Patterns in Nature Exhibit

Educator Resources Packet

Lasdon Park, Arboretum and Veterans Memorial

Table of Contents

Welcome!

Dear Educator,

Thank you for your interest in our *Patterns in Nature* Exhibition. In this packet is information on how to prepare for your visit, what students will learn in the exhibit and suggested educational activities.

Preparing for your Visit

Maximum Students/Chaperones/Aides/Parents

Up to 30 children per group. The role of the chaperone/aides and parents is to enhance the positive learning by encouraging attentiveness, participation and appropriate behavior.

During your Visit

When arriving, attendees will be split up into two groups. One group will be taken to the conservatory to experience the exhibition, while the other group will have a leisurely "Walk-n-Talk" about what an arboretum is, why trees are important and how they connect to *Patterns in Nature.* Groups will then swap. The second group will be taken to the conservatory and the first group will have a leisurely "Walk-n-Talk."

When both groups are done, they will go on a *Patterns in Nature* Scavenger Hunt, looking for natural patterns in the park. The Scavenger Hunt, included as an activity, can also be used indoors to identify man-made patterns.

At your discretion, you may have a snack/lunch break on the lawns or picnic tables either before or after the Scavenger Hunt.

The following manual will provide the Scavenger Hunt activity (pg. 3-5) that will be completed during your visit as well as Pre or Post trip activities (pg. 6-17) for you to complete with your group.

We look forward to inspiring conversation, awareness and discovery about all the patterns that surround us!

Lasdon Park Educators

Patterns in Nature

Introduction

Nature provides us with a mesmerizing tapestry of patterns that can be found everywhere! Our brains constantly crave patterns and search for ways to respond to them. By becoming aware of the patterns of nature, we can gain an understanding and appreciation of the world we live in and find out that we are all interconnected by patterns.

Patterns in nature can be formed by a repetition of shapes, colors, movements, sounds, or textures, and they exist in nature for a variety of reasons. Some patterns exist because they are the most efficient way to make use of space, such as the hexagon shape of a beehive. Some patterns offer protection to animals, like the camouflage on leopards or the spiral of a ram's horns. Overall, patterns evolve in nature because it gives that organism the best chance of survival.

We curate and mimic patterns all the time in order to make sense of the natural world, and to adapt and evolve our own way of life. Nearly every area of study and invention has relied on the study of natural patterns. Mathematics, engineering, science and art in particular each have origins in observing the patterns found in nature.

Having an awareness of patterns also helps our well-being. Looking for patterns in nature reduces stress, increases mindfulness and creativity, and helps us realize the interconnectedness of all things.

The Six Patterns:

While there are many kinds of patterns in the world, most can be placed into six main categories:

1. **Tessellations**
2. **Spirals**
3. **Symmetry**
4. **Branching/Meandering**
5. **Explosions**
6. **Fractals**

For each of these types of patterns, the exhibit has a corresponding room that explains what each pattern is, why it is important, where it is found in nature, and how we have adapted it for our own uses.

Pattern Scavenger Hunt

Objective

- To deepen childrens' connection to nature by looking for the patterns that are all around us
- To enhance observation skills

Materials

- Copy of scavenger hunt for each participant
- Pencil or pen

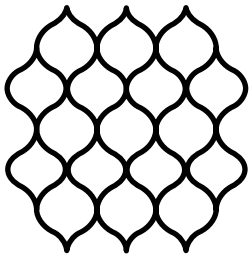
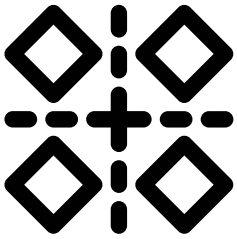
Procedure

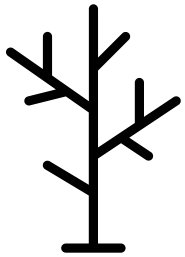
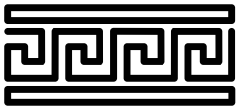
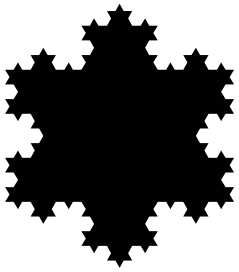
1. Hand out copies of the scavenger hunt to each participant.
2. Identify and categorize different types of patterns. Search outdoors in the park to find natural patterns, and indoors to find man-made patterns.

