Azim Premji University

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TEACHING Area and Perimeter

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A PRACTICAL APPROACH

At Right Angles
A Resource for School Mathematics

Area and Perimeter

Area and perimeter are forms of measurement that are used commonly in many day-to-day activities. In particular, area is used in an intuitive way on an everyday basis when we select a plate to cover a utensil, a table cloth for a specific table, a sheet of paper to cover a book, etc. Without really knowing the specific words, children also commonly make judgements which involve an intuitive understanding of area. A question that naturally arises is: When or why do we want to know the exact size of a space? Demonstration of this point needs to happen repeatedly through real world applications.

Area and perimeter are generally introduced together and dealt with as a single topic. However, perimeter is a linear measure, whereas area is a measure of a two dimensional space. One can also think of perimeter as the distance around the outside of a shape whereas area is the amount of space inside the shape.

Since they are introduced together, one frequently finds children mixing up the two concepts. Also formulae for arriving at these measures are brought in too quickly - well before the concepts are fully understood. One can avoid this problem by spacing out these two concepts. Area could be explored in the first stage as it occurs frequently in a child's everyday experiences. "Who has got a bigger portion of the chocolate?"

In this article, I have suggested plenty of activities which will slowly lead them into the topic and strengthen their conceptual understanding. It is best to let children work in groups of four so that enough discussion happens amongst them.

Keywords: *Shape, area, perimeter, mensuration, experience, formula, length, breadth, units, square units, geoboard*

ACTIVITIES FOR AREA

ACTIVITY ONE

Materials: Squares of different sizes (preferably wooden or plastic).

Objective: To compare sizes through stacking.

Let each group pick up 4 different squares and put them in order of size. Children may be able to visually compare and determine the smallest size, largest size etc. Ask them to show a way by which the order can be clearly seen. They may stack up the squares in order in different ways as shown in Figures 1 and 2.

Let children draw these in their books and describe the relationships.

The yellow square is smaller in size than the pink square.

Notice that the word 'Area' is not introduced immediately. It is important to focus on the concept of size and ensure that the sense of size is clearly understood. It is good to use familiar words like size when the concept is introduced. Once the concept is comprehended through commonly understood words one can introduce the terminology (area).

Repeat the same activity with circles.

Superimposing one shape over another shape is one way of comparing sizes which works for certain objects.

Figure 1

Figure 2

ACTIVITY TWO

Materials: Rectangles of different sizes (books can also be used).

Objective: To compare sizes through the usage of non-standard units.

Let each group pick up two rectangles and try to determine the smallest and the largest.

With some rectangles determining the largest size and the smallest size may be obvious.

Ask the children if it is possible to show the smallest by stacking one rectangle over the other.

This may be possible with some rectangles where both the length and breadth of the smaller sized rectangle are less than the other. But in the case of some rectangle pairs, the length of one might be shorter, but its breadth might be larger, as shown in Figure 3.

Figure 3

Ask the question "How can we show or how do we find out for certain which is smaller?" "What does *smaller* mean?" Help the children to express their understanding of what makes one shape bigger or smaller than another.

Most children are familiar with chocolate bars which have square partitions. Let them state how they would compare such chocolate bars. In a similar manner, lead children to the discovery that both the rectangles can be covered with smaller units like erasers, rectangular or square biscuits, post-it notes or any other appropriate objects available in the class to compare the sizes.

Let them experiment with different objects like triangle shapes, diamond shapes and circular objects like coins, as units of measure. Help them discover that only shapes that do not give rise to any gaps while covering areas, can be used as measuring devices. Discuss the reason for why circular objects would not give accurate answers.

Verify that the children understand the need for measuring both the rectangles with the same unit.

Observations are recorded using non-standard units as measure.

See Figures 4 and 5.

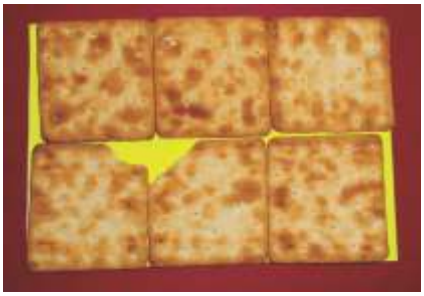

Figure 4

The yellow rectangle is 6 biscuits in size.

