

Montessori Primary

Geometry

ESSORI ARY

Mathematics Lesson 4



Addla Montessori

Geometry

Geometry is the study of 2 and 3 dimensional shapes.

The goal of studying geometry at Primary level is to enable the child to experience several levels of geometrical thinking, they include:-

1. Sensory
2. Visual
3. Descriptive
4. Informal deduction
5. Deduction
6. Advanced mathematical thinking, (rigorous level)

These levels are sequential and success at one level depends on the development of proper geometric thinking and understanding at the preceding level, which can be achieved through different activities. The activities include observation, manipulation, research, description, construction, creativity.

The Geometric Cabinet

It is arranged differently for the Primary school aged child. The drawers are arranged in a different order. They are grouped according to the number of sides of the shape, with the smallest number of sides first.

The work the children do with the shapes include drawing round templates, cutting, pasting and labelling and proving theories. The child is reasoning now and grown beyond the sensorial/tactile learner.

Tell the child that you will be studying Geometry: the study of shapes.

Geo - means earth

Metre - means measure

So we are measuring things on earth, measuring shapes. This area of study is known to have originated from Ancient Egypt in Africa where the land was measured out after the annual Nile flood.

Drawer 1: Triangles

Materials

The Geometric Cabinet with the drawers in the correct order:

Triangles

Rectangles

Polygons

Quadrilaterals

Curved Figures

The Labels for triangles by sides and by angles

A floor mat

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Objective:

To give the child a further understanding of triangles and the reasons for the names they are given.

Presentation 1

Take the child to the Geometric Cabinet and explain the new order of the drawers: The drawers have been arranged according to the shapes and number of sides.

Set the first drawer up on a workstation.

Take out the **Equilateral triangle**. Ask the child if they know the name of the triangle, if not teach it using the 3 Period Lesson.

Rotate the triangle and ask what he notices: the equilateral triangle has three equal sides. The child may want to use a ruler to establish if this fact is true.

Find the right label and place it under the triangle. Explain how the word was derived - **Equi** is a Latin word meaning equal and **lateral** is also Latin meaning sides, therefore equilateral triangle means a **triangle with equal sides**.

Next take out the **Isosceles triangle**. Ask the child what they notice about the Isosceles triangle: it has 2 equal sides, again the child could use a ruler to confirm this.

Explain that this is called an Isosceles triangle. The word isosceles comes from the Greek words **Isos** meaning equal and **sceles** meaning legs.

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Find and place the right label under the isosceles triangle.

Finally pick out the **Scalene triangle** and place it on the mat, explain the origin of the word: Latin word: **scala** meaning ladder. A scalene triangle has no equal sides. The early Romans used ladders with each rung being a different rung. Find the label and place it under the triangle.

Remove the labels and teach the names with the 3 Period Lessons.

Presentation 2

Review the names of the triangles by names and sides.

Explain to the child that there are 2 ways of describing triangles: by the length of their sides and the other is by their angles.

Tell the child that all triangles have 3 angles. Triangles that have one angle that looks like the sides of a square are called 'right-angled' triangles. Ask the child to bring a square from the cabinet and place it by the triangle.

You can compare the right-angled with the corner edge of a book, table piece of paper etc.

The right -angle was the measuring angle carpenters used in the old days to make various items such as tables, boxes etc.

Get the child to label the triangle correctly.

Now take out the **Obtuse-angled** triangle and ask the children if they know its name.

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Ask if there are any right- angles in this triangle, the answer is ‘No.’

Ask the child to describe the angles: one of the angles is larger than a right-angle.

Tell the child the triangle is called an obtuse -angled triangle. An obtuse angle is greater than one right angle but lesser than two right angles. Obtuse means **of blunt form** or **dull**.

Ask the child to find the right label and place it by the obtuse-angled triangle.

Then take out the **acute-angled triangle** ask the child its name, and if there are any right angles or obtuse angles in the triangle. The answer is (no.)

All the angles of this triangle are sharp. They are smaller than a right angle. Explain to the child that we say a sharp pain is acute, because it penetrates like a pointed end. An acute angle is a sharp angle.

