Patterns and Symmetry

Intended for Grade: First

Subject: Math

Description: These activities allow students to create, identify, and describe different patterns and symmetries. Through their investigation and subsequent activities, students will begin to develop a greater understanding of patterns and symmetries.

Objective: The student will be able to identify, describe, and extend/manipulate patterns. Students will also be able to identify symmetric objects. Further, students will be able to identify lines of symmetry for a particular symmetrical object.

Mississippi Frameworks addressed:
- Math Framework 1a: Represent and explain patterns using various methods.
- Math Framework 1b: Identify, describe, and extend patterns.
- Math Framework 2e: Identify symmetrical objects and their lines of symmetry.
- Math Framework 2g: Use multimedia resources to explore patterns, symmetry, and shapes.

National Standard addressed:
- Math Standard: Number and Operations and Algebra
- Math Standard: Geometry
- Math Standard: Geometry, Algebra and Representations
Background:

Patterns can simply be described as a procession of repetition of subpart(s). Most people are introduced to patterns by being exposed to a very simple linear pattern which is labeled using a linear sequence similar to form "ABAB". We are surrounded by patterns everyday. In fact, we would have a difficult time making it through just one day without patterns. Patterns are important in bringing order to our daily lives.

Patterns usually are created/recognized from the following: color, size, shape, and order. Color, size, and shape are usually easily used to identify a pattern. Order, on the other hand, can sometimes be difficult to use when trying to identify a pattern. This is somewhat ironic, in that many of the patterns that we experience everyday are ordered patterns, such as time and numbers. Patterns can be found in our simple daily habits such as waking up, brushing our teeth, taking a shower, then brushing our hair.

Common patterns that are created from color, size, and shape, bombard us everyday. Many of these patterns are from simple advertisements or company logos that we see in magazines and on TV. This is because patterns tend to "draw us in," and thus, they are considered a good way to subconsciously sell us goods and services.

Patterns can be found everywhere. From common household items like a quilt or a tablecloth to simpler patterns like the number of windows on a house, patterns surround us. Patterns can also easily be found in music and poetry.

There are many software applications like MS Word and paint shop programs as well as online application that can be used to develop/test students interactively in regards to patterns.

Similar to patterns, symmetry can also be found all around us. Symmetry can be found in living and nonliving things: animate and inanimate objects. Given an item, the item can be classified as either symmetric or asymmetric. The concept of symmetry has been around for a very long time. The word Symmetry comes from the Greek word, "symmetria", meaning "measured together". When we measure something and find it is the same on one side as on the other, we say that it is symmetrical. There are several types of symmetry, but for the purposes of first graders, we are concerned with only one type of symmetry which is line symmetry. Line symmetry is based upon the concept of reflective symmetry. Simply stated, reflective symmetry
is the idea of drawing an imaginary "line of symmetry" down the middle of an item, the right and left sides of the item would be "mirror images" of each other.

An object can have more than one line of symmetry. For example, a two dimensional diamond has four lines of symmetry.

If a line of symmetry can be drawn for an object, then the object is considered to be symmetric.

One way of incorporating technology in teaching symmetry is to use an imaging application like Adobe Photoshop. Using a picture of a human face (for example a student’s or teacher’s face), you can divide the face in half on the y axis, mirror the half of the face, and paste the mirrored image to form the entire image. An example is included in the "Activity Three" section.

Further, although mathematically complex, fractal images can be used to demonstrate both patterns and symmetry. A fractal can be defined as a term for shapes that are "self-similar," appearing the same at different magnifications. A fractal can be created by duplicating a shape successively according to a set of rules. The results can be complex structures, which resemble seemingly random-shaped things in nature, such as clouds, trees, and mountains. An application of fractals is to represent complex imagery in very concise algorithms."

The complex nature of fractals, and the fractal geometry that creates a fractal image, however, should not be introduced due to age appropriateness. Instead, simple introduce the images as examples.
Activity One

Materials:

- Pictures of various patterns
- Pencils
- Paper
- PowerPoint Slide Show

Procedure:

1. Explain to the students that a pattern can be created by color, size, shape, and/or order.
2. Begin this activity by selecting five volunteers from the class.
3. Have the volunteers discuss a pattern that they can create by lining up in a straight line. (Perhaps they can discuss this pattern away from the rest of class, so the rest of the class can try and guess the pattern).
4. Have the volunteers form the straight line.
5. Have students from the class try and interpret the pattern.
6. Next, have the students look around the room, and try and find patterns in the room.
7. Ask several of the students to describe the patterns that they have found in the room. In discussing the patterns that they have found, introduce the linear pattern labeling of the form ABAB . . .
8. Display the patterns included in this activity. For classroom demonstration purposes, the patterns in this activity can displayed using a PowerPoint Slide Show. Have the students identify the patterns that they recognize.
9. Next, have the students create a pattern using a “6”, “3”, & “2”.
10. Next, have the students label their pattern using the ABAB format.
11. Discuss the patterns that were created.
Patterns for Discussion (including answers):

#1

A simple pattern based on color and shape.

