



Azim Premji  
University

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TEACHING  
**GEOMETRY**

PADMARIYA SHIRALI

AT THE  
**PRIMARY LEVEL**

**At  
Right  
Angles**  
A Resource for School Mathematics

## TEACHING GEOMETRY AT THE PRIMARY LEVEL

Prior to entering formal school, a child in her interaction with the environment and natural surroundings encounters different forms and shapes (2-D and 3-D). She has absorbed the perceptions that every object has a form with recognizable features which can be observed, identified, named, described and categorized. She has already experienced numerous examples of these forms.

The teaching of geometry at the primary level needs to factor in such familiarity with the world, with regularly used objects like cuboids, cylinders, spheres and the commonly encountered shapes like rectangles, circles, squares, triangles. However it is important to note that the child may not know the names, and therefore introduction to vocabulary should happen only after they have become familiar with a shape and how it behaves. Till then a child may use simple descriptions: 'sun like', 'door like', 'ball like', 'box like' and so on.

Teaching geometry at the primary level has to do with building spatial sense and visualisation ability in the child. Consequently it essentially involves study of shape, size, position (one object in relation to another), direction and movement (slide, flip, rotate). This then leads to certain questions:

1. What kind of experiences and activities should we create for the child so that her spatial sense and visualisation ability grows?
2. Why is play important? Should it be free play or should the teacher direct the activity in a particular way? At what point should the teacher intervene?
3. Should the activities be open ended?
4. Where should the teacher's focus lie? In helping the child to understand the situation or in achieving a result?
5. Does knowledge need to be recreated?
6. How do we know that the child has abstracted the properties of different shapes?
7. At what point should we introduce formal vocabulary?
8. How do we evaluate a child's understanding of shapes and their behaviour?

While I have suggested some age appropriate activities which I have found helpful, there are many other activities which will lead to building the same knowledge. At this point I would like to suggest some criteria by which we can evaluate the activities that we select to achieve our objectives.

1. Does it provide first-hand knowledge?
2. Will it develop interest in the topic?
3. Does it lead to understanding of major concepts?

4. Does it help the child explore the main content which we intend to cover?
5. Does it let the children create and answer questions which he or she poses?
6. Does it lead to acquisition of relevant skills?
7. Does it give sufficient concrete experience to abstract out the needed knowledge?
8. Does it help in building connections and creating a mental map?

The activities I have suggested do not follow a linear order. Many of the activities in the initial years involve playing around with forms (2-D and 3-D) and understanding how they behave. Children naturally investigate shapes by fitting them together, rotating them, arranging them in patterns and building composite pictures with them. During this process they internalise properties of these shapes, how these shapes fit together, how some shapes fit together to form other shapes, how changes in an attribute affects the shape etc. They may begin to see the causes for a particular behaviour. For example, a young child might instinctively realise that for two shapes to fit together without any gap they need to have straight edges. They may see how the properties connect with other properties, how features connect with other features. Example: A shape with 3 sides has 3 corners; a shape with 4 sides has 4 corners. From the way a child represents a shape through a drawing, one begins to see whether the child has perceived the shape as a whole or has focussed on a single attribute (example: equality of the sides of a square).

One must keep in mind that in the end it is the child's own struggle to make sense which will lead to greater learning.

I have also included activities which require children to use their bodies either in forming shapes or walking on shape outlines in a ground. It is well established that such activities which require body movement enhance the child's mental imagery and ability to visualize.

I have also suggested paper folding activities at different points. A friend of mine who does a lot of origami work with children has given me these inputs. It would be good to keep them at the back of one's mind while holding these paper folding activities. Children are able to make sharp creases by age 4, but accuracy comes only by age 7. Similarly, children are quick to recognise basic geometric shapes and seem to be able to imitate the teacher in creating them through paper folding but are generally able to do accurate work only by age 7. Another interesting observation by her is that only by age 7 is a child able to imitate folding while sitting opposite the teacher; younger children need to sit beside the teacher. Also, children seem to feel comfortable with mirror-images only by age 7.

Geometry is closely linked with measurement and as teachers we frequently use measurement related concepts and language while conducting activities. However in this article I have focussed only on the geometric aspects. I will take up measurement later.

One word of caution to the teacher is that activities should never happen in a scattered manner. They must be gradually built up in order to lead to consolidation of learning.