Teaching Concepts

- A scavenger hunt is a great way to get thinking about some of the patterns that surround us, and to start noticing more details in nature that we see all the time.
- Being aware of patterns can inspire curiosity, spark creativity and lead to new scientific, mathematical and artistic research and discoveries.

Patterns in Nature Scavenger Hunt

Pattern	Example	Patterns Found in Nature	Man-made Patterns
Tessellations			
Spirals			
Symmetry			

Pattern	Example	Patterns Found in Nature	Man-made Patterns
Branching			
Meandering			
Fractals			

Tessellations

Objectives

- To learn what a tessellation is and what makes it a pattern
- To identify tessellated patterns in nature and the man-made world

Teaching Concepts

From the Latin word meaning small blocks of stone or glass, tessellations (also known as packing or tiling) are shapes that fit neatly together like jigsaw puzzle pieces. There are no gaps between the shapes, nor do they overlap. The result is a repeating pattern that covers a space in an efficient way.

When nature tries to fit in as much as it can while using as little space as possible, the tessellation is called "packing." The most common shape for this pattern is the hexagon, which can fit together seamlessly. Hexagons can be found in beehives, insect eyes and clumps of floating bubbles.

Because of their visual appeal, tessellations are a design pattern that dates back at least 4,000 years. Mosaics and tilework, for example, are two common forms of art that use tessellations to create stunning and intricate designs. Because tessellations are adept at using space in an efficient way, people have adapted this pattern to design infrastructure such as parking lots, office cubicles and housing. Tessellations can also be found in math and crystal formations.

Tessellated shapes can have regular geometry, such as equilateral triangles, squares and hexagons, but they can also be irregularly shaped as well. These irregular patterns are called Voronoi patterns. Dragonfly wings, giraffe spots and cracked dried mud all have Voronoi patterns.

An artist famous for using tessellations was Maurits Cornelis Escher. He was born in Holland on June 17th, 1898. He is one of the world's most famous graphic artists. His first artwork to feature tessellations, *Lions*, was made in 1925 and block printed on silk. By the time he died in 1972, he had created 137 tessellating artworks.

Lions, 1925

Sky and Water I, 1938

Tessellating Tiles Activity

Objectives:

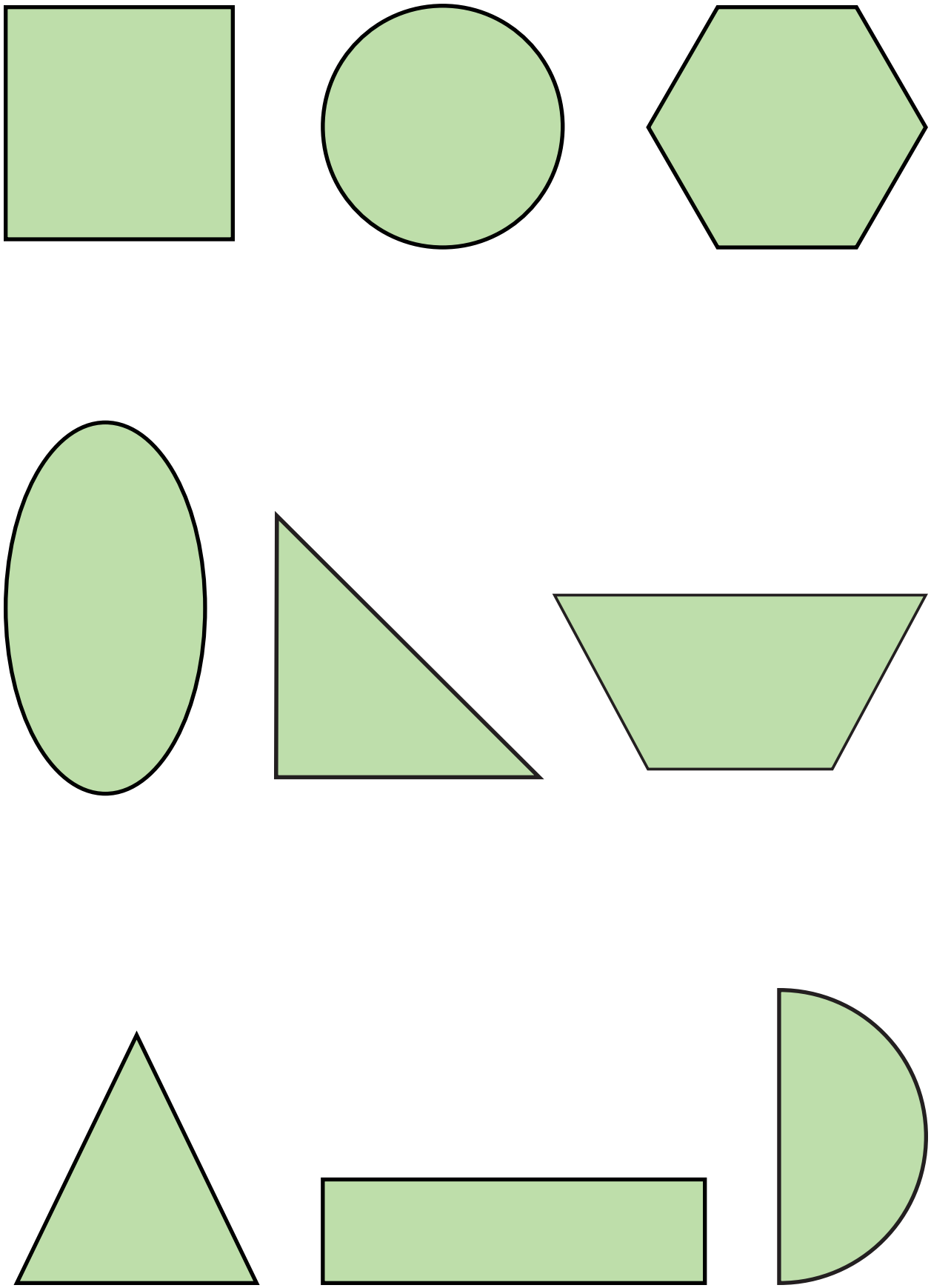
- To gain a better understanding of tessellations by creating your own pattern