Figure 5

The brown rectangle is 8 biscuits in size.

Similarly, rectangles can also be measured with triangle units.

The brown rectangle in Figure 5 is 16 triangles in size. The yellow rectangle in Figure 4 is 12 triangles in size.

Repeat this activity with slightly larger sized objects. Size of the teachers table compared with the size of the students table, etc. Children can choose appropriate units of measure (compass boxes or small dictionaries).

While holding this activity, children will encounter situations where the unit of measure may not cover the space completely (e.g., while dealing with irregularly shaped objects). Discussion about this can lead to understanding the norm that more than half of a unit space is counted as one.

ACTIVITY THREE

Materials: Regular and irregular shapes, cm squares, cm square grid paper.

Objective: To compare sizes through usage of cm squares

Tell them that the area of a shape refers to the space that it encloses or covers.

Pose the question: "How does one measure the space occupied (area) by a book? By a leaf? By a circle?" It is not necessary to use the word regular shape and irregular shape.

Children may suggest usage of small objects. They could do that. However by this stage they are already familiar with centimetre as a measure for lengths. They also use square ruled notebooks which have cm squares. They can stick some of these papers onto thick card sheets and cut cm squares to use as a measure for covering these shapes.

Tell the children that a square that measures one centimetre by one centimetre is a square centimetre.

See Figure 6.

Figure 6

Pose the question: "Who has the biggest hand in the class?" Let children draw an outline of their hands and check the area by filling them in with cm squares. They could also measure the area of their foot. They could draw the outlines of these on square grid paper. It may also be interesting to find out how much variation can be there if the same hand is traced in different positions on the square grid paper.

See Figure 7.

Figure 7

My hand is ___ cm square in size (area).

See Figure 7a.

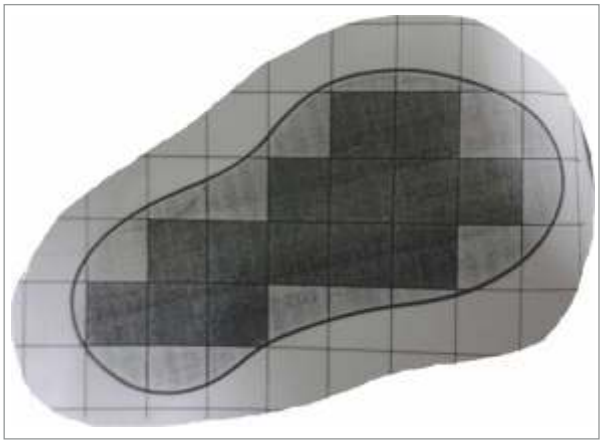

Figure 7a

As an extension they can do a craft activity of mosaic work with coloured cm squares and create beautiful motifs and write about them.

Does everything have an area?

At some point it is good to pause and ask: "Does everything have an area?" A discussion about this can reveal students' understanding and misconceptions about area. It can lead to questions about 3-D objects, curved spaces. Through discussion, difference between closed shape and open shape, area and capacity (volume) can be clearly brought out.

ACTIVITY FOUR

Materials: Irregular shapes and shapes with curves, transparent grid or thread frame.

Objective: To compare sizes through usage of cm grid

A transparent grid can be prepared using hard transparent plastic sheet as shown in Figure 8 to create a cm square grid. A thread frame can also be prepared using a thick cardboard frame with threads running across in a grid form.

Objects can be placed underneath the grid and squares can be counted.

Figure 8

ACTIVITY FIVE

Materials: Irregular shapes, square grid paper, triangular grid paper, hexagonal grid paper.

To compare sizes through usage of various types of unit measures.

In the earlier activity, the shapes to be measured were placed underneath square grids. In this activity, shapes are placed over grid paper and their outlines are drawn as shown in Figures 9 and 9a.