## ACTIVITY **ONE**

### SORTING ACTIVITIES

**Materials required:** 3-D objects like balls (tennis balls, Ping-Pong balls), wooden blocks or small taped cardboard boxes filled with sawdust, cylinders (tin cans), prism shaped objects, cylindrical pipes of different diameters, cones



Sorting activities are part of free play, but the teacher can direct them by asking children to sort the collection in various ways. Let each child pick up one object. All children who have picked up a cuboid can form one circle. All who have picked up a sphere form another circle.

**Sorting by the property of rolling** – objects which roll, and objects which do not roll. Children might test the objects by actually rolling them; or, if they have already played around with such forms and abstracted the property which leads to rolling (curvature), they may be able to sort the objects on that basis without testing them. However, it would be interesting to see how they respond to cylinders. Teacher can initiate a discussion on that. Does a cylinder roll when it is placed on its flat side (teacher may not actually use those words but indicate the flat side)? Or its curved side? Among the objects that roll, there can be a further sorting now between balls and tins.

**Sorting by size:** Big balls and small balls, big cubes and small cubes, big cuboids and small cuboids (without naming them as such).

**Sorting by faces:** Objects which have rectangular faces, objects which have triangular faces, objects with circular faces.

**Sorting by materials:** 2-D objects or shapes: rectangles, squares, triangles, circles, ovals, paper plates, rings, bangles – many of each type and in different sizes

**Sorting by edges:** Shapes with straight edges and shapes with curved edges.

**Sorting by the number of sides:** Children can sort shapes into triangles and rectangles. Pre-school children look at objects as a whole and the ability to notice the attributes of a shape in terms of number of sides etc. develops around the age of four.

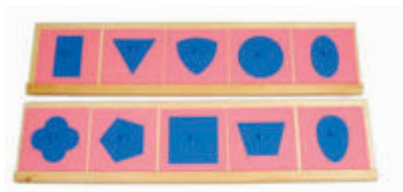
## ACTIVITY **TWO**

### MATCHING ACTIVITIES

**Materials required:** 3-D objects, different shapes (each in two sizes), Geometric insets (see the image, which is taken from [http://www.chuckswoodentoys.com/content-popup\\_image/plD-2689/popup\\_image.html](http://www.chuckswoodentoys.com/content-popup_image/plD-2689/popup_image.html))



**Shape Post Box:** Let children drop shapes through the holes into the box (as shown in the picture, downloaded from the site <http://www.mommymoment.ca/2011/11/the-aims-of-metal-insets.html>). It is possible to create such a box using sturdy cardboard box or plywood.



**Geometric insets:** Children can place each shape in its corresponding place (as shown in the picture). They may rotate the shape and see whether and how it fits.

Let children match a big cube with a small cube, a big sphere with a small sphere, a big square with a small square, a big triangle with a small triangle, and so on.

## ACTIVITY **THREE**

### OUTDOOR ACTIVITIES

**Forming shapes:** Draw a big circle on the floor or outside in the ground. Ask the children to walk on the circle. Let them walk one way, clockwise. Let them walk another way (anti-clockwise). Ask them to jump in the circle, jump out the circle.

Ask the children to sit in a circle. At times they find this difficult and they may form an oval. Help them to hold hands and make a good circle.

**Musical square:** You can play a modified form of musical chairs. Draw a square and get the children to walk on the square as you clap. Ask them to stop on a side when you stop clapping or ask them to stop at a corner when you stop clapping.

**Yoga posture shapes:** They can use their arms and legs to create shapes like squares, rectangles and triangles. One can see shapes in many yoga postures.

**Rope activities:** Give children a long rope (can be a skipping rope too) and let them stretch it tight to make a straight line. Let them stretch it loose so that it forms a curved line. They can also make a wavy line.

Draw a straight line, a curved line and a zigzag line on the ground. Get children to walk along the lines to a beat. They can try walking on a line by placing one foot immediately in front of another without losing balance.

Take them for a nature walk, collect different objects: leaves, sticks, stones etc. Let them observe the edges of leaves: some are curved, some have a zigzag pattern. Some stones have a straight edge, some have an irregular edge. They can do rubbings of these objects (i.e., placing a paper over the object and rubbing the paper with a pencil or crayon to get an imprint).

# ACTIVITY **FOUR**

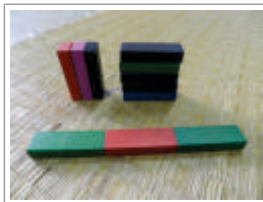
## BUILDING FORMS

**With 3-D objects:** Children may build towers using different sized blocks: they may create tunnels, houses, roads etc., or regular shapes.