So this triangle is named an acute-angled triangle.

Now get the child to label the acute angled triangle.

You can remove the labels and use the 3 Period lesson to teach the names of the triangles.

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Extensions: You can make task cards of these activities

1. Use blue construction paper and draw

A right-angled triangle,

An obtuse-angled triangle and

An acute-angled triangle.

Cut them out and stick them into your work books.

1. Use the Triangle Detective Game material, sort triangles into sets according to the length of the sides, size of their angles or both.
2. Draw birds using different types of triangles as their beaks. Draw fish, reptiles dinosaurs as well in the same manner.
3. Using a blindfold, give the child a triangle, let them feel it and return it, Then remove the blindfold and show the child the line diagram of different triangles, ask the child to identify the one that matches the triangle he has just felt. Give him the triangle and ask him to place it over the diagram chosen to see if he is correct.
4. Use the Terminology Cards for the Geometric Cabinet.

- Match the word and picture cards with the triangles
- Lay out the set of triangle word and picture cards from left to right at the top of the workstation
- Now match the picture only cards below each triangle word and picture card.
- Turn over the triangle word and picture cards so that they cannot be seen.
- Then use the triangle naming labels and place them under the correct picture cards
- You can now use the word and picture cards at the top of the mat as a control of error.

Drawer 2: Rectangles

Ask the child to bring the drawer of rectangles to the workstation.

Ask the child to count the sides. Yes they are four sided shapes and are called rectangles or quadrilaterals.

Quads are 4 children born at the same time: a quad bike has 4 wheels.

Get the children to carefully examine the sides of the rectangles and describe what they notice (2 shorter and 2 longer sides).

Point out that the square is a special rectangle. It has sides all the same length!

Extensions:

A group activity: Make several envelopes containing different sized rectangles in one colour (the envelopes could be rectangles of different colours).

The children work in small, or individually to create a picture from their rectangles.

They do not have to use all the shapes in their envelope

When they have finished, discuss with children what inspired them to create their picture.

Drawer 3: Polygons

Ask the child to bring the drawer of polygons to the workstation.

Explain that it is the tray of polygons. Polygon is a word derived from Greek words **Polys** meaning **many** and **gonos** meaning **angled**.

Remove the shapes from the tray and put them out on the mat. Ask the children what they notice about the shapes. (they have many different angles).

Say to the child, 'These shapes derive their names from the number of sides that they have.'

Give the child the octagon and get him to count the sides. Then tell him, 'This shape is called an **Octagon**, the word comes from the Greek word **Okta** meaning eight. As like the octopus that has 8 legs'

Get the child to count the sides of each polygon and name them.

Five sides: - **Pentagon** - word comes from the Greek word **Pentas** meaning five.

Six sides: - **Hexagon** - the word comes from the Greek word **Hexas** meaning six

Seven sides: - **Heptagon** - the word comes from the Greek word **Heptas** meaning seven

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Nine sides:- **Nonagon** - the word comes from the Latin word **Nonas** meaning ninth

Ten sides:- **Decagon**- the word comes from the Greek word **Deka** meaning ten

Now present 3 shapes at a time doing a 3 Period lesson if you need to. Let the children label the different shapes, tracing and drawing each shape into their book and labelling them.

Extensions:

Make a polygon booklet and poster by drawing around, cutting and labelling the regular polygon shapes

Ask the children to draw regular polygon vehicles, they can use polygons rather than circles for the wheels.

Ask them to create animals using using a polygon for its body, then give their animal a name e.g. a pentacat - a five sided cat with five legs!

Work with the terminology cards for polygons in the same way as the triangles.

Play the sensorial game and name the shape by laying out the diagrams of the polygon shapes then put a shape in a bag, let the child feel the shape without putting their hand inside the bag, with their eyes closed or blindfolded. Now let the child open their eyes and chose which of the shapes he thinks he felt. He can now take the shape from the bag and see if he was right.

Use the short bead chains to make closed shapes, then match them to the flat shape diagrams of the shapes from the Geometric cabinet.