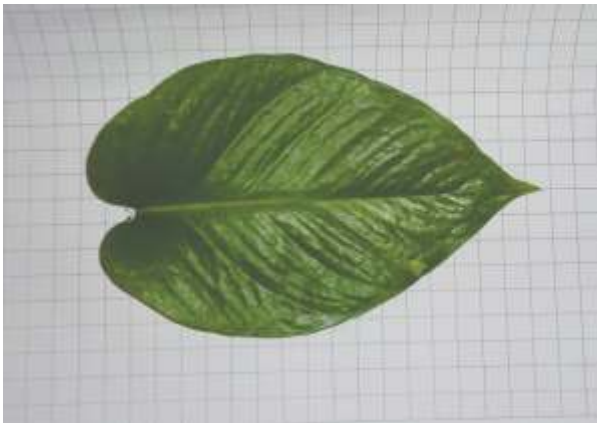

Figure 9

The area of the leaf is _____square centimetres.

The area of these shapes can also be found without drawing the outline; it can also be deduced from the grid around.

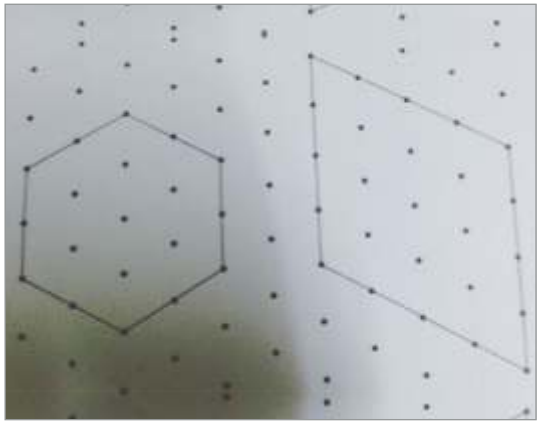

Figure 9a

ACTIVITY SIX

Materials: Geoboard and rubber bands.

Objective: To construct different polygons and count the squares to find area.

Initially children can construct different shapes (squares, rectangles, triangles, rhombi etc). They can record these on square dot papers and describe the shapes in terms of their measures.

In the next stage teacher specifies the measures (length or breadth) of different squares and rectangles. Children construct them on the geoboard and give the area in cm squares.

ACTIVITY SEVEN

Materials: Square grid paper.

Objective: To create composite shapes and sum the areas.

Children can create figures of robots or houses (as shown in Figure 10) to create composite shapes, and find the areas of what they have drawn.

My house has a door of 8 square cm. It has a window of 4 square cm.

Figure 10

See Figure 11.

Children can draw different shapes on square grid paper and find the total area by counting the full squares and half squares.

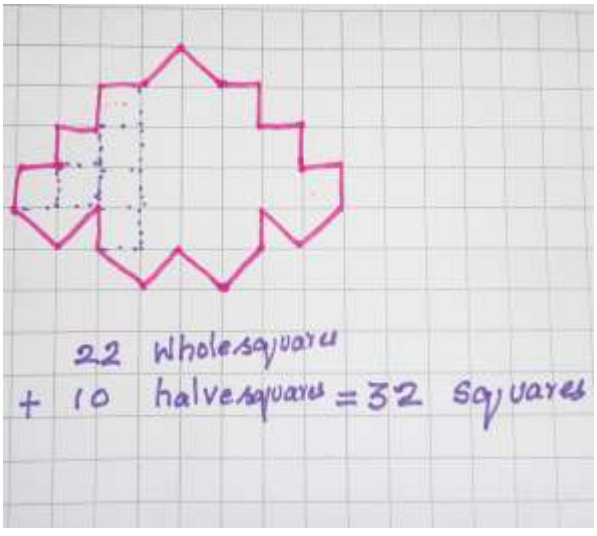

Figure 11

ACTIVITY EIGHT

Materials: Square grid paper.

Objective: To discover that cutting and rearranging the pieces of any shape does not alter the area.

Children can draw the outline of any shape on square grid paper as shown in the picture. They record the area of the original figure. They can draw a couple of lines to cut along. Let them assemble the pieces together in some other shape and total the area.

ACTIVITY NINE

Materials: Geoboard and rubber bands, square grid paper.

Objective: To discover the formula for the area of square and rectangle.

Let children construct various squares (1x1, 2x2, 3x3, 4x4) on the geoboard and draw the outlines on a square grid paper and write the area of each figure by counting the unit squares. Now pose the question: "Do you see any relationship between the length of the side and its area?" Lead them to discover that the area of a square is 'side times side'. Connect this to the multiplication model.

