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## Digital Kids Club

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Are you really symmetrical?

Perhaps no other image is as well-known as the human face. What better subject could be used to reinforce simple principles of mathematics and to generate interest in middle school students? This lesson will utilize digital manipulation of a personal image to help students visually understand geometric concepts.

**Grade level:**

6th-8th

**Subjects:**

Math, visual arts, technology

**Skills addressed:**

Photography, Geometry, Composition

**Materials:**

Computer  
Digital cameras  
Printer (optional)

**Time**

**commitment:**  
Approximately class periods (dependent on students' computer skill levels and availability of software and hardware)

**Products used**

Adobe®  
Photoshop®  
Elements

Objectives

- Develop an understanding of geometric concepts by analyzing the relationships of points, lines, and angles by observing patterns.
- Differentiate between symmetry and asymmetry.
- Use reflectional (or mirror) symmetry, and repetition design, to transform images and to create original compositions.

Background information

- Frontal headshots of each student are required for this lesson. Head-and-shoulders pictures should be taken to the lesson. The photographer should be perpendicular with the subject, creating a full-face image; i.e., there is no angle of the subject's face to the camera lens.
- Students should be familiar with the Photoshop Elements

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**Blue Pixel**

Professional advice from the photography experts

**Whyville.net**

An online community dedicated to learning through exploration and communication

interface and toolbox.

- Students will use their own headshot image for image editing and manipulation.

Discuss the meaning of symmetry and asymmetry. Ask students to think about features and arrangement of the p of the human face. If needed, the teacher may want to prc his/her own facial image, pointing out points, lines, or ang

Ask students to point out the imaginary line at which the arrangement, or *design*, of the human face becomes repetitious. Ask students whether their faces are symmetri Challenge students to prove that *they are truly symmetric*, creating two distinct images: a “left” face composition and “right” face composition. Finally, have students compare th results of each composition, and compare the results of th transformations to the original headshot image.

**Vocabulary — mathematical and visual imaging conc**

- Symmetry
- Asymmetry
- Axis
- Balance
- Repetition
- Composition
- Reflection
- Rotation

Process/investigation:

**Adobe Photoshop Elements Opening Screen**

Adobe Photoshop Elements Opening Screen gives the user many options for working with images.

In this project module, we will START FROM SCRATCH to explore many painting tools and filters. The following exerc will introduce the painting tools students can use to create original drawings in Photoshop Elements.

**Step 1.** Using Photoshop Elements, ask students to open t headshot image.



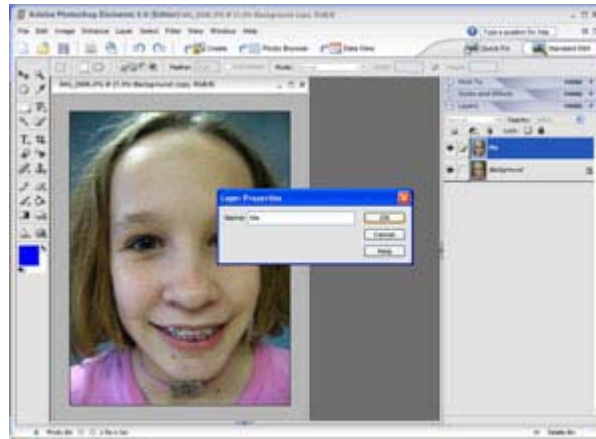
**Step 2.** Using the layers palette, duplicate the background by right-clicking the layer and selecting Duplicate Layer.



**Step 3.** Rename the duplicated layer by right-clicking the "Background Copy" layer and choosing "Rename."



**Step 4.** Rename the layer "your-name."



**Step 5.** Make your named layer active by selecting it. It will appear highlighted in the Layers Palette.

Using the Rectangular Marquee tool, drag a rectangular selection from the upper or lower left corner through the "imaginary axis" of facial symmetry on the image.

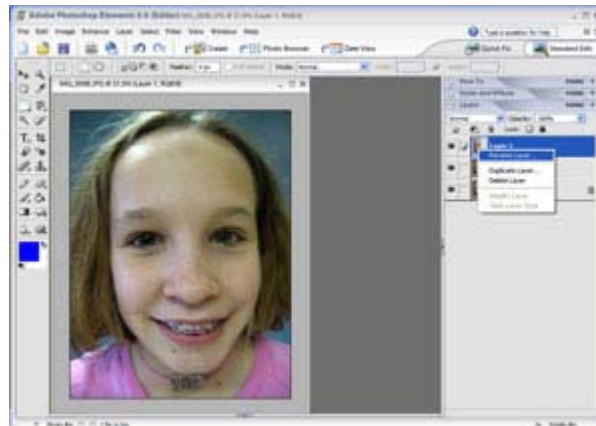
Right-click the selected area and choose Layer Via Copy.



