Montessori Primary

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Mathematics 6

Addlo Montessori

Geometry 3

The Blue triangles: rotation about a point.

Materials

The wooden box with 12 blue right-angled, scalene triangles

Objectives

To be able to identify objects that turn about a point.

To be able to recognise and make full, half, quarter and three quarter turns

To be able to follow and give instructions involving position, direction, turn and movement

To know that a right angle also represents a quarter turn.

Presentation

The children needs to have worked with the Geometric Cabinet and also know the properties of a square and hexagon.

Take the box of blue triangles to the workstation, remove the lid and take out the triangles, placing them in a pile on the mat. Take a triangle and examine it with the children, then point out the length of the sides: One short the base, one medium the height and one long the hypotenuse. Then point out the angles: one small - acute, one medium - acute and one large –right angle.

Tell the children: 'Today we are going to make stars by rotating the triangles about a given point.

Now place a triangle one on top of another triangle. Show the children how to rotate the triangle around the largest angle, the right angle, keeping the right angle still and moving the triangle through 90 degrees. Place another triangle on the second triangle and repeat the movement. Then place the final one on the third triangle and repeat the same movement. The children will see that you have made a four pointed star.

The Four Pointed Star
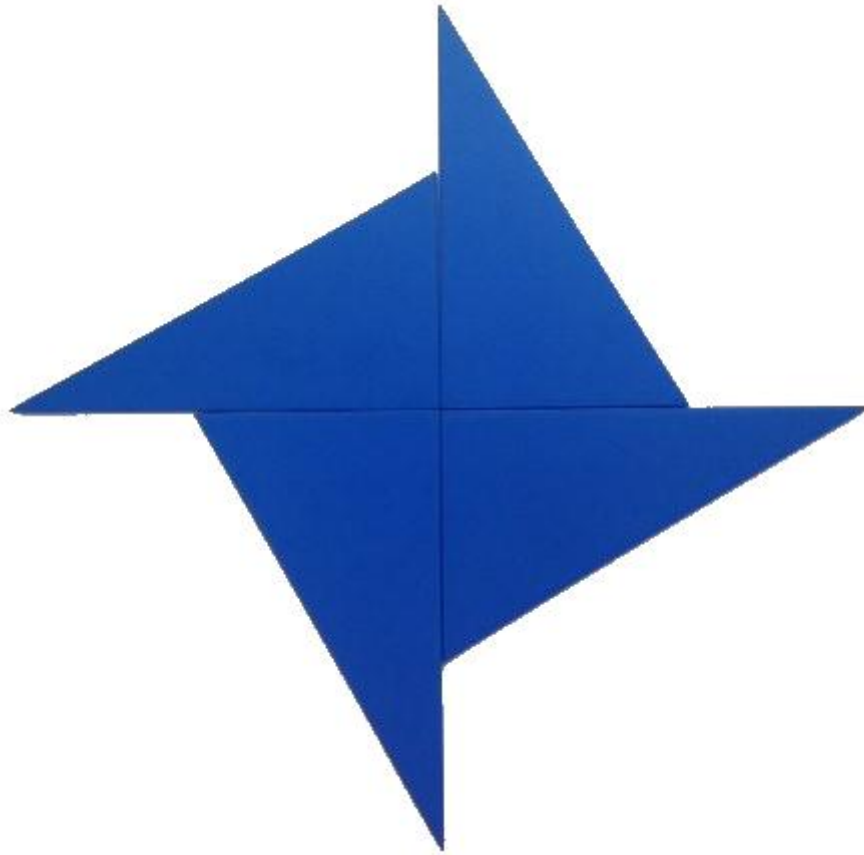
Now examine the star and point to the four triangles, show them how the first triangle, when rotated about the point of the right angle, has made a full turn, if it returns to its original place.

Ask the children if they can tell you how far the triangle has rotated when it rotates through the right angle once.

One quarter turn is the answer.

Ask them how far it would have rotated when it rotates through two right angles

One half turn.

Get them to demonstrate with their bodies doing half turns, quarter turns and full turns