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Choose 3 polygons from the cabinet with the yellow frames.

Lay them out in a row on the mat

Give the child the flat shape diagrams and ask them to go and choose from the pack the same shapes and spread them left to right in the same order.

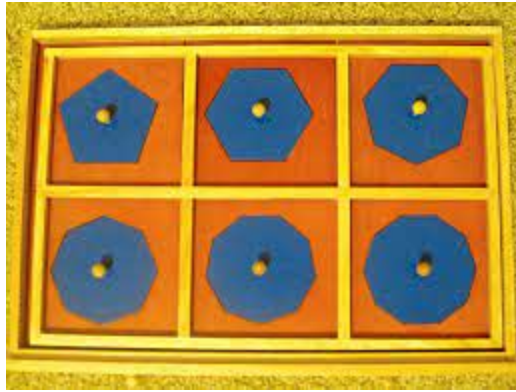
The child can then go back to pick the shape on the left and place it above his choice on the left on the other mat, then the second shape and finally the third shape. This way he can see if he was correct.

Another game would be to blindfold the child, or ask them to close their eyes. Give them a shape to feel and remember. Then place the shape on the table. Then give the child another shape, when they have felt the shape place it on the table next to the first one.

Give the child yet another shape, a third one to feel and then place it on the table next to the other two shapes. Now cover the shapes with a piece of fabric.

Ask the child to open their eyes or remove the blindfold and give him the flat diagrams and ask him to find the three corresponding shapes to those he felt and place them in order on the table.

Once he is done uncover the shapes and see if the child remembered the shapes correctly and in sequence.



Drawer 4: The Quadrilaterals

Take the tray of other quadrilaterals to the workstation. Remove the shapes and lay on the mat, now ask the children what they notice about the shapes.

Tell the children that they are like the rectangles, and are therefore **quadrilaterals**.

The word comes from the Latin words **quadri** and **lateris**- meaning a four sided shape. It could be any four sided shape.

Take each shape and explain how their names were derived:

Trapezium - from the Greek word **trapezi** which means table- a **trapezium** is a quadrilateral with one pair of parallel sides.

A Trapezoid is a quadrilateral with no parallel sides.

Rhombus comes from the Greek word **rhombos**, which means something that spins.

A **Rhombus** has 4 sides of equal length. The opposite sides are parallel and the angles are equal. It looks like a square that is being pushed over (a diamond).

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Parallelogram comes from the Greek words **para** which means besides, **alleos**, meaning one another and **gram** meaning writing or drawing.

A **parallelogram** is a rectangle that has opposite sides are the same length and they are parallel.

A **kite** has two pairs of sides next to each other that have equal lengths. But none of the sides are parallel. The name comes from the toy kite which was named in 1664 because it appeared to hover in the air as the bird of prey of the same name.

The **Chevron** polygon is a closed, straight-lined, two-dimensional plane with four sides, and is composed of two pairs of consecutive congruent sides.

Teach the names of the polygons using the 3 Period Lesson and get the children to label the shapes.



Extension

Draw around the shapes, cut them out and stick into the notebooks labelling them.

Get the children to make shapes out of the polygons, roofs, houses doors etc.

Play the memory games and do the activities mentioned previously for the polygons with the quadrilaterals.

Drawer 5: Curved Figures

Invite the child to take the tray of curved figures to the workstation and lay out all the shapes, ask the children what they notice about them.

Teach the names of the shapes:

Circle from the Greek word **kirkos** which means ring.

