortion, and then apply the second distortion to the new coordinates instead of the original ones? How do you think the funny face exhibit was distorting the image coming from the webcam at the exhibit?*

[Answer: If you look at a computer screen closely, the image is made of pixels, which are tiny divisions of the entire image. Each of those pixels has coordinates, just like the vertices of the polygons from this activity.]