Now show them how to slide the Blue Triangles to the edges of the star, to make a closed shape with a square shaped diaphragm in the middle.
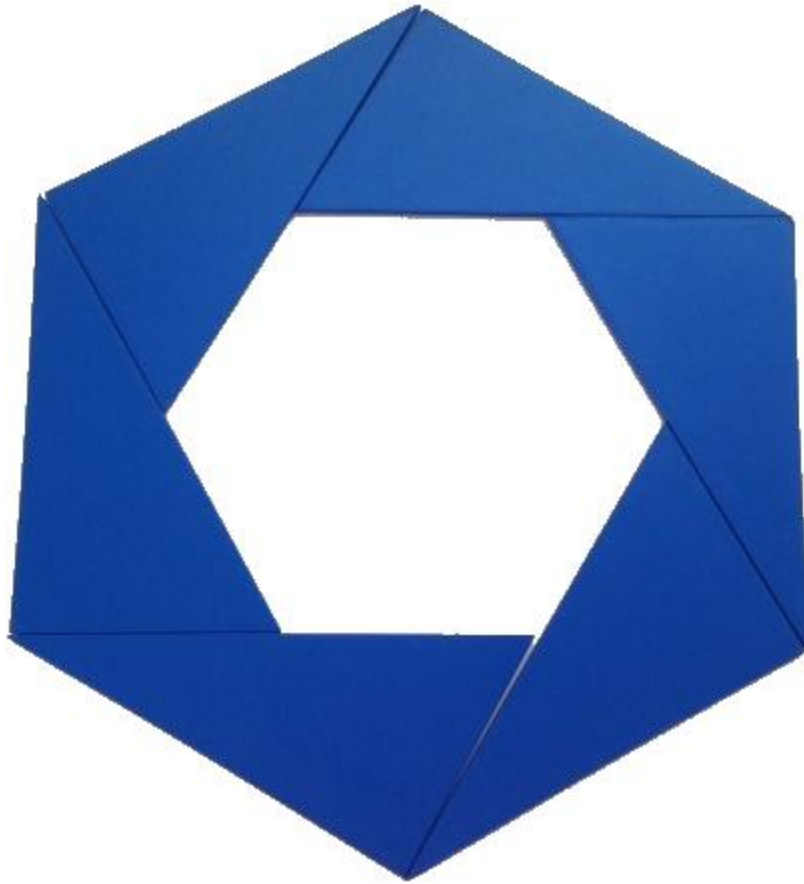

The Six Pointed Star

Give the children six of the Blue Triangles and show them how to rotate about the middle sized angle in the same way as before.

The child will make a six pointed star.

When the child slides the triangle to make a closed shape the diaphragm in the middle will be a hexagon.
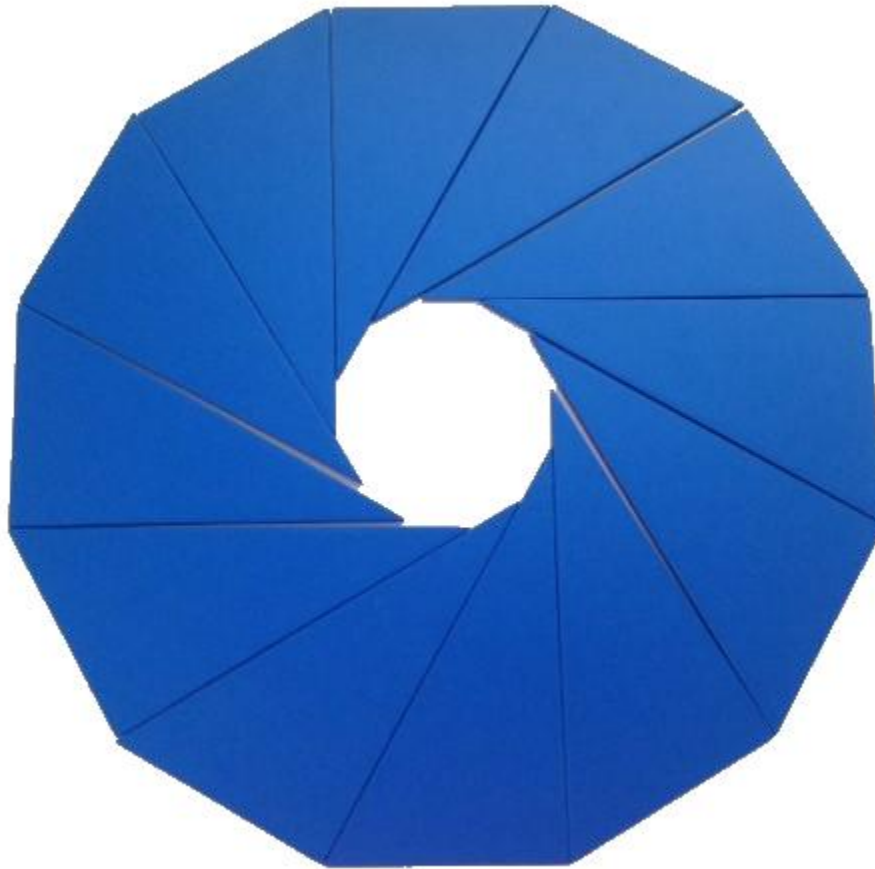
The 12 pointed star

Give the children all the 12 triangles and show them how to rotate the triangles about the smallest acute angle to create a 12 point star.

Show them how to slide the triangles to make a twelve sided closed shape this will produce a dodecahedron.

Allow the children to continue to explore with the Triangles if they so wish. They may want to draw their stars and diaphragms or make models out of construction paper.

Introducing the Four Compass Points

Material

Large circular mat or circle cut out of paper or fabric.

A north pointer

East - West dividing line

Cards with N,S, E, W

Objectives

To be able to recognise and use the whole, half and quarter turns, both clockwise and anticlockwise

For the child to be able to follow and give instructions involving position, direction and movement.

To visualise and use everyday language to describe the position of objects and the direction and distance when moving them.

Presentation

Do this in a group

Place the circle on the floor, then add the North pointer and the East - West divider. Point out to the children that the circle is now divided into 4 sections.. If they are familiar with fractions explain to them that these are quarters.

Point out that the angle of each quarter is a right angle.

At the North point place the card with N on it and say, 'This is North'.

Ask a child to stand up and face north then ask her to turn and face the opposite direction. Tell them that she is now facing the south. Place the S letter card on the pointer opposite North.