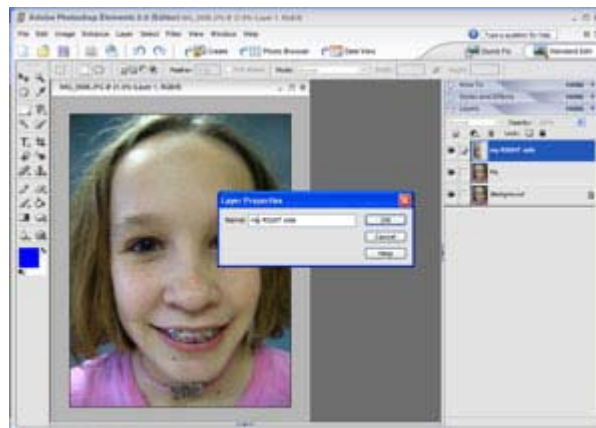
**Step 6.** The layer should appear in the Layers Palette as L 1.

Rename the layer "my RIGHT side."

NOTE: You are facing the image by working on it — it is the right side of the face of the subject in the picture.



**Step 7.** Layer name will appear as “my RIGHT side.”



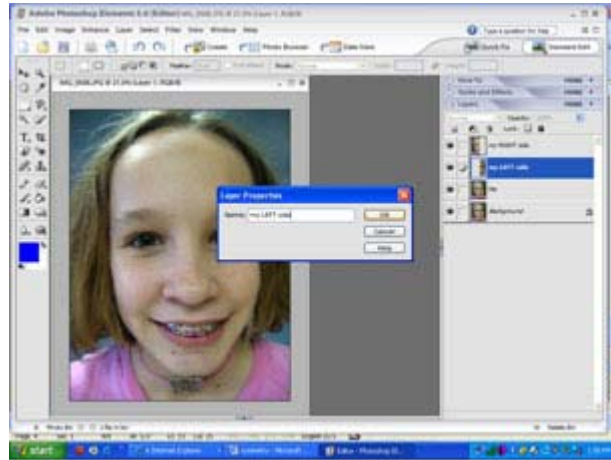
**Step 8.** Now return to the layers palette and make sure the layer with your name on it is the active layer. You will know it is active when it is highlighted in blue.

Use the rectangular marquee tool to select the right side of the image from the upper or lower right corner through the “imaginary axis” of facial symmetry on the image.

Right-click the selected area and choose Layer Via Copy.



**Step 9.** Rename the new layer “my LEFT side.”

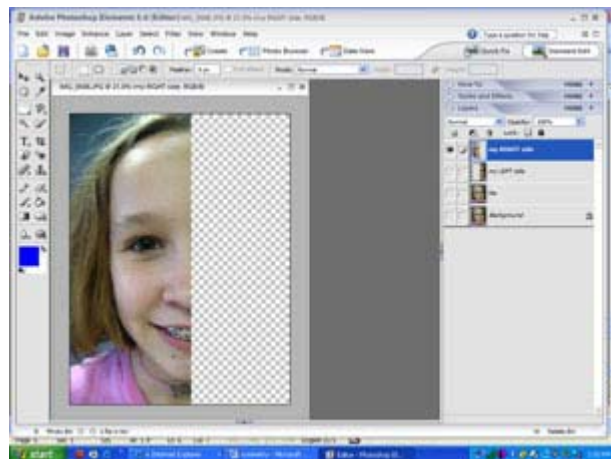


**Step 10.** Now let's work on one layer at a time.

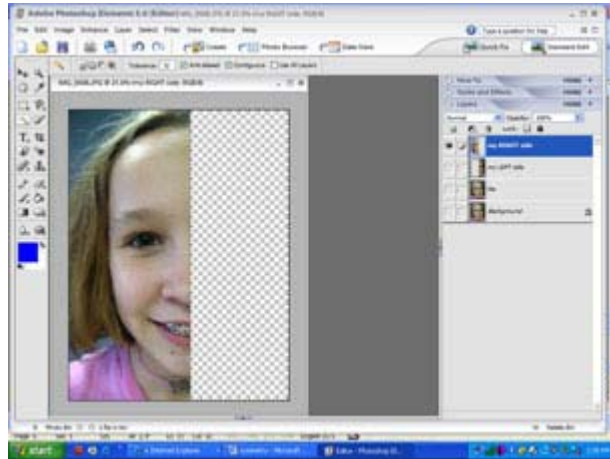
We'll work on “my RIGHT side” first.