In a similar manner let children construct and draw outlines of various rectangles (2x3, 3x4, 2x4, and 3x5). Let them observe the patterns to realise that the area of the rectangle is length times breadth.

ACTIVITY TEN

Materials: Self checking cards of specific measures.

Objective: To compute the missing measure and verify the result.

Make cards of different integral sizes (2x3, 2x4, 3x3, 3x4, 4x5 etc). Each card can pose a question related to the actual area of that card. Ex. 'My area is 12 cm square. My length is 4 cm. What is my breadth?' Children can work out the answer through calculation and verify by actually measuring the card. They could note down the related multiplication or division facts.

ACTIVITY ELEVEN

Materials: Square dot paper.

Objective: To discover that different shapes can have the same area.

Ask children to draw all possible shapes that can be made with three connected squares. (Squares are connected if they share a common side).

Let them then explore all possible shapes that can be made with four squares.

Specify an area, say 12 sq. cm and let children construct different shapes that have 12 sq. cm as their area.

Let them discover that different shapes can have the same area.

ACTIVITY TWELVE

Materials: Floor tiles or wall tiles.

Objective: To determine areas of class rooms and any other spaces which are already tiled.

Explain to the children that tiles can also be used as a unit of area.

Let children look around spaces around the school to compute the area of these spaces.

They can write the areas of these spaces in terms of the measuring unit, the tile and compare different areas in the school.

Area of the class room is (12 x 15) 180 tiles.

At this stage it may not be necessary to teach conversions of one unit to another. However if the question arises naturally, it would be interesting to see the strategies employed by children to calculate the area of a floor in other measures like square feet or square metres.

They could decide to calculate the area of each tile and multiply by the total number of tiles.

They may calculate the length of the room by multiplying the length of the tile by the number of tiles placed on the long side of the room. They may calculate the breadth in a similar manner, and then compute the area.

They may decide to ignore the tiles and measure the length and breadth with a tape and compute the area.

ACTIVITY THIRTEEN

Materials: Bulletin boards, windows, floor mats.

Objective: To determine areas of larger spaces

Discuss with children the need for a larger unit to measure areas of bigger spaces. By this stage they may be already familiar with a foot as a measure. Tell the children that a square that measures one foot on each side is a square foot. They can measure the areas of larger spaces and record them as square feet or square metres etc. At this point it would be good to have a discussion on length unit getting converted to square length unit, e.g. cm → sq. cm, matchstick → sq. matchstick, inch → sq. inch etc.

Game: Area with dice

Materials: Square grid paper of A4 size, two dice

Objective: To develop a sense of area and minimise wastage of space between shapes.

Each child starts from one end of the sheet as shown in Figure 12. A line is drawn separating the sheet into two equal parts. Each child throws the two dice and draws a rectangle or square with the numbers that appear. They continue to take turns in throwing dice and building more and more rectangles attached to the previously drawn ones. Each child continues to throw the dice and build rectangles as long as there is space on their side even if the other has stopped. At the end they sum the areas of the gaps that arise. The one with the smallest gap area is the winner.

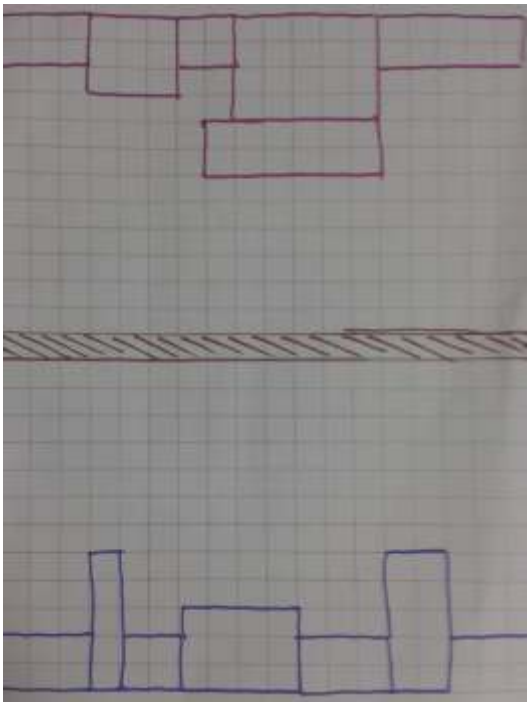

Figure 12

ACTIVITIES FOR PERIMETER

The word perimeter comes from the Greek word 'peri', meaning around, and 'metron', meaning measure. Help children to understand that perimeter means the distance around a figure.