Now say: 'When you turn and face the opposite side from the north, you have made a half turn and you will be facing South.'

Ask all the children to stand up and face north, then ask them to make a quarter turn with their bodies. Ask them if they know where they are facing.

Place the E card in its correct position and say: 'When you make a quarter turn from north following the hand of the clock you will be facing East.'

Ask them to sit and then ask if they turned to face the opposite of East where will they be facing?

The answer will be west.

Place the W letter card in its correct position.

They can play the mapping game as an extension, describing the position objects around them in relation to the cardinal points'

Children could also draw simple diagrams mapping their homes and classrooms using the practical cardinal points now known.

All About Lines: The Straight and Curved Lines

Materials

An eight inched string tied between 3 pieces of wood

Geometric cabinet and Cards (the triangle and curved figure drawers)

Heading cards saying 'Curved Lines' and Straight Lines'

Objectives

To help reinforce and idea of a line and to learn the terminology, straight lines and curved lines.

Presentation

Lay out all the items on the workstation, ask a child to make the string first into a straight line and then next into a curved line, if the child doesn't understand show them how to do this and name each line as you do. Teach the concept with the 3 period lesson.

Now ask the child to make a straight line with the string again. Point to the drawers and ask the child which one has shapes with straight lines.

Then get the child to make a curved line with the string and ask them to point out the tray with curved shapes.

Now set out the header cards and the geometric cards shuffled together and get the child to sort them out under the two headings: Straight Lines/ Curved Lines.

The drawers of the Geometric Cabinet can serve as the control of error for this exercise.

The child can also draw the shapes under 2 headings in their notebook.

Parts of a Line

Material

A long length of string wound around one piece of wood and 8 inches of string open between the 2 pieces of wood.

2 pairs of scissors

Red felt tip pen

Geometry sticks

Terminology Cards

Objectives

To learn the parts of a line and the terminology: ray, origin, line segment and end points.

Presentation

Lay out the items on the work station, use the length of the string, make a straight line and use the red felt tip pen to make a mark in the middle, ask the child to cut the string at that point. Tell the child that they have made a ray.

Pull the line and point out how the string keeps going on and on.

A **ray** is a line with a definite starting point but then it goes on forever.

A **line** is a line that goes on forever at both ends, it does not have a definite starting or ending point.

The starting point of the **ray** is called the **origin**. Use the 3 Period lesson to teach the terms **ray** and **origin**.

EXERCISE 2

Make a straight line with a string, mark with the red felt tip pen 2 points not to far from each other and cut the line at the same time, you and the child.

←——————→	**A Line**
●——————▶	**A Ray** **Origin**
●——————●	**Line Segment** **End points**

Explain that the small piece of string that you now have is called a **line segment**, and that the ends of the line segment are called **end points**.

A Line.

A Ray.

A Line Segment.

The Relationships of Lines

Materials

Craft sticks

Bowl

Jug of blue water

Plumb line

Spoon

Cards or slips of paper for Vertical and Horizontal

Objective

To learn the concept of the relationship of lines to the eart and learn the terminology: **Horizontal** and **Vertical**.

Presentation

Lay out all the items on the work station. Pour the blue water into the bowl, stir the water and wait for it to become level. Explain that ithe position of the water is **horizontal** - this comes from the Latin word **horizon** meaning limit or boundary where the earth meets the sky.

Put the craft stick in the water, tell the children you want to see the position the stick takes.

Point out that it is laying on the horizontal plane of the water.

Now use the Plumb line to show the child that it gives us a straight line and this line is known as a **vertical** line.

The Relationship of Lines 2

Materials

Geometric Stick Material

Board

Objectives

To show the children lines that are neither horizontal nor vertical.

To introduce the terminology: **oblique** to the child.

Presentation 1

Place the board flat on the mat and tell the children that the board represents a flat plane.

Ask them the position of the plane.

The position of the plane is **horizontal.**

Hold the board up straight and ask the children the position of the plane.

The position of the plane is **vertical.**

Now hold the board at an angle and ask the children the position of the plane.

The position of the plane is **oblique.** The word comes from '**obliquus'** a Latin word meaning **slanting**.

Horizontal position Vertical position Oblique position

Presentation 2

Place the board flat on the mat

Remind the children that the board represents a plane.

Point to the bottom edge of the board and say : 'This is the horizontal edge.'

Ask the children what the side edge of the board would be: Vertical.

Take a stick from the box and ask a child to position the stick in a horizontal line on the board.

Ask another child to position another stick in a vertical line, and a third child to position a third stick in a diagonal line on the board.

Explain to them that when we look at something in a horizontal position we look back and forth, demonstrate by pointing to the horizontally laid stick and move your head back and forth

When we look at something in a vertical position we look up and down

When we look at something in an oblique position we look diagonally.

Demonstrate these by using your head to follow the directions just as you did with the horizontal lines.

Horizontal Line

Vertical Line

Oblique Line

More about Lines

Materials

Geometric Stick Material

Cut outs of children

Arrows

Objective

To understand the relationships between two lines and to learn the terms parallel, interesting, divergent, convergent, perpendicular and oblique lines

Parallel Lines

Lay the items on the work station. Fix a long stick to the board with drawing pins, take two shorter sticks of the same length and place them perpendicular to the first stick.