Cut the visibility of all the other layers off by clicking the eye icon beside each layer.

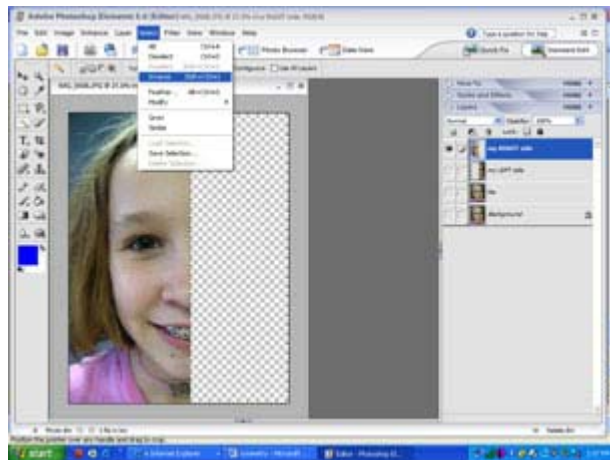
Make sure “my RIGHT side” is the active layer by clicking it verifying that it is highlighted in blue.



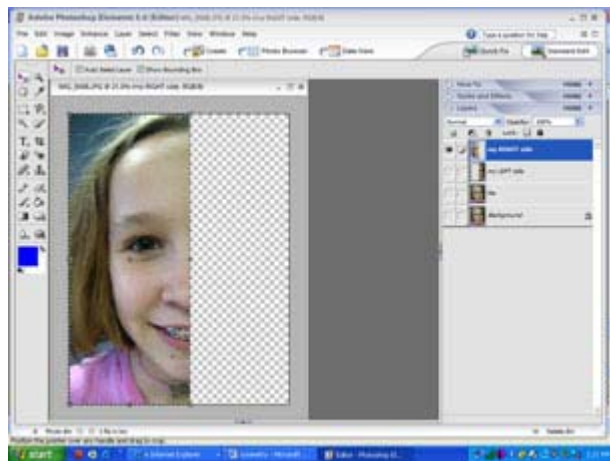
**Step 11.** Use the Magic Wand tool to select the blank checkerboard area of the image.



**Step 12.** Invert the selection by going to the Select menu choosing Inverse.



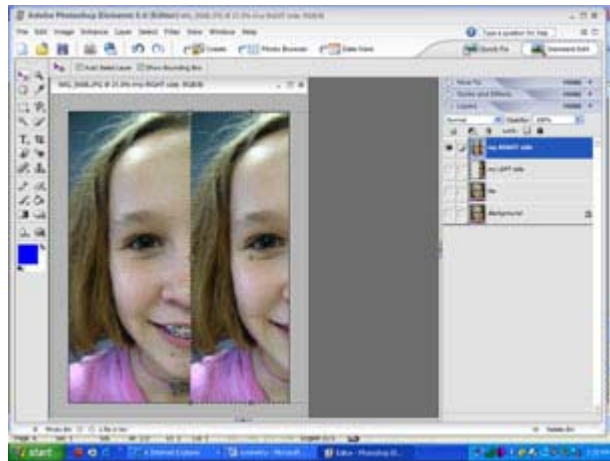
**Step 13.** Performed correctly, facing the computer screen, left side of the image will be selected.



**Step 14.** Choose the Move tool. Hold down the Alt key while using the move tool.

Click and drag the selection to the right while holding down Alt key.

