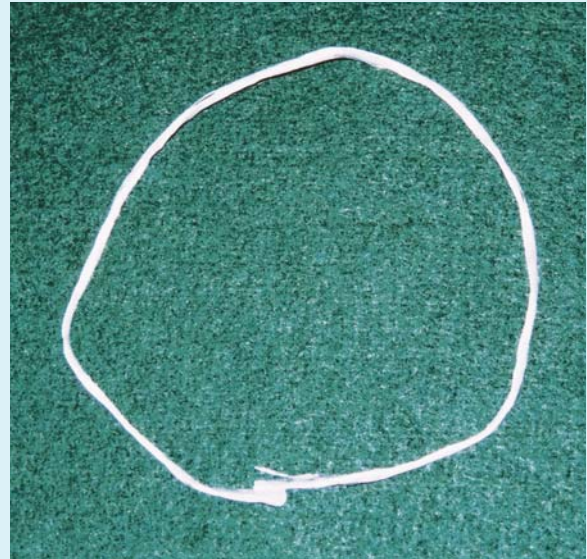


ACTIVITY 1

Making Open and Closed Figures



An open figure



A closed figure

Purpose

To learn what open and closed figures are.

Material

Twelve inches (30 cm) of string.

Nomenclature Cards for open and closed figures.

Math journals and pencils.

Presentation

- Most Montessori teachers present this concept in Year 1 and review it in Years 2 and 3.
- Invite a student to come to a table or mat where you have the material already laid out.

- Announce that today the student is going to learn about shapes called open figures and closed figures.
- Invite the student to lay the string out in the shape of a semi-circle or horseshoe.
- Encourage the student to trace all around the figure with his/her fingers. Tell the student that this shape is called an open figure because it is possible to go from one side of the figure to the other without passing through the string.
- Now invite the student to close the string to form a circle.
- Have the student trace around the string with her/his fingers.
- Tell the student this is a closed figure because it is not possible to go from the inside to the outside or from the outside to the inside without passing through the string.

- Invite the student to lay out the string in the shape of a V. Ask the student whether the figure is open or closed. (Open.)
- Encourage the student to close the V shape by bending one side of the string and joining the two ends to make a triangle.
- Ask the student whether the triangle is an open or a closed figure. (Closed.)
- Ask the student to draw and label three examples of open figures and three examples of closed figures in his/her journal.

Extensions

- Working independently or with a classmate, practice matching up the Nomenclature Cards for open and closed figures. Check your work against the control set of Nomenclature Cards.
- Print the following capital letters of the alphabet in your journal: B, C, D, F, H, O, S, V, D. Beside each, write “o” for open or “c” for closed, depending on whether the letter is an open or a closed figure.

ACTIVITY 2

Learning the Difference Between Closed Curved Figures and Polygons

Purpose

To learn that there are two kinds of closed figures, namely closed curved figures and polygons, and to learn the difference between the two.

Material

Geometry Sticks.

Sheet of red paper.

Scissors.

Nomenclature Cards for open and closed figures.

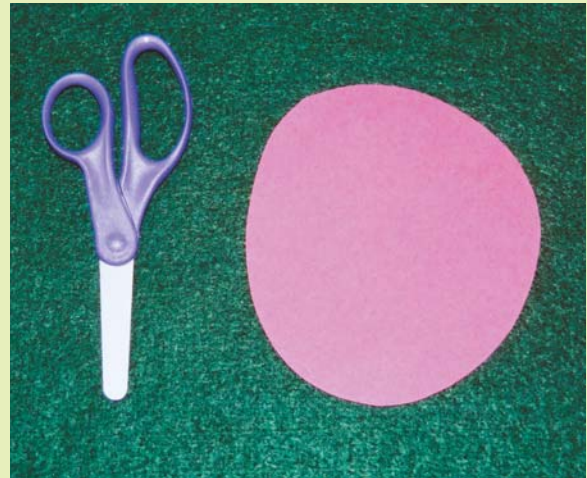
Nomenclature Cards for closed curved figures and polygons.

Math journals and pencils.