Place another stick identical to the first one along the top edge of the two perpendicular sticks, this will be parallel to the first stick. Now remove the two small sticks.

Place a picture of a child above each stick and tel the children that the children can walk forever , but they will never meet, just like the lines would never meet.

Explain that the lines are parallel to each other and are called **parallel lines**.

Remove the pictures of the children and replace them with arrows pointing in both directions.

Explain that the arrows will go on forever to infinity and will not meet.

Intersecting Lines

Place a long stick on the board in a diagonal position

Take two small sticks of different sizes and place them perpendicular to the first stick, then place a long stick along the top edge of the 2 sticks at a slant, the stick will cross the first stick.

Now remove the small stick. Use the cut out children to demonstrate that as each child walks along their own line they will meet.

Substitute the children with the arrows and say to them: 'these lines meet and are called intersecting lines. Lines that cross over each other are called **intersecting lines**.'

Convergent Lines

Place a long stick on the board diagonally the higher end should be to the left, now place two shorter sticks not the same length beneath the first stick, with the longer of the two sticks to the left.

Take a long stick the same length as the firs stick and place t below the two unequal sticks

Remove the 2 shorter sticks, Place the children sticks facing the smaller end and say: 'These children will eventually meet just like the lines. These are called **convergent lines**.'

Remove the children and replace them with arrows

Divergent Lines

Place a long stick on the board in a diagonal position, the higher level should be on the right side.

Put two shorter sticks not the same length under the first stick with the longer of the two to the right.

Take another long stick, the same length as the first stick and place it below the two unequal sticks.

Remove the two shorter sticks and place the pictures of the children on the sticks then say to the children, 'They will never meet just like the lines will never meet. We call these lines **divergent line**.' (Use pictures of sad children if you have them).

You can now remove the children and replace them with arrows.

The Perpendicular Line

Start with reviewing the intersecting lines.

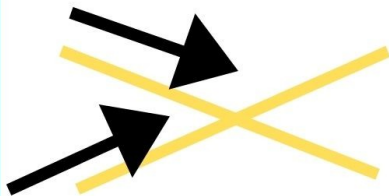Now take the long horizontal stick and remove all other sticks.

Place another stick at right angles to the remaining stick and make sure they are touching.

Tell them that a line segment which starts from another line and forms a right angle with it is called a **perpendicular line.** The word comes from **perpendiculum** a Latin word meaning '**plumb line.**'
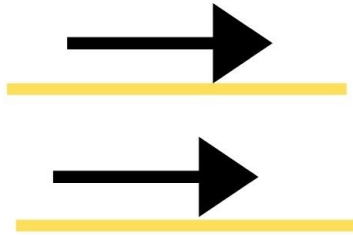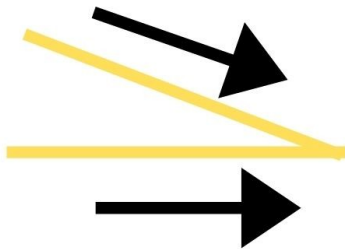
Parallel Lines

Intersecting Lines
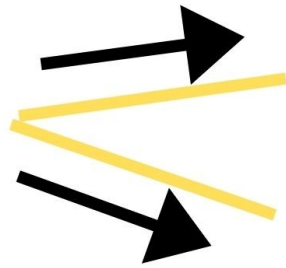
Convergent Lines

	Divergent Lines
	Perpendicular Line

The Study of Angles

Materials

Geometric Stick Material and Board

Geometric Cabinet; The Triangle Tray

Angle Terminology Cards

Objective

To reinforce the parts and types of angles and to learn the correct terminology

Presentation 1

Take the items to the work station, tell the children that you want to teach the different parts of an angle. Make an angle on the board by using two geometry sticks of different lengths.

Place the end of the long stick over the short one. Name the sides and name the vertex pointing to them with your fingers. Continue with a 3 Period Lesson teaching the words sides and vertex. Get the child to work with the terminology cards or you can use them on a later occasion for a review of the words.

The Types of an angle

Presentation 2

Take two sticks of different lengths.

Place the long stick over the short one and attach them to the board at the vertex

Now attach the shorter stick to the board and leave the long one hanging lose. Make each angle:

A right angle,

An obtuse angle and

An acute angle

Now do a 3 Period lesson to teach the terms.

With the triangle tray of the Geometric Cabinet, the child can draw around the various triangle shapes and use a red felt tip pen to colour in the angles and name them.

