

Math and Art

Grades: 4–6

45 minutes

Procedures

- As with all tours, timing is critical. Therefore, please refrain from discussing concepts that are not included in this tour packet. If you are asked by the teacher or students to do so, invite them to return to the galleries after the tour or activity themselves. When the teachers sign up for this tour, they are informed that their students will not see the entire museum.
- This tour is cyclical. Each stop starts off with a concept discussed at the previous work.
- You may start at any painting; however, they must be seen in order.
- All tours should begin with the introduction, and all stops should start with the timeline exercise.
- Props and one docent stool need to be placed at each stop prior to the beginning of the tour.
- The timeline will be carried with your group.
- Be sure to give yourself enough time (roughly nine minutes) to cover all five stops.
- If needed, use other paintings in the immediate vicinity to further the discussion.
- Pertinent vocabulary is written in italics.

Rotations

1	2	3
Foyer Floor- Radial design	Contemporary Hallway- Rock Shop Billboard	Portrait Gallery- Samuel Morse- <i>Untitled</i>
Portrait Gallery- Samuel Morse- <i>Untitled</i>	Landscape Hallway- Avenue of Oaks	Contemporary Hallway- <i>Daughters of the South</i>
Contemporary Hallway- <i>Daughters of the South</i>	Foyer Floor- Radial design	Contemporary Hallway- Rock Shop Billboard
Contemporary Hallway- Rock Shop Billboard	Portrait Gallery- Samuel Morse- <i>Untitled</i>	Landscape Hallway- Avenue of Oaks
Landscape Hallway- Avenue of Oaks	Contemporary Hallway- <i>Daughters of the South</i>	Foyer Floor- Radial design

Props:

Timeline

Shape overlay chart

Facial proportion chart

Perspective Chart

Tour Objectives

Students will...

- Learn about and discuss mathematical concepts found in artwork.

- View five different paintings in the Morris Museum's permanent collection galleries.
- Analyze paintings to determine how artists used mathematical concepts to create unified compositions.

Tour Tips

- Demonstrate balance by having a volunteer stand on one foot with their arms to the side, discussing how they can be easily tipped towards the weight-bearing foot. Paintings have the same issue with visual balance; if it is desired, artists must use various techniques to achieve it.
- This can also be used to demonstrate symmetry and asymmetry.
- When discussing one-point perspective, ask the students to close one eye and use their index finger to follow the orthogonal lines to the vanishing point.
- Teach the students how to use a pencil to identify proportions. Close one eye (the same eye each time). Keeping the arm completely straight, hold the pencil so it is parallel to the picture plane. Use your thumb to measure lengths and widths of shapes and compare these measurements to other areas.
- Have the students hold and manipulate the props. Use different volunteers at each stop.
- Ask questions! Before providing information, ask the students various questions that lead them to discover the answers themselves.
- Do not hand out pencils until they are to be used. Once the activity is over, collect them.
- **If time permits**, ask the students to identify the concepts you have just discussed in surrounding works.
- Stick to the nine minute rule. If there is more than one group in the gallery, you must be aware that their tour also depends on your timing. If you spend more than your allotted nine minutes at one stop, other groups may end up waiting, which decreases their discussion time with the artwork. Please use a stopwatch to keep track of your time.
- Avoid referring to artists or artwork the kids have not seen.

Introduction

Concept:

Estimation

Props:

Timeline

1. Explain that the students will view artwork from different time periods, with the oldest work having been completed in the nineteenth century, and the newest done in the twenty-first century.
2. Briefly discuss *estimation* (a calculated approximation).
3. Have two students hold up the timeline, while a third estimates where the artwork would fall on the line. **This procedure should be repeated at each stop.**

Radial design in the second-floor lobby, c. 1992

Concepts

Estimation
Symmetry
Asymmetry
Radial pattern
Polygons

Props:

Timeline
Shape overlay chart

Procedure

1. Complete the timeline exercise.
2. Define the term *polygon* (a plane figure bounded by straight edges). Using the overlay chart, identify the types of polygons, pointing out how smaller polygons are grouped together to create larger ones. [Shapes include squares, diamonds, *parallelograms*, triangles (*equilateral*, *isosceles*, *right*, and *scalene*), trapezoids, *trapeziums*, *rhombuses*, stars, and a *triacontakaidigon* (also known as a *dotriacontagon*)—which is the overall 32-sided shape.]
3. Discuss *radial patterns* (a pattern that branches out in all directions from a common center). Describe the characteristics of the radial pattern on the floor using the paper copy. How many folds does it take to create a tricotakaidigon? List other radial patterns found in math or nature.
4. Define the terms *symmetry* (exact reflection of form on opposite sides of a dividing line or plane) and *asymmetry* (a balanced and orderly arrangement of objects and/or space but not a mirror image arrangement). Which term best describes this pattern? Identify examples of symmetry in the floor pattern, as well as other areas of the room and/or in nature.

Samuel F.B. Morse *Untitled*

Concepts

Estimation
Symmetry
Proportion
Ratios

Props

Timeline
Facial proportion chart



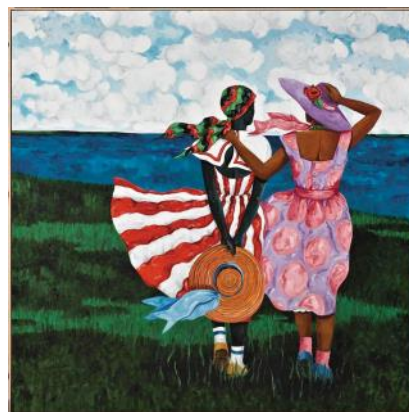
Procedure

1. Complete the timeline exercise. [Since this work is undated, have the student place it in the “early-nineteenth century.”]
2. Define the terms *symmetry* and *asymmetry*. Which term relates to the human face?
3. Define the term *proportion* (*the relation between elements and a whole*). Using the facial proportion chart, relate the various proportions of the face noting that these are only guidelines as every individual is unique.
 - a. The height of the head is equal to the width (tip of the nose to back of head) of the head.
 - b. The eyes are halfway between the top of the head (excluding hair) and the chin.
 - c. The bottom of the nose is halfway between the eyes and the chin.
 - d. The mouth is halfway between the nose and the chin.
 - e. The corners of the mouth line up with the centers of the eyes.
 - f. The top of the ears lines up above the eyes, on the eyebrows.
 - g. The bottoms of the ears line up with the bottom of the nose.
 - h. The space between the eyes is the same as the width of one eye.
 - i. The width of a face is equivalent to the width of five eyes.
 - j. The mound of the chin starts at the inner corners of the eyes.
4. Demonstrate how to use a pencil to look for these proportions in the Morse portrait, excluding a, f, and g.
5. Define the term *ratio* (*the relationship between two quantities*). Guide the students through the process of determining the ratio of the width of the eye to the width of the face. (Eye:Face= One Eye:Five Eyes=1:5). It is a 1:5 (one to five) ratio.

Jonathan Green ***Daughters of the South, 1993***

Concepts

Estimation
Asymmetry
Balance
Proportion
Ratio
Depth



Props

Timeline
Figure proportion chart

Procedure

1. Complete the timeline exercise.
2. Define the terms *symmetry* and *asymmetry*. Which term relates to the painting? [It is an

asymmetrical design.] How does Green achieve *balance*? [Although it is asymmetrical, Green achieves balance by placing heavy horizontal lines to the left of the center line. These mimic the horizontal lines formed by the landscape.] Which term, symmetry or asymmetry, describes the human body?

3. Define the term *proportion*. Using the figure proportion chart, relate the various proportions of the human body noting that these are only guidelines as every individual is unique.

- The human figure is on average 8 heads high.
- The width from shoulder to shoulder is equal to 3 heads for men (or two heads on their sides for women).
- The distance from the hip to the toes is 4 heads.
- The distance from the top of the head to the bottom of the chest is 2 heads.
- The width of the hips is two heads.
- The distance from the wrist to the end of the outstretched fingers of the hand is 1 head.
- The distance from the elbow to the end of the outstretched fingers is 2 heads.