Materials, per student:

- Shape printout
- Pencil
- Safety scissors
- Sheets of white paper

Procedure:

1. Cut out the shapes from shape printout.
2. Choose one shape. On a piece of paper, line the shape up with the edge of the paper and trace the shape.
3. Move, flip or rotate the shape so the edge lines up with the first traced shape. Trace again. Continue this step to create a pattern that covers the paper.
4. Repeat the process with the other shapes on their own piece of paper.
5. Figure out which of the shapes can successfully create a pattern that covers the paper with no gaps or overlap. Which shapes made a true tessellation?
6. Compare the tessellated patterns to ones you find in nature.



Spirals

Objectives

- To recognize spirals in the natural and man-made world
- To understand the Fibonacci Sequence and how it appears in nature

Teaching Concepts

Spirals are patterns that wind around a central point then become larger and larger as they move away from that point. By design, a spiral pattern creates a more efficient flow of energy and minimizes any stress on the shape.

Spiral patterns in nature, fascinatingly, have all been found to follow the same precise mathematical sequence regardless of where the pattern is located. This is known as the Fibonacci Sequence, or Golden Spiral.

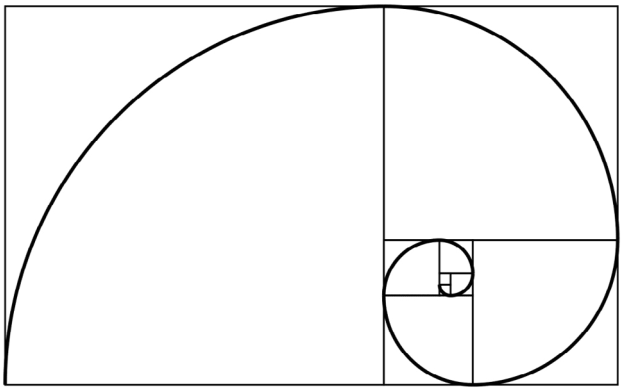
The Golden Spiral

The Fibonacci Sequence, also known as the Golden Spiral or ratio, is a complex natural pattern that presents as a spiral. It can be generated by adding the two previous numbers in the sequence to get the next number: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34 . . . . . .

The sequence is named after Italian mathematician Leonardo of Pisa, who was also known as Fibonacci. His sequence was introduced to the world in 1202.

The Fibonacci Sequence occurs a natural phenomenon in a wide variety of ways. The rows of seeds in a sunflower, the scales of the pinecone, fingerprints, and every spiral-shaped shell precisely follows this mathematical sequence.

In art, design and architecture, this naturally occurring spiral has been adapted to add efficiency and aesthetic sophistication since ancient times. Art in particular uses the spiral as a way to draw the eye to a specific point, communicating and emphasizing its importance to the viewer visually. Vincent Van Gogh's *The Starry Night* is one such example of an artist using the spiral to depict a dynamic, swirling night sky.