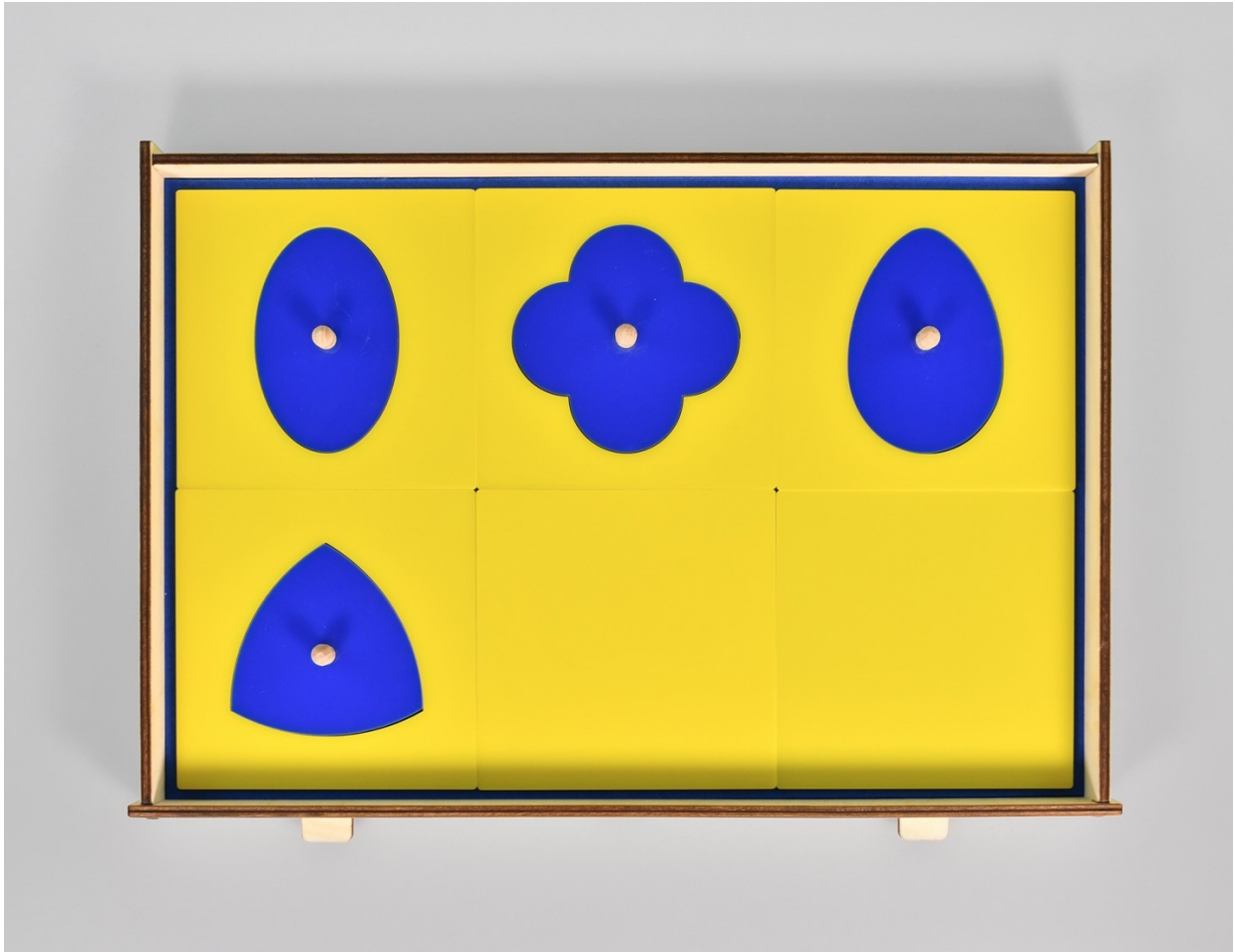
Curvilinear triangle derived from Latin meaning a curved lined triangle.

Quatrefoil from the French words **quatre** meaning four and **feuille** meaning leaf.

Oval comes from Medieval Latin **ovum** meaning egg

Ellipse is from the Greek **elliptikos** which means something is missing – from the circle.

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Extensions

Get the children to cut out the shapes and label them

Ask the children to use the shapes to form curved figure caterpillars.

Definitions

Materials

Definition cards (I have provided a version of this which you can print out and use in your settings. This set is for sale so please do not give out. Thank you.)

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Objective

For the child to learn to use the appropriate geometric terms correctly and identify the figures.

Presentation

The child is shown the set of cards and the term is explained.

The child will take out the pictures and match them to their definitions.

Note how all these exercise help the child not only develop geometric skills but it is a lesson in many areas of the curriculum as well.

