Educator Guide: Geometry with Natural Shapes

This guide provides step-by-step instructions for conducting the 'Geometry with Natural Shapes' experiential learning. The goal is to help students understand why some objects in nature have their shapes, what do you mean by some dimensions, areas, volumes etc., and why it is necessary to know them.

1. Course Objectives

By the end of this lesson, educators will:

- Introduce students to the basic ideas of identifying some shapes and some objects via their shapes.
- Engage students in hands-on scientific observation through an interactive experiment.
- Encourage critical thinking by prompting students to make predictions and analyse transformation of shapes and the different dimensions.
- Develop students' skills in recording observations and making scientific conclusions.
- Connect shapes and sizes of materials in nature to sustenance concepts and then to real-world applications of shape transformation, such as water and phase changing materials.
- Foster curiosity and appreciation for nature and its mathematics by encouraging students to make articles out of natural materials using the shapes and sizes and a study of areas and volumes.

2. Learning Outcomes

By the end of the experiment, students should be able to:

- Explain how shapes determine many aspects of natural objects like leaves, creepers, sticks, stones, flowers etc..
- Identify why and how perimeters and areas can be measured.
- Recognise the impact of volume measurement in commerce, construction, transportation etc..
- Describe the process of stringing things together, and building walls.
- Record and analyse scientific observations systematically.
- Apply their knowledge to make useful things in case of emergency and pretty things for relaxation.

3. Materials Checklist

- Leaves, creepers, sticks, stones,
- Paper & natural glue
- Water
- Containers (recycled tins, or small vessels)
- Mud (if possible)
- Dark enclosed space (e.g., a cupboard or box
- Notebook and pencil for observation

4. Icebreaker Preliminary Questions Session

Facilitating a common ground between students and teacher to introduce the topic of the lesson.

Teacher asks “thought provoking” questions and students are encouraged to ask their “curiosity questions”, to make kids excited or expectant about class.

- Why do leaves have different shapes? Is the shape useful?
- Why do sticks and trees get those bends and dents?
- How do some stones become well rounded and polished?
- How many shapes can you identify? E.g. circles
- If you could create an experiment to transform shapes what will you do
- If you could create an experiment to measure perimeter, areas and volume what will you do

Encourage students to give their perspective on what they know on shapes and sizes found in nature.
Present a “story” that serves as example or introduction to the topic - a story that merges science and folklore - can be dynamically spread along the experiment.

Story:
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Story 1: A king asked his subjects to bring the biggest leaf they could find to give the bringer of the largest leaf a prize. His minister finally chose a very very long leaf and a huge round leaf for deciding the winner. Then he told the king “Now your majesty can decide one among these two leaves as the winner according to your liking and your command is our wish”. The king was not happy with this dilemma before him. He requested his Math teacher to come to his assistance. The teacher measured the perimeters

and the areas and came to a conclusion that both were of the same size. Why? Should we find out?

This is a real story: During ancient times, the Nile's annual flooding, a crucial factor for agriculture and civilisation in Egypt, washed away existing land boundaries and made land area calculation for re-establishing ownership challenging, requiring surveyors to mark out boundaries using simple geometry. The people used knotted ropes to establish boundaries and a system of land units. After the Nile floods, surveyors, known as "rope stretchers," used knotted ropes to re-establish property lines.
They developed methods for calculating the areas of rectangles, triangles, and even circles, using arithmetic operations.
They also knew how to calculate the volume of pyramids and other shapes, including a method for calculating the volume of a truncated pyramid.
Can we make some solids using mud/stone/ sticks etc.?
Another true story of Archimedes!

Archimedes was a super smart scientist and mathematician who lived a long time ago in ancient Greece! Archimedes was a curious child who grew up to be one of the greatest minds of his time! As a young boy, he loved playing with shapes and numbers. Archimedes discovered unique shapes called Archimedean Solids! These are special 3D shapes with flat faces that are all the same type. There are 13 different Archimedean Solids, like the cuboctahedron and the truncated icosahedron (the shape of a soccer ball)! Each shape is made with different polygons (flat shapes). Archimedean Solids are important in math and art and are used in architecture. Today, we still study these shapes to learn about solids and geometry!

Archimedes discovered the Principle of Buoyancy! This principle states that when you put something into water, it pushes some water out of the way. The amount of water pushed away is equal to the floating object's weight! This led to the famous saying, "Eureka!" when Archimedes discovered this while taking a bath! This discovery helps us understand why boats can float on water. Thanks to Archimedes, we know how to build safe and sturdy ships!
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5. Experimental Setup

1. Begin by asking all children to bring in all kinds of leaves in different shapes, some creepers, arm lengths of sticks and stones.
2. Divide students into groups to make collages from the leaves and let them give names while identifying the shape differences.

- Before sticking them on a paper place them on a graph sheet (made by drawing lines vertically and horizontally and measure the size as number of square. Convey the idea of area and units.
- Study the change in shape while the leaves dry and reason out why.

2. Divide students into groups to make bridges from the sticks and creepers collected and let them speak on how they made them stronger..
- Let them devise tests to assess the strength of their bridges in comparison with their lengths.
- Let them identify the stick that gets stressed more and reason why.

4. Find the volume of stones using a container of water and the displaced water.

5. After explaining regular shapes, let the children make a few using mud/ stones/ sticks etc..

6. Explain how a wall can be constructed by interlocking stones and plastering with mud

7. Take a creeper and form a circle with it. Then bend it to form a triangle, a square/ rectangle, a pentagon, hexagon etc. and observe the angle.

What to Expect - What kids should focus on:

- The students should hopefully observe how a circle is the largest inscribed area for the same perimeter. Invite them to understand inscribed and circumscribed circles and the importance of π.
- They may also be encouraged to create designs and art using geometrical figures.

Additional References or Material:

https://www.google.com/search?q=simple+geometry+from+nature&rlz=1C5CHFA_enIN985IN985&oq=simple+geometry+from+nature&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIICAEQABgWGB4yDQgCEAAYhgMYgAQYigUyDQgDEAAYhgMYgAQYigUyCggEEAAYgAQYogQyCggFEAAYgAQYogQyCggGEAAYgAQYogTSAQg5OTYzajBqN6gCALACAA&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:cf327058,vid:mveE67FnQFY,st:0

https://study.com/learn/lesson/geomety-in-nature-shapes-types-examples.html#:~:text=What%20are%20some%20examples%20of,in%20animal%20noses%20and%20ears.

6. Facilitation Tips

- Ask students what they think about making shapes and if they have noticed different shapes in nature and at home.
- What is the shape of houses/ nests built by animals, birds or insects?
- Beehives, bears, beavers, ants etc.and the igloo too.
- Encourage them to observe shapes in nature and understand why they are shaped so.
  • Use storytelling to explain how water cycle explains the transformation

for several purposes.
• Connect the lesson to construction, commerce, taxation, food, .

7. Class Conclusion and Takeaway

As “assessment evaluation” kids can be divided in groups, given time and space and asked to come out with a “skit” summarising what they learned.

Ask kids to come up with a story themselves about the topic of the lesson.

Give feedbacks to students on what they produced