It is interesting to watch the shapes of the blocks they select for this purpose. A child who has seen sloping roofs may use an inverted cone for a roof. A lot of measurement related language (tall, short, wide, narrow, long) and positional language (in, on, under, over, behind, front, on the side) can be used to reinforce such concepts.

Teacher may give instructions like 'Place 5 blocks one over the other. Place 3 blocks in a line next to each other'



**With 2-D objects:** Children can use 2-D shapes to make designs and patterns, and composite pictures like a cat, a house, etc.



The manner in which children represent an animal or a house indicates the mental image they have of that form. In the initial stage a child represents each part of the body by one shape. They may select a circle for the head, a rectangle for the body and four triangles for the four legs. By age 5 they may use triangles for the ears of the animal, a circle for the head, begin to combine or repeat many rectangles to represent the body (indicating a growing awareness of the size of the body with respect to the size of the head), and may make legs using longer or shorter rectangles.

**Chess board and coloured buttons:** Children can arrange buttons in a line on the chess board in different ways. They may also arrange buttons to form interesting shapes.

**Play time discussion:** The Teacher can initiate a discussion as the children play with shapes. For instance, if a child is playing with circles, a teacher can ask: "What does it look like?" The child may say 'sun' or 'moon'. "What other objects look like this? Is there anything in the class which has the same shape as this? Does any part of your body look like this?"

**Representing and drawing:** The child can be asked to represent a circle on a sheet of paper. He may draw an approximate circle. He can be asked to draw a big circle, a small circle, smaller circle, bigger circle. Ask him if he can make a circle inside a circle, if he can make a face with 1 big circle and 2 small circles. In like manner let them represent other shapes. Many children draw a sun and rays emanating from the sun. They can also make this with a circular shape and sticks. As they grow older, they begin to space the rays equally around the sun.

Sometimes children call a square as a rectangle. It is important not to say that 'this is a square and not a rectangle'. You can say, instead: 'This is a special rectangle called a square'.

**Connecting dots:** Many activity books for children and work books have pictures made of dots which require children to connect dots with lines. They are enjoyable exercises which improve the free hand line-drawing ability. (It is best to not require them to use a scale in such an activity.)

**Drawing patterns with different types of lines:**

Teachers can also give some simple line patterns for children to copy and practice. They can create their own patterns.

**Shape hunt:** Organize a “shape hunt” in the school. Children can look for a specific shape, say circle, all around and in the school. (Examples: The school clock, bell, water can, tumbler, dust bin.)

## YEAR - 2

Many activities suggested in Year One can be repeated. Teachers will find that children at this stage demonstrate a higher ability in all areas in terms of recognizing shapes, describing their properties, articulating their sorting rule (i.e., the basis on which they sorted the shapes), building and drawing shapes, etc.

However, the teacher can pose more probing questions which will help the children to observe more keenly and express their understanding of the shapes.

Example: The teacher can point to a rectangle and square and ask: “How is that shape like this one?” “In what way is this shape different from that one?”

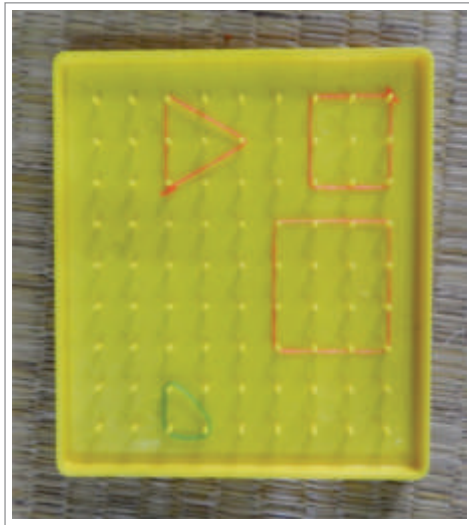
Teacher can show same sized rectangles oriented in different ways and raise questions. “Are these the same? If I turn the shape what would it look like?”

**Making solid shapes with plasticine:** Let children create 3-D shapes like sphere, cylinder, cube and cone with plasticine. This will reinforce the idea of a flat surface and a curved surface, and draw their attention to the faces, the straightness of an edge, etc. It is important to remember that all the objects they make are approximations and we do not expect these objects to resemble the models closely.

**Matching activities:** Show children a 3-D object, say a cuboid. Ask children to pick up 2-D shapes that they see in the object. Similarly one can pick up a cylinder, a prism, etc. Can one pick up a sphere?