Language development: learning the root of words as well as the names and why the figures are different.

Reading skills are constantly being expanded and practiced. You may have read out the definition cards when explaining each figure to the child but when they take over to do the matching the child will have to read each card understand it and match it. Obviously if they need any help do help, but as time goes on they will really get into the hang of reading. Practice always makes perfect.

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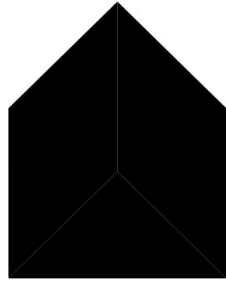
A Point is a small dot or mark having no length or breadth.



A Line has length but it has no breadth..



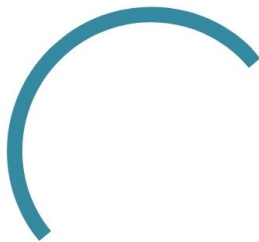
A Surface has length and breadth but no depth..



A Solid has length, breadth and depth..

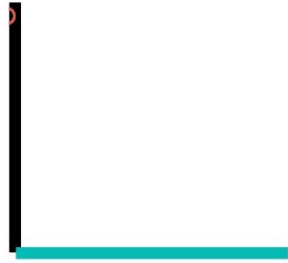


A Straight Line joins two points in the most direct way.



A Curved Line joins two points but changes direction.

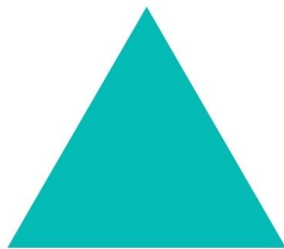
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A Vertical Line
points to the center
of the earth..



A Horizontal Line
makes a right angle
with a vertical line.



A Plane is a flat
surface..



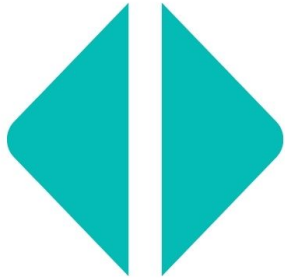
A Perpendicular line is when one line stands on another and the adjacent - side by side- angles are equal..



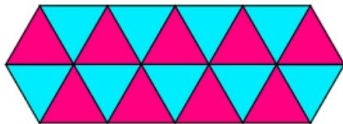
Parallel Lines are two lines on a plane that never meet. They are always the same distance apart.



A Line of Symmetry occurs when one side of the dotted line matches the other exactly.



Congruent Figures are figures that have the same angles and lengths of sides.



A Tessellated Figure is a shape repeated over and over again without any gaps or overlaps.



Montessori Training Centre

Relationship of point to line to plane to solid

Materials

10 Golden Unit Beads

10 Bead Bars

10 Hundred Bead Squares

1 Thousand Bead cube

Objectives

To represent in the concrete form the relationship between a point, a line a plane and a solid

To introduce the language and terms: point, line, plane and solid.

Presentation

Take the materials to the workstation and lay out the bead materials. Ask a child to name one and another to name another item until you have gotten all the names.

Take a single bead and place it on the mat.

Say: 'This is like a point on a plane.'

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Lay out nine more beads and say:

‘This is like a line.’

Take a ten bead bar and say: ‘A line.’

Lay out nine more bars next to it and say:

‘This is like a plane. This plane extends in all directions along a flat surface.’

Take a Hundred Square and say: ‘A plane.’

Place nine more Hundred Squares on top of each other and then ask:

What does this look like: A thousand cube, a solid....

Say: ‘Yes this is like a solid.’

Then take the Thousand cube and place it next to it and say to them: ‘A solid.’

We started with a ...?(point). Lots of points make a ...? (line) Lots of line make a ...? (plane). Lots of planes make a ...? (solid). All these began with a point.

An alternative Presentation which I love involves using the same materials in a sand tray.

Place a unit bead, then a bead bar, a hundred square and a thousand cube into the tray and take them out leaving the prints which show the point, line, plane and solid (show the child how the solid is formed) This requires abstract vision capabilities from the child, as the breadth is not seen with this representation.

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