The child may be introduced to a protractor as a means of measuring angles (zero point must be aligned to one of the sides) and a means of checking the angle coloured in the drawings n their workbooks.
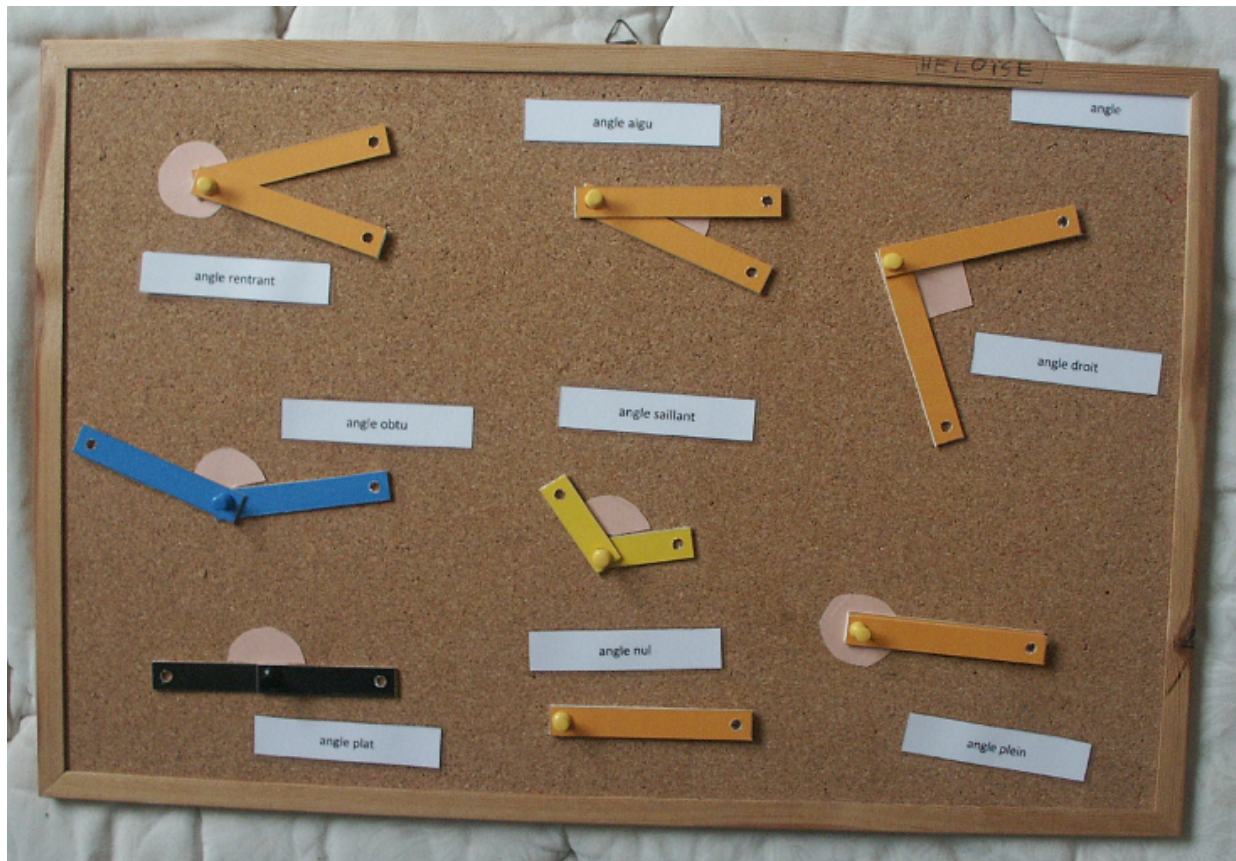
The study of Regions

Materials

Geometric Stick Material and Board

String, coloured paper and scissors

Terminology cards

Objective

To learn the concept of regions and learn the terminology: closed curved figure, curved figure.

Presentation 3

Lay the items out on the work station, then review the line segment and end points with the child.

Use the string to make a curved shape - semi circle, ask the child to trace the figure with his fingers. Tell the child that it is an **open figure**.

Close the string to form a circle. Ask the child to trace the string with his fingers. Tell the child that this is a **closed figure**.

Get the child to cut out a circle and label it as a **closed figure**.

Let the child work with the Geometric Stick Material creating closed and open figures, and recording them in their workbook.

Parts of a Triangle

Materials

Geometric Stick Material and Board

Corresponding Terminology cards

Objective

To learn the various parts of a triangle

Presentation

Take all the items to the work station and tell the children that you want to teach the parts of a triangle.

Ask the child to make a triangle using three sticks.

Identify the different parts using your finger to outline each part - sides, angles, vertices, base, perimeter and area.

Continue with a 3 Period lesson.

Use the terminology cards to review the different parts the children can draw and label these in their notebook.

The Study of the Triangle

Materials

The Geometric Stick Material and Board

Geometric Cabinet - triangle tray

Terminology Cards

Objectives

To study the triangle by sides and by angle

To review the terminology -equilateral, isosceles, scalene, right-angled, obtuse-angled and acute-angled.

Presentation

Put out the materials on the workstation, and tell the children that you are going to study the sides of the triangle.

Aske the child to take three sticks the same size and form a closed figure. They will make an **equilateral triangle.**

Now ask the child to take 2 sticks the same length and one that is of a different length and form another closed figure. They will make an **isosceles triangle** this time.

Also ask the child to build a closed figure with 3 sticks all of different lengths. They would have a **scalene triangle**

Then ask the child to collect the tray of triangles form the Geometric Cabinet and compare the triangles they have made with those in the cabinet, and discuss the types of triangles with the child.

Use the terminology cards to review the work.

The Seven Triangles of Reality

Materials

Geometric Stick Material and Board

Geometric Cabinet - tray of triangles

Measuring angle

Objective

To study the seven triangles of reality:

Equilateral

Right-angled isosceles, acute -angled isosceles, obtuse -angled isosceles

Right-angled scalene, acute- angled scalene, obtuse- angled scalene.