**Rope activities:** Ask children to use a looped rope to make a square shape. Ask: “How will you arrange yourself to make a rectangle?” “How many children are needed to make a triangle?”

**Geoboards:** Shapes can also be made on geoboard with rubber bands. Let children explore different ways of making squares.

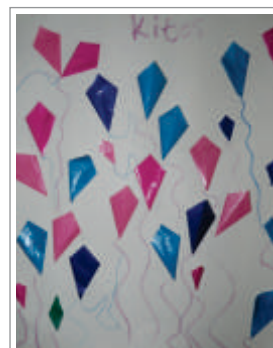


Initially they may make mistakes and not get a proper square. It may be an irregular quadrilateral. Point to a square shape and ask “Does your shape look like this?” “Where does it look different?” Raise questions: “Can you make a bigger square than what you have made?” They can explore making different sized rectangles. In the same way they can explore making triangles of different shapes and different sizes. While doing this activity they may turn the board over and see different orientations of their shapes. Children who have had a chance to play with shapes in this manner do not carry a fixed mental image of an upright triangle and will be able to identify the shapes even when they are oriented in multiple ways.

**Designs and Patterns:** Let children create designs and patterns using the same shape repeatedly. They can use many triangles to make a windmill shape, a man, an animal, a flower etc.



**Composite pictures:** Let them combine shapes to make composite pictures or scenes (house, tree and sun).





They can also make pictures using only lines and shapes and make a composition. Or they can create pictures using lines and dots. The teacher can make a few such drawings: house, fish, star, boat, etc.

**With straws or sticks of different lengths:** Ask children to make a rectangle with sticks. Initially they may use four sticks but the sticks may not be placed parallel to one another. However over a period of time one will notice that they internalise the properties of a rectangle and will select sticks of the right length, may also take care to place the opposite sticks parallel and create square corners. However if a child does not build it that way, it is best to give him or her more time and opportunities to work with rectangles. At a later point one can give him a rectangle and then ask: "Does your shape look like this?" "What should you do to make it look like it?"



Children may also build other polygons or notice such shapes in a tiling pattern on the pavement. In their natural curiosity they may ask "What is it?" Avoid the temptation of giving complicated names. One can just say: "It is a six sided shape" or an appropriate answer depending on the shape.

## CLASS ONE

By the time children enter Class One, their hand motor coordination skills have grown, their sense of spatial relations has grown, and so has their ability to identify different orientations of a shape. The teacher can bring in paper folding exercises, drawing outlines of shapes, seeing relationships between shapes, constructing simple maps with shapes, etc.

**Materials:** Assorted shape tray (squares, triangles,

circles, rectangles in minimum three sizes, four of each size)

**Exercises:** Pick squares of same size. Pick one square of each size and arrange them according to size. Ask: "Can you arrange all the small squares to form a big square?" "Will it be still a square if you turn it around?" "Can you make a square with two small squares?" "What shape will it be?" "What will it be

when you turn it around?" "Can you make a rectangle with three small squares?" "Can I make some other shapes using these three squares?" (Example: An L shape.)

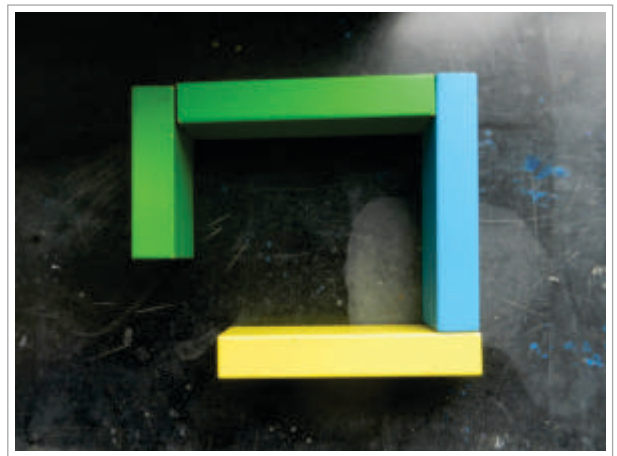
Let children explore shapes in various ways. They can observe them in different orientations. After creating new shapes, the shapes may resemble an animal or an object the children are familiar with. Let them write "It looks like a ..." or "It reminds me of a ...." They can then place their shapes on paper and draw their outlines.