Differentiate between perimeter and area using drawings as shown in Figure 13. Link it with their earlier understanding of the word metre as length.

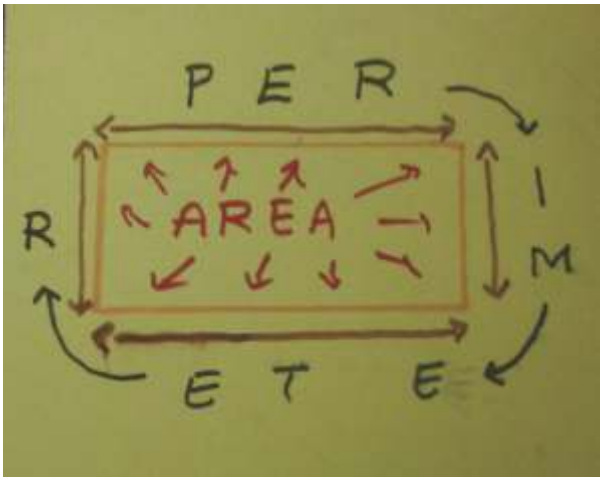

Figure 13

ACTIVITY FOURTEEN

Materials: Classroom objects like children's tables, teachers table and bench.

Guess the shape with the largest Perimeter (distance around a figure)

Mention any three objects and pose the question 'Guess which of these objects has the longest length around?'

Let children place sketch pens or straws all around the edge of the top to find the object with the largest perimeter. Some rounding of numbers may be involved. Has their guess come right?

ACTIVITY FIFTEEN

Materials: Different polygon cut outs and curved figures, Tape.

Objective: Find the shape with the largest Perimeter (distance around a figure)

Each group of children can be given four different polygonal shapes cut from chart paper. They can measure all the lengths in centimetres and total them up.

They could also measure the perimeter of curved figures with the help of a string or tape.

See Figure 13a.

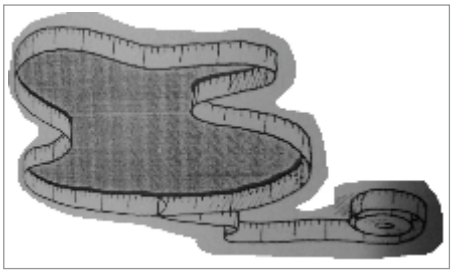

Figure 13a

ACTIVITY SIXTEEN

Materials: Square tiles, square dot paper.

Objective: To discover that shapes with same area can have different perimeters.

Ask children to use 3 tiles or squares to make different shapes. Each tile must touch the other along one complete side.

How many different shapes can be made? What is the perimeter of each?

Repeat the same with 4 tiles and construct all possible shapes. Which shape gives the largest perimeter?

Repeat the same with 5 tiles and construct all possible shapes. Which shape gives the largest perimeter? The pentomino U stands out as the one with "more" perimeter. There can be a discussion on why this is the case.

ACTIVITY SEVENTEEN

Materials: Square dot paper.

Objective: To discover the formula for calculating perimeter of squares and rectangles.

Insist that they mark the measures on all sides with arrows as shown in Figure 14. They need to clearly understand that the number stands for the length of the side.

Let children draw squares with sides 1, 2, 3, 4 etc. in order, and let them calculate the perimeter of each one. They will easily see that it is 4 times the side.

Let children draw rectangles of different length and breadth combinations (1 x 2, 2 x 3, 2 x 4, 3 x 4 etc). Let them write the perimeter as a sum of all the four sides. As they begin to record these results, lead them to discover that the perimeter is twice the sum of the length and breadth.

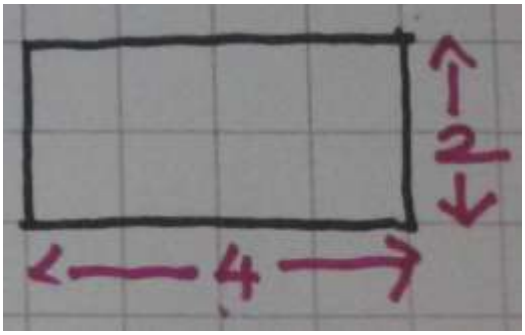

Figure 14

ACTIVITY EIGHTEEN

Materials: Sketch pens or toothpicks.