Presentation

Ask the child to lay out the Geometric Stick Material on the mat with the board and tell them that they are going to learn about the 7 triangles of reality.

Instruct the child to pick 3 sticks that are the same and make a closed figure with them

Now ask the child to measure all the angles - they are all the same.

Ask the child for the name of the triangle.– This is an **equilateral triangle** and all its angles are the same.

2. Ask the child to make a right angle with two different sticks then to choose a third stick to make a closed figure.

Ask the child for the name of this triangle - It is a **right- angled scalene triangle**

3. Ask the child to choose 2 sticks the same length and make a right angle then to make it into a closed figure with a third stick.

Get the child to name the figure- a **right angled isosceles triangle**

Continue as before giving the children direction until all seven triangles have been formed.

4. 2 different sticks - make an acute angle - close the figure - **acute- angled scalene triangle**

5. 2 sticks the same length - make an acute angle - close the figure - **acute- angled isosceles triangle**

6. 2 different sticks - make an obtuse angle - close the figure - **obtuse- angled scalene triangle**

7. 2 sticks the same length - make an obtuse angle - close the figure - **obtuse- angled isosceles triangle.**

The children can now compare the triangles in the Geometric Cabinets tray of triangles.

The child can draw and label the 7 triangles of reality in their Geometry note book.

Use command cards for further practice.

1.

Use the Geometric Stick Material to make an **obtuse-angled isosceles triangle**. Draw it in your book and label it.

2.

Use the Geometric Stick Material to make a right angled triangle with two equal sides. What is this triangle called? Draw this in your book and label it.

Parts of a Right- Angled Triangle

Materials

Geometric Stick Material

Geometric Cabinet - tray of triangles

Terminology cards

Objective

To learn the parts of the right-angled triangle: leg, major leg, minor leg, hypotenuse.

Presentation

Put out the Geometric Stick Material and board on the workstation and tell the children that you will be teaching the parts of a right-angled triangle.

Ask the child to make a right -angled scalene triangle.

Now tell them that the two sides that formed the right angle has a special name - leg. Use your finger by outlining the legs to show them. Explain that in a scalene triangle where one leg is longer than the other, the longer one is known as the major leg and the shorter leg is called the minor leg. Use your finger to outline and name each leg.

Then show the child that the last port of the triangle opposite to the right angle is called the hypotenuse.

Use the 3 Period lesson to teach these terms.

On another occasion review the work using the terminology cards and the children can draw and label the parts of a triangle in their book.

It is important to purchase Montessori Geometric terminology cards, booklets and Command Cards for the children to work with.

Measuring Angles

Materials

A ruler

A pair of compasses

A protractor

Objective

To introduce geometrical instruments and enable the child to practice using them

Presentation

The child will be familiar with rulers and their use from work on length. Show the child how to put the pencil in the pair of compasses and how to make sure that the two sides are equal, by closing and pressing gently on a flat surface.
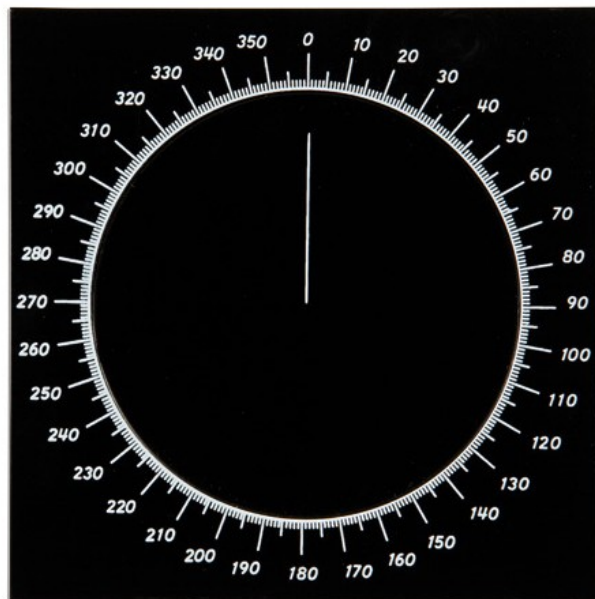
The child can now draw circles of varying sizes by twisting the handle between the thumb and forefinger.

The protractor can be introduced either immediately or at another lesson. Explain that you can use this to measure angles. Introduce the Montessori instrument for measuring angles as well.