Presentation

- Most Montessori teachers present this concept in Year 1 and review it in Years 2 and 3.
- Announce that today the student will learn more about closed figures.
- Review the concept of closed figures, using the Nomenclature Cards for closed figures to illustrate.
- State that closed figures come in two types. Some have curves, and some have straight lines only.

- On the Nomenclature Card for simple closed figures, invite the student to point to an example of a curved figure and a figure with only straight lines.



Making a closed curved figure

CLOSED CURVED FIGURE

- State that the figure with one or more curves is called a closed curved figure.
- Invite the student to cut a closed curved figure such as a circle or oval out of the red paper. Tell the student it is a closed curved figure. Ask the student to glue or tape the closed curved figure into his/her journal.

POLYGON

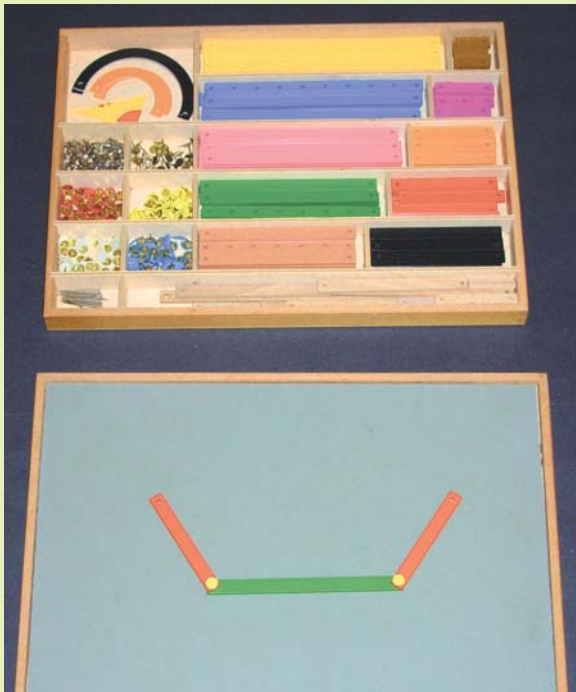
- Invite the student to choose a long Geometry Stick. Tell the student this is a straight-line segment, and review the concept if necessary.



Making a polygon - step 1



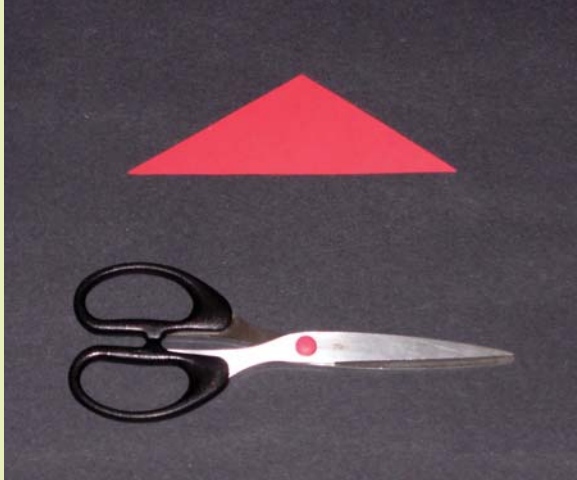
Making a polygon - step 3



Making a polygon - step 2

- Invite the student to take two other sticks and join them to the first, making a bent line.

- Encourage the student to join the end of the line segments to make a triangle.
- Ask the student whether the figure is open or closed. (Closed.)
- Ask the student to say what shape the figure is. (A triangle.)
- Tell the student that the triangle is a type of polygon. Explain the meaning of the word polygon.
- Tell the student that many types of polygon exist and the student will learn about them in a different lesson.
- Encourage the student to make a polygon such as a triangle or square using the red paper.
- Ask the student to glue or tape the polygon into her/his journal.



Making a polygon

- Conduct a three-period lesson to review the concept of a closed curved figure and a polygon.
- Remind the student that every closed figure is either a closed curved figure or a polygon.