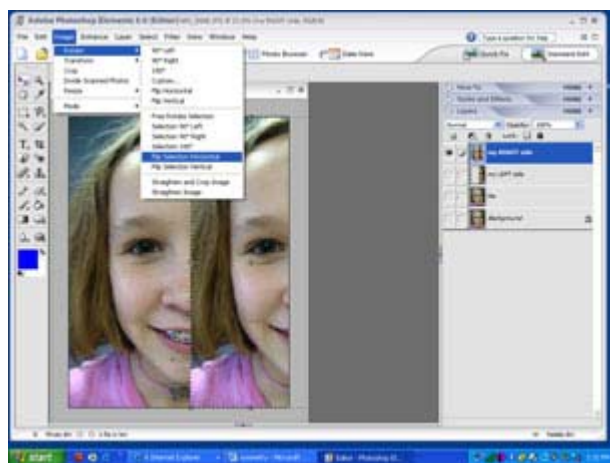
You'll be duplicating and moving a copy of the selection to other side of the image.



**Step 15.** When the duplicated selection is properly aligned against the imaginary center axis of the subject's face, release the mouse to set the selection in place.

Next, you will need to flip the selection to create reflection (mirror) symmetry.

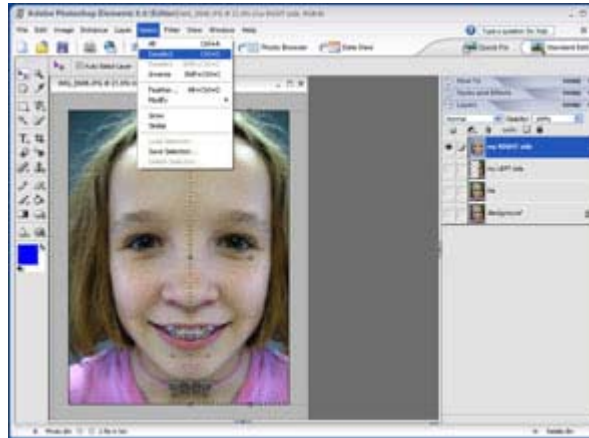
Go to the Image menu, choose Rotate, and Flip Selection Horizontal.



**Step 16.** Go to the Select menu and choose Deselect to remove the selection lines.

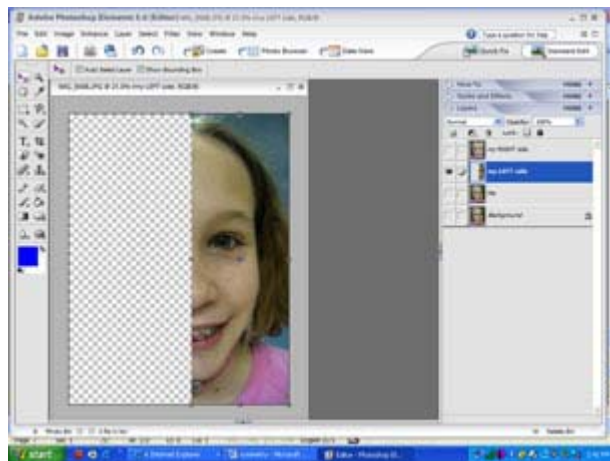
This completes the layer "my RIGHT side."

Turn the visibility/eye icon off for the Layer "my RIGHT side"



**Step 17.** Now make the Layer "my LEFT side" the active layer

Cut the visibility/eye icon on and repeat the process described in steps 11-16.



**Step 18.** Upon completion, save the file as an Adobe Photoshop document so that all the layers are intact.

If needed for discussion, print hardcopies of layers:

- my RIGHT side
- my LEFT side
- your-name layer



### Background information

1. The teacher should point out that the duplication of the right sides of the face and two left sides of the face is an example of reflectional symmetry.
2. Ask students to examine the layers "my RIGHT side" and "LEFT side" and to compare them to determine their similarities or differences.
3. Ask students to describe the reasons for similarities or differences in the two composite layers. (Remind students that the quality of the original headshot may alter some representations and conclusions.)
4. Ask students whether a truly "symmetrical face" would appear the same in both right and left composite layers. Why or why not?

### Evaluation criteria

Evaluations should be based on the student's:

- Ability to draw a critical analysis from the composite image
- Ability to follow directions and utilize computer technology and software application.
- Understanding and use of vocabulary in discussion and descriptions.

### Extension activities

- Stylize layers by applying filters or other enhancements
- Copy selected layers to new Photoshop Elements documents, repeating, rotating, and further transforming to create new patterns and motifs.

### Credits

This lesson was created by Cathy Layman of Roanoke County Public Schools in Virginia.

Related resources can be found at the [PBS TeacherSource Mathline](#).

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