Similarly they can fit triangles together and explore the outcomes. When they try to fit two equilateral triangles together, they will notice that they have to turn the second triangle upside down to make it fit it properly. Note whether the edges are placed next to each other exactly.



When they try to do the same activity with circles they will see that circles do not fit together. Ask them "Why don't the circles fit together?" I have often got interesting replies to such questions. While children may not have the necessary language to express the causes for particular behaviour of shapes or numbers, they do have an intuitive understanding which they express in their own ways.

While doing these activities and through discussion about a wide variety of shapes, a child learns to recognize examples and non-examples of particular shapes. Often, a discussion about non-examples clarifies and deepens a child's understanding (as shown in the picture). "Why is this not a rectangle?"



**Geo-boards:** Let children make different shapes with rubber bands on geoboards. They may make parallelograms, trapeziums, kites, rhombuses, etc, or other polygons. Discuss in what way each shape is different from a square or a rectangle. During these discussions reinforce the language of sides and corners. Ask: "In what way are these two shapes the same?" "In what way are they different?" "What can I do to convert one shape into another?"

**Paper related activities:** Keep plenty of used paper (A-4 sheets, magazine paper or gift wrapping paper) for paper tearing and paper cutting activities. Ask children to make a rough square shape by tearing off excess with their hands. There is no measurement involved at this point. It develops their hand coordination skills, gets them to imagine a square in the given paper, identify the extra bit to be removed. And, of course, there is the skill of removing the extra portions with care. Children will need a lot of

practice to get an approximate square. They can also use large square shapes to draw the outline and cut the shape with a child-friendly pair of scissors. They can cut differently sized squares and make a collage from them. They can also create a shape album where they can stick various shapes that they have cut. They can make a list of the objects or places where they have seen a square shape. In like manner they can work with rectangles, triangles and circles. They can cut rectangles of paper strips, string these shapes and make a wall decoration.



**Paper folding:** Let children fold any piece of paper, crease it, open it up and see the line that has formed. They can also look at the two shapes that the fold has created in the paper. They may be regular shapes like rectangles and squares, or non-regular shapes. They can crease the same paper another time and see whether the creases cross each other. They can observe the new shapes that have formed. While they may experiment with vertical fold, horizontal fold and diagonal fold, their work may lack accuracy.

**Toothpick activities:** They can also use toothpicks to make shapes. Let them identify the shapes they have formed. They can remove one stick and see what it does to their shape. They can remove another stick and see what that does to their shape. What if they remove a stick which is on the edge?



**Dot paper:** Children can be given square dot paper or isometric (triangular) dot paper to draw shapes, composite pictures and patterns. They can join dots in the dot paper to make shapes with 4 sides (need not be regular shapes), shapes with 5 sides, increasing sizes, etc. Children can name the familiar ones.



**Mystery bag:** Drop different 3-D shapes into the bag. The child places her hand in the bag, selects one shape, feels it and describes it in terms of flat or curved surface, number of faces, shape of the faces, etc. Other children then have to guess the object. A similar game can be played with 2-D objects. This game refines their sense of touch, observational skills, mental imagery and logical thinking.

The teacher can also draw a shape in the air while the child observes attentively and names the shape. Such games reinforce the child's understanding of the structure of a shape. Given a shape, a child should be

able to describe it, mentioning its relevant details, and given the description, a child should be able to identify the shape. This leads to the development of skill in analysing and describing geometric figures in meaningful ways.

**Jigsaw puzzles:** In the process of solving such puzzles, children begin to look closely at the shapes of the pieces, the corner pieces which have 2 edges, the side pieces with one edge. They often rotate the pieces and develop a sense of a quarter turn, a half-turn, a three quarter turn, etc.

## Let the classroom come alive in many different ways!



[To be continued in the next issue ...]



Padmapriya Shirali

Padmapriya Shirali is part of the Community Math Centre based in Sahyadri School (Pune) and Rishi Valley (AP), where she has worked since 1983, teaching a variety of subjects – mathematics, computer applications, geography, economics, environmental studies and Telugu. For the past few years she has been involved in teacher outreach work. At present she is working with the SCERT (AP) on curricular reform and primary level math textbooks. In the 1990s, she worked closely with the late Shri P K Srinivasan, famed mathematics educator from Chennai. She was part of the team that created the multigrade elementary learning programme of the Rishi Valley Rural Centre, known as 'School in a Box'. Padmapriya may be contacted at [padmapriya.shirali@gmail.com](mailto:padmapriya.shirali@gmail.com)