Objective: To create different shapes with the same perimeter

Construct rectangles and squares with a perimeter of 16 units. How many could you make?

This activity allows children to see that different shapes are possible with the same perimeter and they have different areas.

Repeat the activity with 24 units. What different sizes can be made? Which shape gives the largest area?

ACTIVITY NINETEEN

Materials: : Geo board, rubber bands.

Objective: To create different shapes of specified measures.

Pose some questions like the ones given below:

Can you construct the following shapes on a geoboard with one rubber band?

Square of length 2 units

Rectangle with an area of 3 square units

Pentagon with an area of 3 sq. units

Square with an area of 2 sq. units

ACTIVITY *TWENTY*

Materials: Square dot paper.

Objective: To discover the effect of an increase in length or breadth on the perimeter and area.

Give children the measures of a rectangle, and let them find its perimeter and area. Now pose the questions:

"What happens to the perimeter of a shape when the length is increased by one unit?"

"What happens to the perimeter of a shape when the breadth is decreased by two units?"

"What happens to the area of a shape when the length is increased by one unit?"

"What happens to the area of a shape when the breadth is decreased by two units?"

One could also experiment with increasing both length and breadth by 1 unit, 2 units, 3 units etc to notice patterns and generalize. There should also be cases where length increases and breadth decreases and vice versa.

ACTIVITY *TWENTY ONE*

Materials: : Tangram set.

Objective: To discover the relationship between the different pieces in terms of area.

Let children play around with the tangram pieces by creating different shapes. In the process of creating shapes they will begin to notice the size of different shapes and how they relate to one another in terms of area.

Identify a pair of shapes that have the same area. Can you find some more such pairs?

Do all these pairs look the same?

How can you show that they have the same area?

Can you find pairs where one shape is one half of the other? Which shapes are these?

How does the area of the square compare with the large triangle?

How does the small triangle compare with the medium triangle?

Note: This activity can come even at an earlier point when they are playing with non-standard units

ACTIVITY TWENTY TWO

Materials: Square grid paper.

Objective: To discover the distributive law.

Use square grid paper as shown in Figure 15 to demonstrate distributive law.

What is the area of the rectangle on the left side? (3x4), that is 12 sq. units.

What is the area of the rectangle on the right side? (3x3), that is 9 sq. units.

What is the area of the whole rectangle? (3x7), that is 21 sq. units

Show that 3x4 + 3x3 = 3 x (4+3)

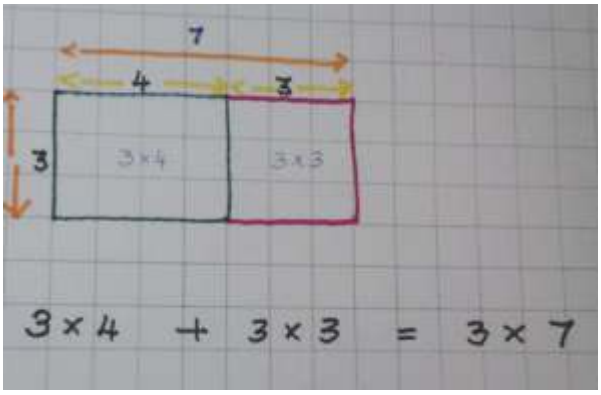

Figure 15

ACTIVITY TWENTY THREE

Materials: Paper rectangles.

Objective: To discover the relationship between a triangle and its corresponding rectangle.

Let children fold some rectangles in half along the diagonal line and cut them along that line.

By placing one piece over the other they see that the two pieces are equal in size (area).

Help them to articulate their discovery that the area of a right-angle triangle is half of its length times its breadth.

It can also be demonstrated for any triangle as shown in Figure 15a.