Extensions

- Working independently or with a classmate, practice matching up the Nomenclature Cards for a closed curved figure and a polygon. Check your answers against the control set of Nomenclature Cards.
- Look at each of the following objects in the classroom and say whether it forms a closed curved figure or a polygon: table top, opening of a wastebasket, cover of a book, puzzle piece, one side of a building block, sole of a shoe.

ACTIVITY 3

Studying Irregular Polygons



Irregular polygons have sides and angles that are not all the same

Purpose

To learn what an irregular polygon is and what makes it different from a regular polygon.

Material

Geometry Sticks and tack board.

Geometric Cabinet — triangles drawer, rectangles drawer, quadrilaterals drawer, and regular polygons drawer.

Math journals and pencils.

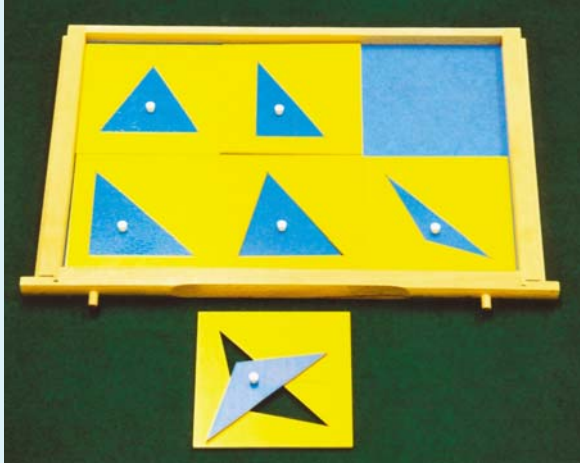
Presentation

- Most Montessori teachers present this concept in Year 1 and review it in Year 2.
- Activity 4, which introduces regular polygons, is best done within a few days after this presentation.

- Invite a student to come to a table or mat where you have set out the Geometry Sticks and the four drawers of the Geometric Cabinet.
- Review what a polygon is. (A plane figure made of three or more straight line segments.)

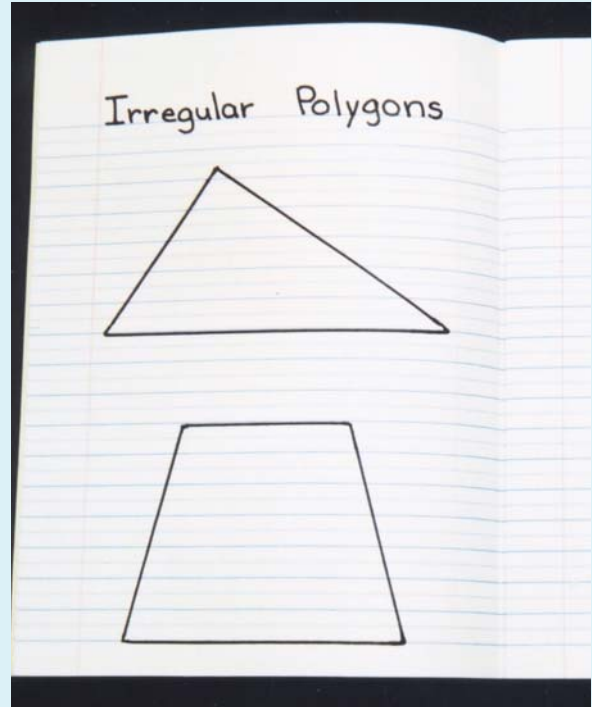
MAKING IRREGULAR POLYGONS

- Invite the student to take three geometry sticks of different lengths. Invite the student to make a triangle on the tack board with the sticks.
- Ask the student what kind of polygon he/she has made. (A triangle.)
- Ask the student whether the triangle's sides and angles are all the same. (No.)



An irregular polygon fits into a frame only if the angles are correctly matched up

- Tell the student that the sides and angles in this triangle are not all the same, and so this triangle is called an irregular triangle.
- Tell the student that any polygon with sides and angles not all the same is called irregular.
- Encourage the student to make more irregular polygons using three or more different Geometry Sticks.
- Invite the student to explore various figures from the Geometric Cabinet. Explain and demonstrate how to test for irregularity by rotating the figure in its frame.