Spinning Spirals Activity

Objectives:

- To make a spiral-shaped papercraft and demonstrate the visual appeal of the spiral

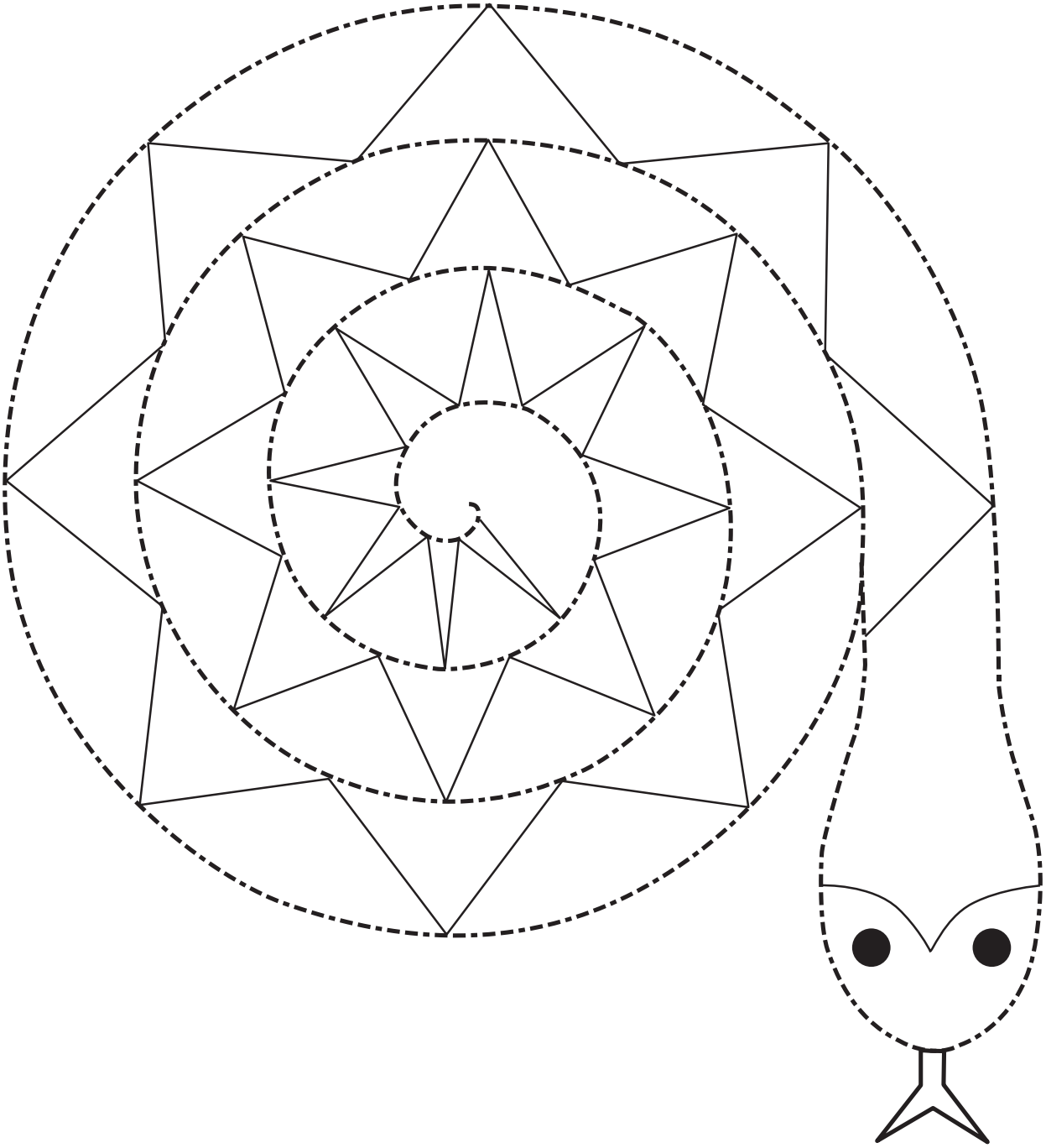
Materials, per student:

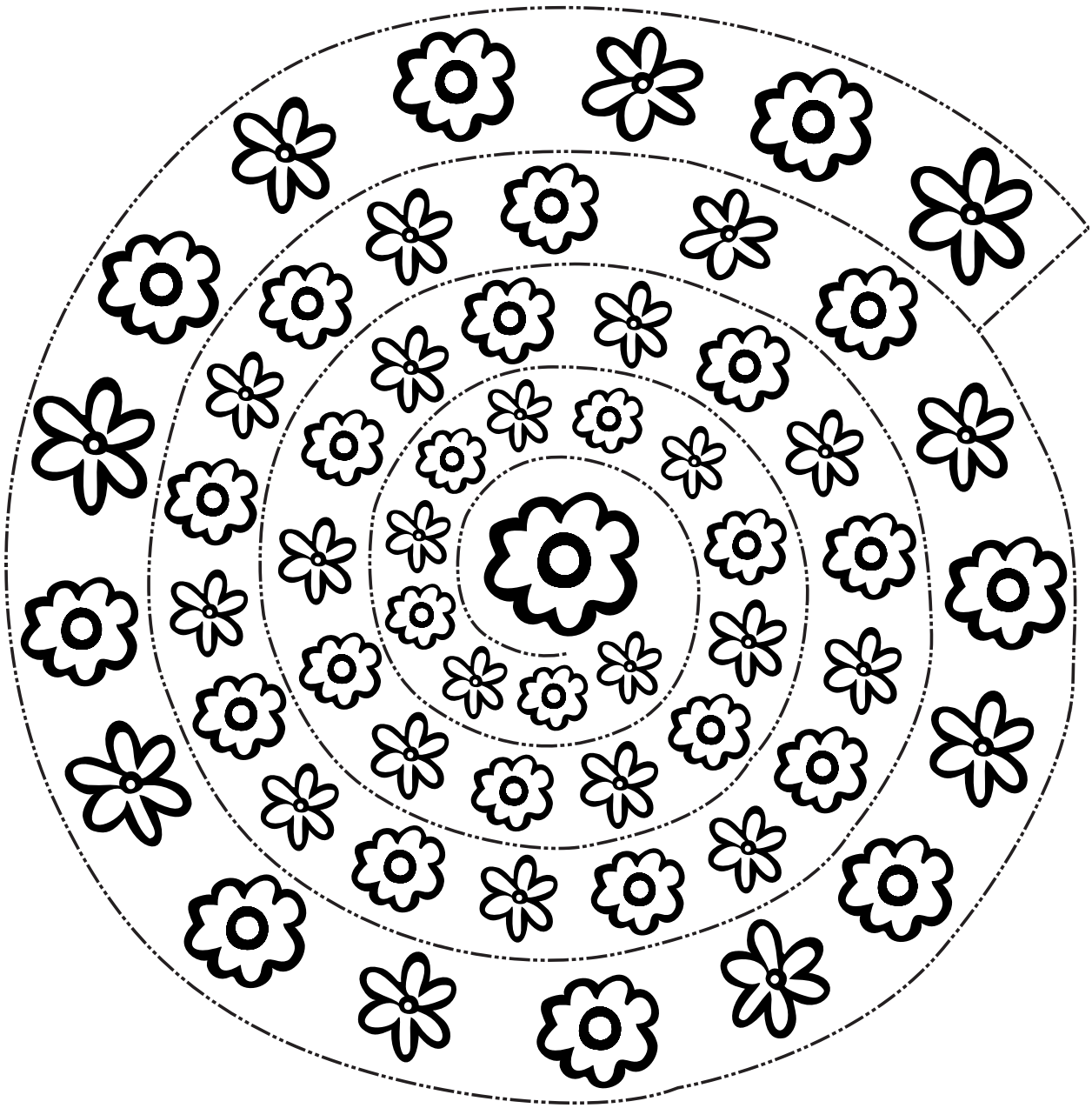
- Photocopy on cardstock of design
- Crayons, colored pencils, magic markers*
- Safety scissors
- Thin piece of string about 6” long

Procedure:

1. Decorate either the snake or the flower spiral using medium of preference.
2. Carefully cut out the design, following the dotted lines to create the spiral.
3. Poke a small hole in the center.
4. Insert string through hole and tie a knot at the bottom so it will not pull through the hole.
5. Gently pull up with the string to expand the spiral.
6. Spin the papercraft and watch the design spiral around!

*Watercolor paint can also be used. If so, cover work surface with newspaper. Have a cup of water for each student to rinse brush.