ABCABC
This is a harder one. This pattern is based only on the shape, (not color).

ABCDABCD
The pattern is based on only size; not shape or color.

ABBABBA...
#4

Moving away from ABAB patterns, discuss these patterns in general.
#6
Make a few Comments to Aid Discussion.
The American Flag provides an example of two patterns:

- The red, white, red, white, ... of the stripes
- The 5,4,5,4 pattern of the stars.
Activity Two

Materials:

- Pictures of various patterns with "gaps" in the sequence
- Power Point Slide Show

Procedure:

1. For each picture, have the students fill in the missing piece. (Images follow this procedure section). For classroom demonstration, many of these are in the included in the Power Point Slide Show.

2. Using a Multimedia resource like Microsoft paint or a website like, http://www.shodor.org/interactivate/activities/patterns/

3. Have the student help design a sequence to be used to create a pattern, and/or quiz students interactively regarding generated patterns.

4. Have the students participate in creating a fractal image. For example, an image of Sierpinski's Gasket.

5. Begin the image by drawing a very large equilateral triangle on the board.

6. Choose a student to place a dot in the middle of every side of every triangle (one triangle the first time).

7. Choose another student to connect the dots.

8. Ignore any middle triangle.

9. Repeat steps 6, 7, and 8 several times. (Since it is a fractal image, the process repeats to infinity).

10. Ask the students what the pattern might be. Explain to the students that the pattern is an ordered pattern consisting of steps 6, 7, & 8. From the ordered pattern, a pattern emerges based on shape, size, and possibly color (if we used a different color to connect the midpoints of each side).
Sierpinski's Gasket
What comes next?
What comes next?

#2
#3

What comes next?

[Images of various symbols in sequence with a question mark]
What comes next?

#4
#4

What comes next?

[Diagram of sequential symbols with a question mark at the end]
**Evaluation:**

Have students create their own pattern. Their pattern must include at least use two of the following criteria: Color, Size, Shape, and/or Order. Next, have the students trade their pattern with a partner. Have the partner label the pattern using ABAB . . . format.

**Extended Activity:**

Have the students create a quilt from a single pattern. The quilt can be created by giving the class a repeating unit in a pattern (i.e., ABAB pattern). Have each student draw and color the pattern unit on a piece of paper. Once the students have completed their “quilt square,” glue together all of the squares of the quilt. Display the quilt in the classroom.
Activity 3

Materials:

- Pictures of symmetric images that have symmetry.
- Pictures of images that do not have a line of symmetry
- Half pictures (so the other side can be drawn).
- Mirror or Reflector
- **Power Point Slide Show**

Procedure:

1. Display an image of a butterfly to the students. For demonstration purposes, some of these images can be found in the included **Power Point Slide Show**.
2. Introduce the concepts of symmetry and lines of symmetry.
3. Fold the picture in half showing how each side of the image is a “mirror” of the other side.
4. Have students “point out” different objects in the room that are symmetric. Discuss with the students individual object’s line of symmetry.
5. Show other images to the class, and have the students find the line or lines of symmetry for each image.
6. Ask the students about the symmetry of a Human.
7. Using Adobe Photoshop, mirror image one half of a student’s face to create a whole face. Explain to the students, that for the most part we are symmetric (see “symmetry pictures 15 & 16”).
8. Have a student draw a repeating pattern on the chalk board.
9. Using that pattern, have another student draw a line of symmetry on that pattern.
10. Investigate with the students the concept of a mirror image. Using the mirror, show the students the mirror reflection of an object placed in front of a mirror. Explain how the mirror surface is the line of symmetry.
11. Have students complete the mirror image of different "half images."

Symmetry Pictures
#1
#3
#5

A Hexagon
#6

A Square
#7

A Triangle
A Heart
#10
Half Image Completion

Directions: Using the dotted line as the line of symmetry, complete the picture.
Half Image Completion

Directions: Using the dotted line as the line of symmetry, complete the picture.
#15

Before

- Image of a person smiling.

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#16

After (Using Adobe Photoshop)
Evaluation:

Given several pictures, students should be able to find lines of symmetry for each picture, if they exist. Given half of an image, students should also be able to draw/complete the other side of the image. The following Worksheet can be used for evaluation purposes. It contains a few of the previously shown pictures.

Sources:

- http://www.punahou.edu/acad/sanders/geometrypages/GP04Symmetry.html
- http://www.adrianbruce.com/Symmetry/
- www.whamtech.com/glossary.htm

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Draw a line of symmetry for each of the following images. There might be more than one line of symmetry for an image. Some of the images do not have a line of symmetry.
Can You Complete the Rest of this image? The dotted line is the line of symmetry.