The Protactor
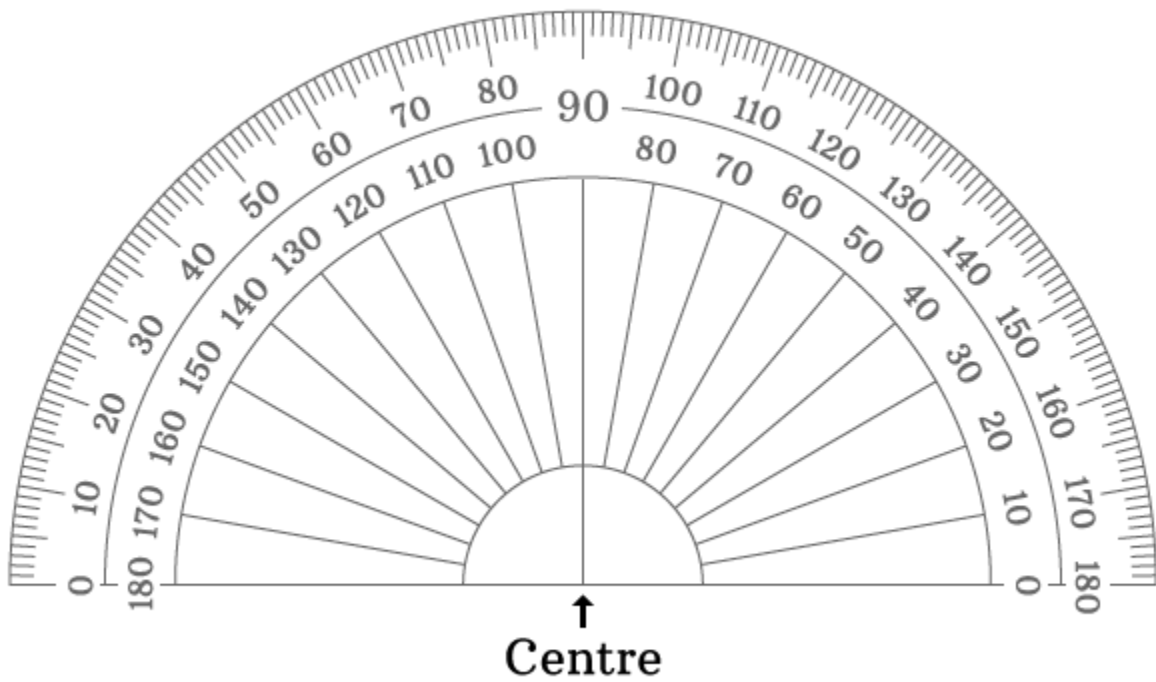
Lots of exercises should now be carried out by the children, practice makes perfect.

Exercises in measuring and drawing lines with specific measurements

'Exercises in drawing circles, semi circles and arcs with a compass

Measuring angles with a compass

Constructing squares, rectangles and triangles with a compass and protractor.

The Red and Green Insets

Materials

Metal insets in metal frames

1. A square 10cm x 10cm
2. A square divided into 2 equal rectangles
3. A square divided into 4 equal squares
4. A square divided into 6 equal rectangles
5. A square divided into 16 equal squares
6. A square divided into 2 equal triangles
7. A square divided into 4 equal triangles
8. A square divided into 8 equal triangles
9. A square divided into 16 equal triangles
10. An equilateral triangle with 10cm sides
11. An equilateral triangle divided into 2 parts
12. An equilateral triangle divided into 3 parts
13. An equilateral triangle divided into 4 parts

Presentation

The children can do this themselves, first they empty the frames and replace the insets to fill an empty frame with the different pieces. While exploring the apparatus the children will discover many things, like the rectangle which is half of the large square which is also the same size as the triangle. Although the shapes are different they are the same size.

This will lead the children into the study or Areas and the Pythagoras theorem.
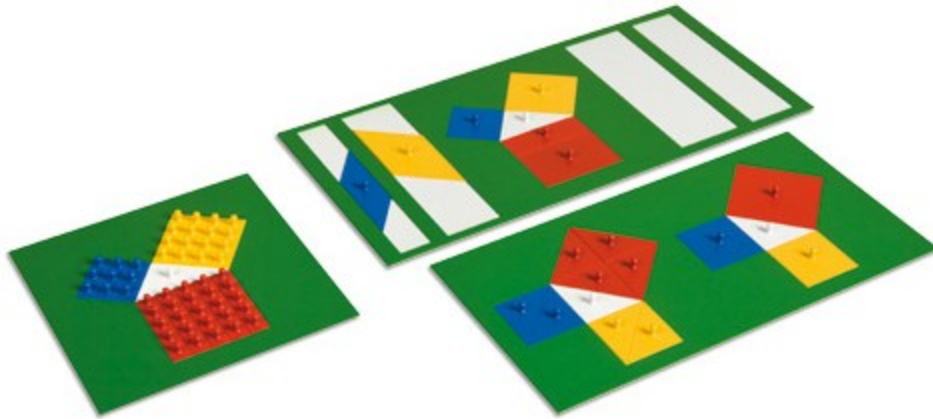
Mathematics 6
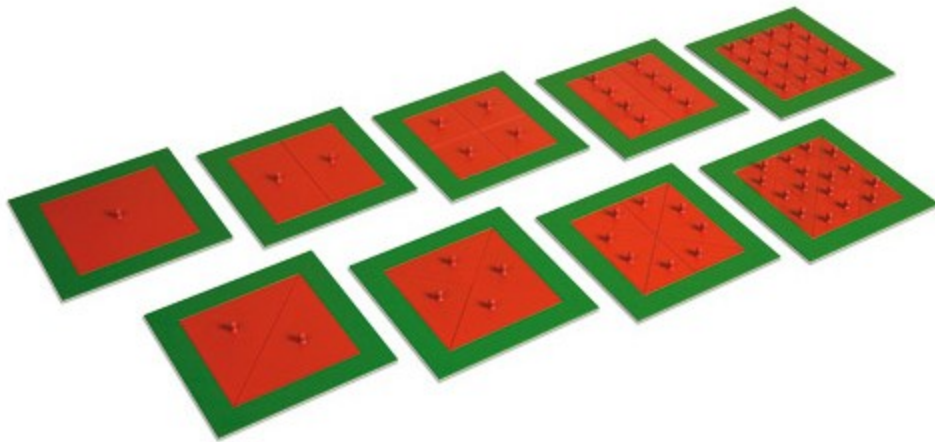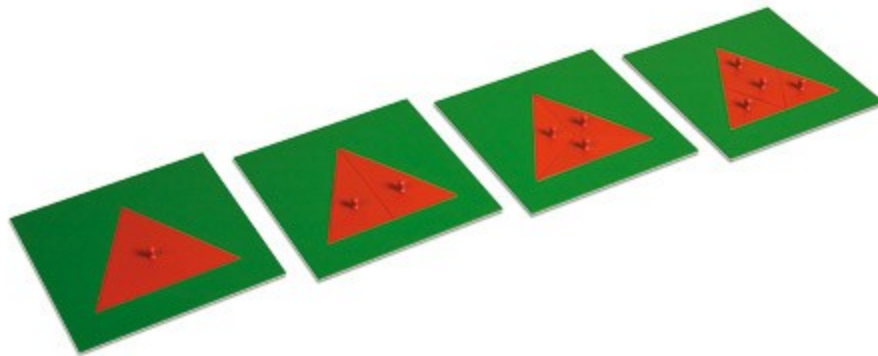
Pythagoras Theorem