Symmetry

Objectives

- To identify common objects that display symmetry
- To learn the difference between bilateral, radial and asymmetric symmetry

Teaching Concepts

There are many kinds of symmetry in nature, but the three main types are *bilateral, radial,* and *asymmetry.*

BILATERAL SYMMETRY

Bilateral symmetry occurs when there is a mirror image with a left and right side. Butterflies, most leaves, the human body and most mammals, such as cats and dogs, all have bilateral symmetry. Bilateral symmetry is important for coordinating the movement of body parts, and also helps with visual perception.

Many animals, particularly insects, have bilaterally symmetrical markings that act as camouflage, hiding them against predators. Some moths and butterflies even have symmetrical "false eyes" on their wings to make themselves appear more fearsome.

RADIAL SYMMETRY

Organisms with radial symmetry have lines of symmetry that radiate from a central point, or equally divide up and cross each other, like a pie or wedge shape. This type of symmetry creates balance and harmony, and draws the eye inward towards the center. In nature, organisms such as flowers, starfish and jellyfish exhibit radial symmetry.

In art, radial symmetry serves as a way to create visually captivating compositions, as seen in mandalas, stained glass designs and kaleidoscopes. Artists often employ radial symmetry to convey a sense of harmony and wonder within their works. Engineers and designers draw inspiration from radial symmetry to optimize functionality and aesthetics in various products and structures, such as wheels, turbine blades and clocks.

ASYMMETRY

When two halves of something don't match, such as in the American flag or the differently sized claws of the fiddler crab, it is called asymmetry. It is the absence of balance of any kind. While nature tends to evolve into symmetrical forms, asymmetry can have a vital role in the biology of organisms and can provide visual interest in design. It can be found in the way snail shells twist, the way horses gallop, in rocks, letters, numbers, art and architecture.

Butterfly Balance Activity

Objectives:

- To gain a better understanding of bilateral symmetry
- Provide an example of an organism exhibiting symmetrical patterns

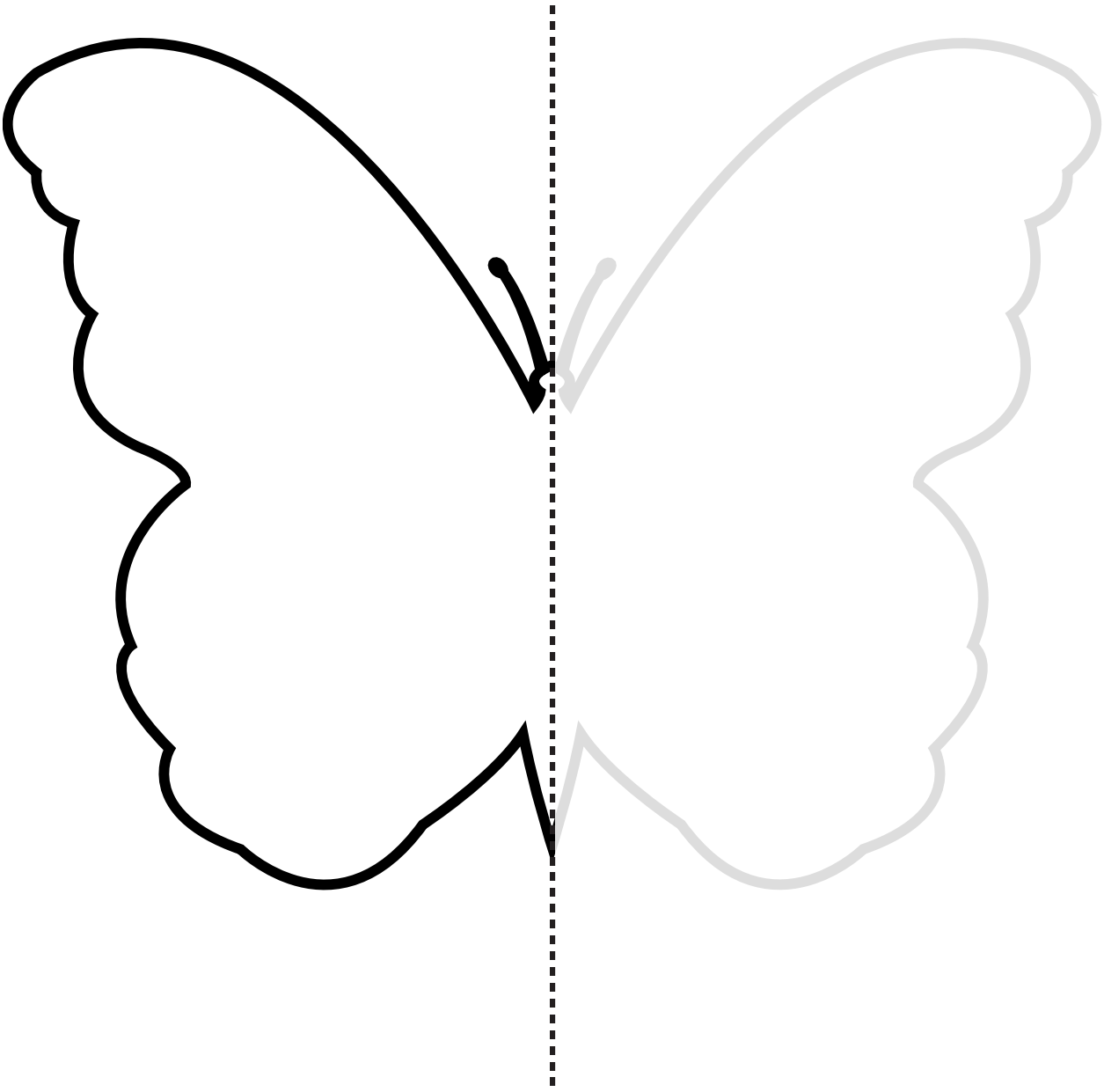
Materials, per student:

- Butterfly handout
- Paint
- Paint brushes
- Container for paint
- White copier paper
- Cup with water for cleaning brushes
- Newspaper to cover tables

Procedure:

Before starting the activity, each person should be working on a newspaper for easy clean-up, and have access to water to clean brushes between paint colors.

1. Fold the butterfly handout in half vertically along the dotted line. Open paper flat again so the paper has a crease dividing it into two equal halves.
2. On the left half, where the butterfly is outlined in black, put dots of paint all over the wing. Do not paint on the right half of the paper (past the dotted line).
3. While the paint is still wet, fold the paper again on the dotted line.
4. Press firmly on the handout while it is folded and then open it to see how the paint transferred to the other side. Do both halves of your butterfly look the same?



Radial Symmetry Snowflakes

Objectives:

- To gain a better understanding of radial symmetry
- To create a radial design resembling a snowflake

Materials, per student:

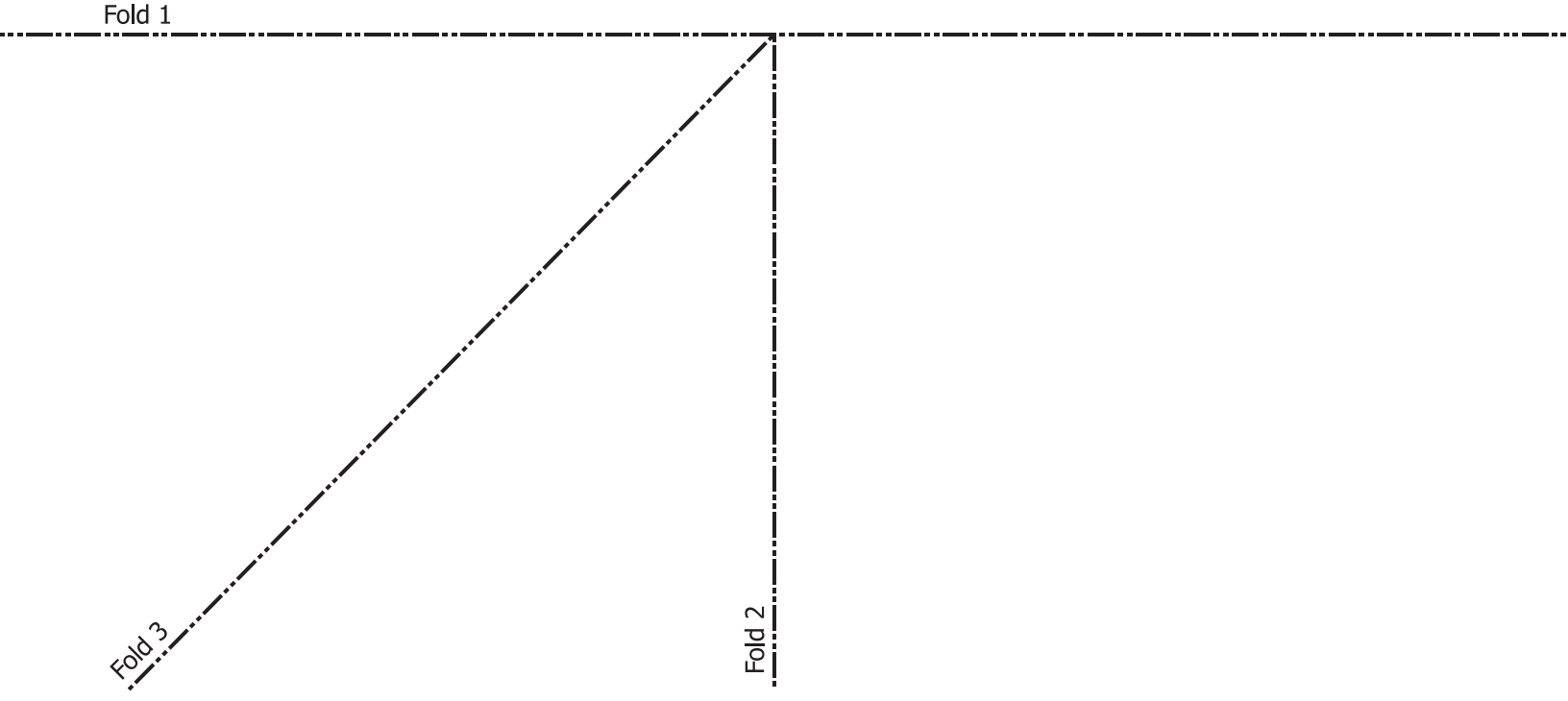
- Template, printed on white copier paper
- Safety scissors