4. Demonstrate how to use a pencil to look for these proportions in the Green painting (steps a, b, and c).

5. Define the term *ratio*. Guide the students through the process of determining the ratio of the height of the head to the length of the body. (Head:Body= Height of Head:Length of Body=1:8). It is a 1:8 (one to eight) ratio. Using the proportions listed above, calculate other ratios.

6. Define *depth* (*in artwork, it is the perception of space*). How has Green created the illusion of depth? [Overlapping shapes and vertical location.]

7. Point out the *horizon line* (*the line where the sky meets the earth*). Estimate how much of the canvas is above and below the horizon line (about 1/3 is sky).

Julyan Davis

Rock Shop Billboard, 2007

Concepts

Estimation
Asymmetry
Balance
Depth
Perspective
One-point perspective

Props

Timeline
Perspective chart

Procedure

- Complete the timeline exercise.
- Define the terms *symmetry* and *asymmetry*. Which term relates to this painting? [It is an



asymmetrical design.] How does Davis achieve visual *balance*? [Although it is asymmetrical, Davis achieves balance by placing heavy diagonal lines moving from the front left to the right rear, and the billboard is balanced by the mobile home and hill to the left of the canvas.]

3. Identify the *horizon line* (*the line where the earth meets the sky, excluding mountains or hills*), leading into a discussion of how artists create depth. What techniques does Davis use to create a sense of depth? [*Overlapping—closer objects are positioned on top of those that are further away; vertical location—closer objects are lower than those that are further away; relative size—closer objects are larger than those that are further away; color—closer objects have purer colors while objects that are further away appear bluish and have a more muted coloring; sharpness—closer objects have sharper focus while objects that are further away have less detail and blurred outlines; and line—the use of diagonal lines to move the eye towards the back of the picture plane.*]

4. Using the perspective chart, note that Davis created a strong line with the rocks that moves the viewer towards the horizon line to create *perspective* (*the appearance of depth in a two-dimensional object*). This technique is called *one-point perspective* (*perspective in which all parallel lines converge at a single point on the horizon or eye level line*).

5. Identify the dominate shapes. How do circular shapes change as they move higher in the picture plane and further back into space? [Using the circle prop, note how the shape becomes an ellipse that progressively gets narrower.] If you were the artist, where would the rock pile (circle shape) be located? How can you tell?

Elizbeth O'Neill Verner

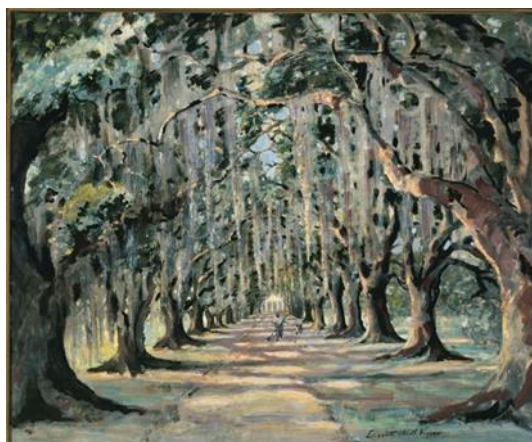
Avenue of Oaks at Litchfield Plantation, c. 1940

Concepts

Estimation
Asymmetry
Balance
Depth
One-point perspective

Props

Timeline
Perspective chart



Procedure

1. Complete the timeline exercise.
2. Define the terms *symmetry* and *asymmetry*. Which term relates to the painting? [It is an asymmetrical design]. How does Woodward achieve *balance*? [Although it is asymmetrical, Woodward achieves balance by painting a heavy patch of bright color, which contrasts with the dark surroundings and matches the sky, to the right of the canvas.]
3. What techniques did Woodward use to create *depth*? [Overlapping, vertical location, relative

size, color, sharpness, and line.] What type of line is most dominate? How does he use these to move the viewer's eye to the back of the picture plane?

4. Using the perspective chart, discuss how Woodward used one-point perspective and define the terms *horizon line*, *vanishing point* (a point in a perspective drawing to which lines appear to converge), and *orthogonal lines* (the converging diagonal lines that meet at the vanishing point).