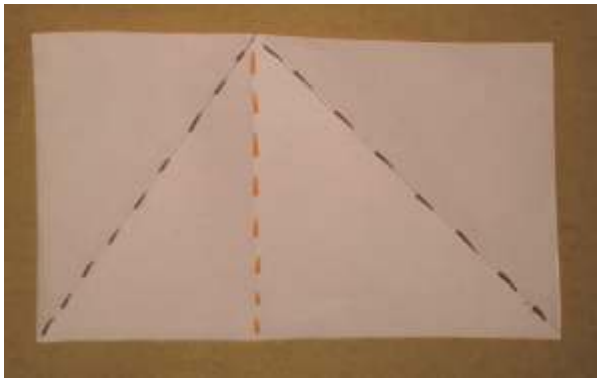

Figure 15a

ACTIVITY TWENTY FOUR

Materials: To notice relationships in areas.

Objective: Ask children to take a square paper. Locate the midpoint of each side through folding. Draw connecting lines between adjacent midpoints as shown in Figure 16.

What is the relationship of the smaller square to the larger square? Can you show why?

Repeat the same process with the smaller square and draw another square inside it?

What is the relationship of this square with the bigger square? Can you show why?

The side of a large square is 20 cm. It is repeatedly folded three times by joining midpoints of the sides to produce smaller and smaller squares. What will be the area of the fourth square?

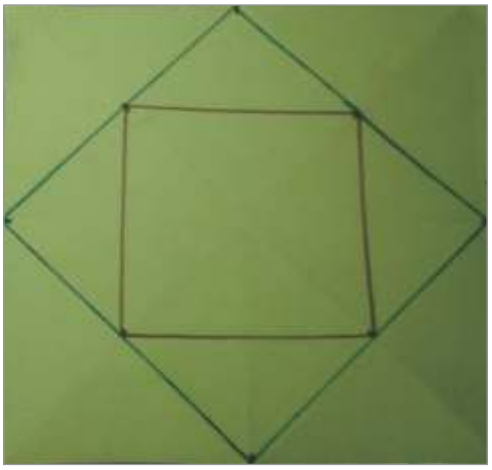

Figure 16

ACTIVITY TWENTY FIVE

Materials: Square grid paper.

Objective: Spotting all possible squares, finding the shape with the largest perimeter

Outline a 6x6 square in a grid paper. How many squares of area 4 sq. units can be found here?

See Figure 17.

Here are some shapes that can be drawn in a 5 x 5 square. Draw some more shapes to find the shape that will give the largest perimeter.

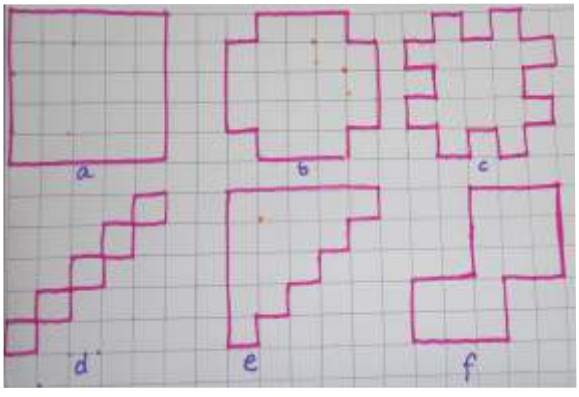

Figure 17

ACTIVITY TWENTY SIX

Materials: Square dot paper.

Objective: To reconstruct shapes based on data.

This is a class activity. Ask each group to draw some rectangles and squares on square dot paper. Without showing others the shapes they have drawn, each group shares the perimeter and area of these shapes with other groups.

'Perimeter of my figure is 12 units; area is 9 square units'

'Perimeter of my figure is 16 units; area is 12 square units'

'Perimeter of my figure is 14 units; area is 12 square units'

Each group has to try and create shapes which match the specifications of the other groups.

The same activity could be repeated by drawing triangles.

Triangle's area is 5 sq. units

Triangle's area is 8 sq. units

More challenging questions can be posed by the teacher:

'Find the side length of a square that has the same area as an 8 x 2 rectangle.'

'A square of side 3 cm is formed using a piece of wire. If the wire is straightened out and then bent to form a triangle with equal sides, what will be the length of each side of the triangle?'

'A rectangle of side 5 cm and 3cm is formed using a piece of wire. If the wire is straightened out and then bent to form a square, what will be the length of the square?'

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