Procedure:

1. Cut on the heavy black line.
2. Fold on the dotted lines.
3. Use the gray line as a center guide; do not cut over it or fold it.
4. Around the outside of the triangle, cut in some fun designs - circles, squares, triangles.
5. Unfold paper to reveal the radial design.

Radial Symmetry Template

Cut Here



Curriculum Connections:

New York State P-12 Science Learning Standards:

Crosscutting Concepts from the Framework: 1. Patterns
2. Scale, Proportion, and Quantity
3. Structure and Function

New York State Next Generation Learning Standards Connections:

Mathematics: NY-PK.G.3 Explore two- and three-dimensional objects and use informal language to describe their similarities, differences, and other attributes. (P-PS 1-1)

Next Generation Science Standards: Structures and Properties of Matter:

Crosscutting Concepts: 1. Patterns: Patterns in the natural and human designed world can be observed (2-PS 1-1).
2. Cause and Effect: Events have causes that generate observable patterns (2-PS 1-4).
3. Energy and Matter: Objects may break into smaller pieces and be put together into larger pieces, or change shapes (2 PSI-3).
4. Influences of Engineering, Technology, and Science on Society and the natural world: Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world (2-PS l-2).

NYS Media Arts Standards:

2nd MA:Re8. l .2: With guidance, determine purposes and themes of media artwork, considering their context.
3rd MA:Re8. 1.3: Interpret the purposes and meanings of a variety of media artworks, considering their context.
4th MA:Re8. I .4: Share reactions and interpretations of a variety of media artwork, considering the purpose and content.

EDUCATOR RESOURCES

WEBSITES:

Fractal Foundation
www.fractalfoundation.org

Natural Patterns are Fantastic
https://ecstep.com/natural-pattems/

Pattern and Design in Nature
https://nature-explorations.com/galleries/pattem-and-design-in-nature/

Tessellation Patterns
https://www.spacemakeplace.com/tessellation-Qattems/

VIDEOS:

Guelph Arboretum: Patterns in Nature
https://www.youtube.com/watch?v=dc9x4VdmnrQ

Nature and Math: The Fibonacci Sequence
https://www .youtube.com/watch?y=;hflyDFIVYz0

Nature Has Patterns Everywhere
https://www.youtube.com/watch ?v=PjOey:jjPEB4

How Fractals Can Help You Understand the Universe
https://www.youtube.com/watch?v==wMNOBWQSDI

Spiral/Mathematical Patterns Example
https://www.youtube.com/watch?v=eupUKJrOlmg

BOOKS:

Ball, Philip. ***Patterns in Nature,*** 2009.

The Self-Made Tapestry, 1999

Campbell, Sarah C. ***Growing Patterns: Fibonacci Numbers in Nature,*** 2010

Dickmann, Nancy. ***Math in Nature,*** 2019.

Hylan, Tony. ***Patterns in Nature,*** 2009.

Wade, David. ***Symmetry: The Ordering Principal,*** 2006