The theorem states that in a right angled triangle, the square of the hypotenuse is the sum of the square of the other two sides.
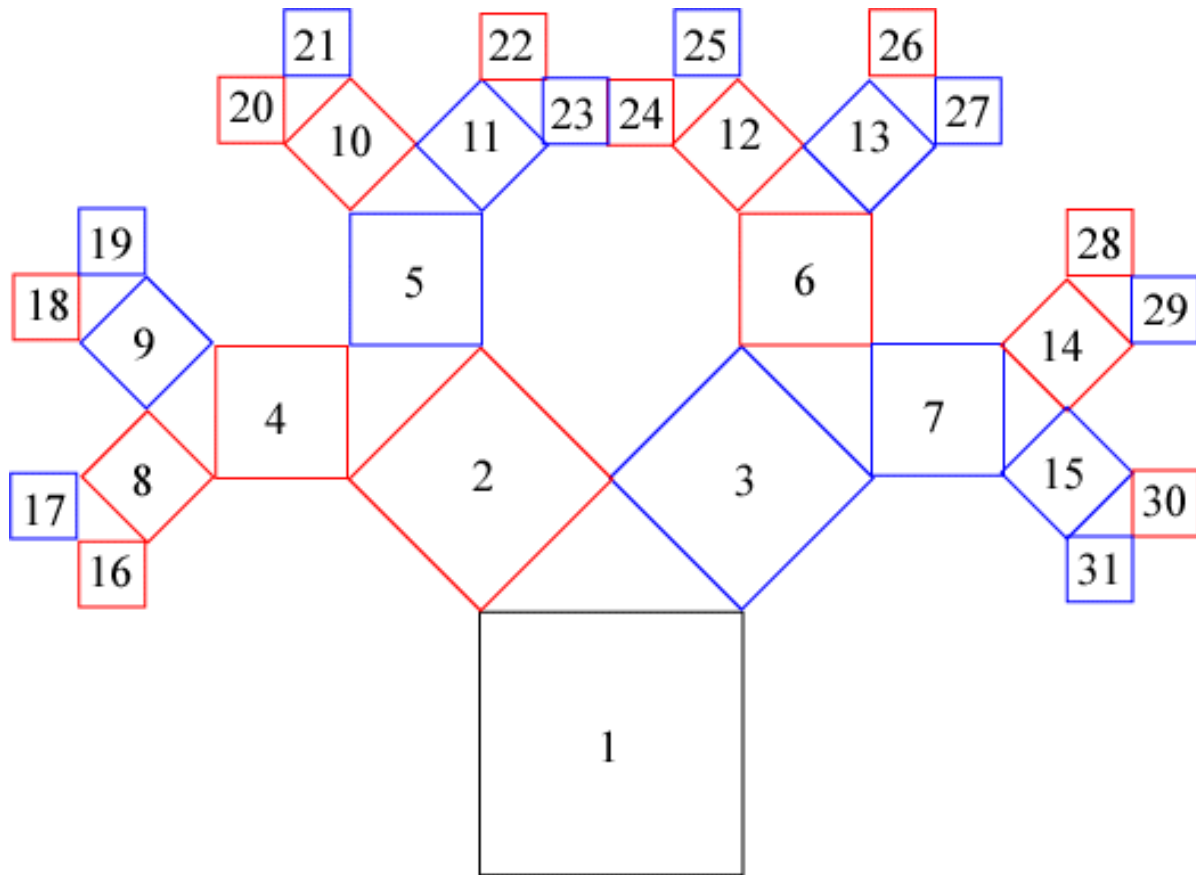
The Pythagoras puzzle

The children should spend time exploring the above material and then once they get a hang of it allow them to prove the theorem with the constructive triangles and the red and green sets.

They can make the Tree of Pythagoras with the red and green sets.

This is the way to build the tree, let the children explore and create they may come up with more than a tree. Who knows !