Tracings of irregular polygons

- Ask the student to choose two irregular polygons from the Geometric Cabinet and trace around them in her/his journal.
- Have older students label the polygons "Irregular Polygons."

Extensions

- Working independently or with a classmate, practice matching up the Nomenclature Cards for irregular polygons. Check your answers against the control set.

ACTIVITY 4

Studying Regular Polygons



Regular polygons have sides and angles that are all the same

Purpose

To practice distinguishing between irregular and regular polygons, and to practice making and recognizing regular polygons.

Material

Geometry sticks and tack board.

Geometric Cabinet — triangles drawer, rectangles drawer, and regular polygons drawer.

Math journals and pencils.

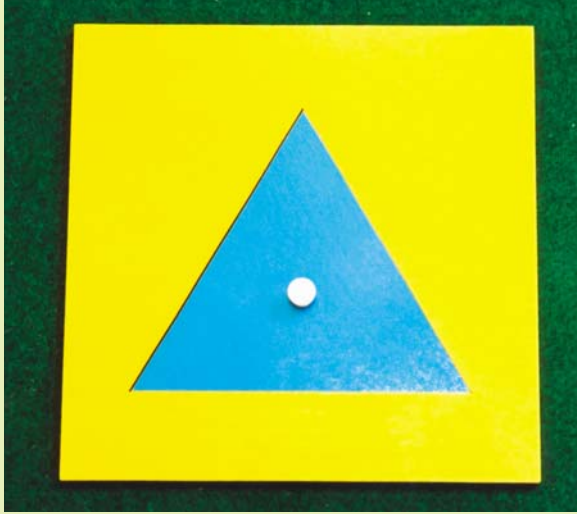
Presentation

- Most Montessori teachers present this concept in Year 1.
- This presentation is best done within a few days following Activity 3 about irregular polygons.

- Invite a student to come to a table or mat where you have the material already laid out.
- Review with the student what an irregular polygon is. (A polygon that does not have all sides and angles the same.)
- Announce that today the student is going to learn about regular polygons.

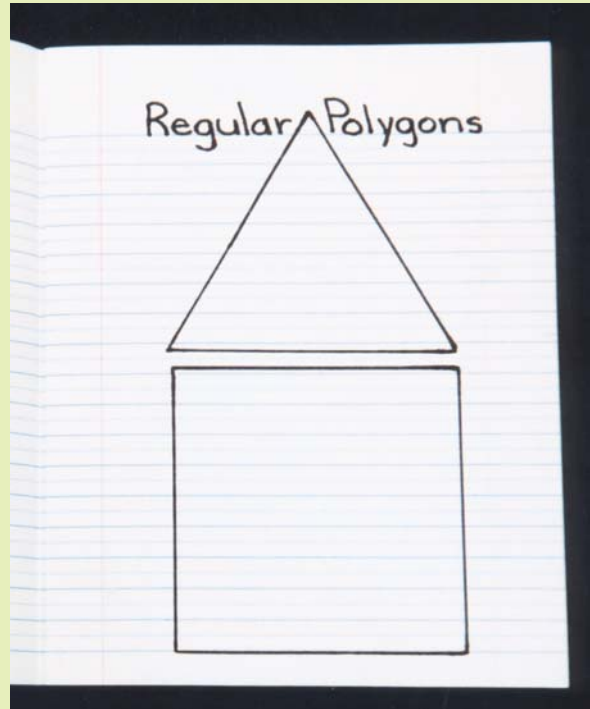
MAKING REGULAR POLYGONS

- Invite the student to take three sticks that are all the same and make a triangle on the tack board.
- Ask the student if the sides and angles are all the same. (Yes.) State that this polygon has all angles and sides the same, and so it is called a regular polygon.



Regular polygons fit into a frame no matter which way they are turned

- Invite the student to make a regular polygon out of four Geometry Sticks that are the same.
- Repeat, this time with six Geometry Sticks.
- Encourage the student to explore the figures from the Geometric Cabinet. Invite the student to decide which ones are regular by rotating them in their frames.
- Ask the student to choose two regular polygons from the Geometric Cabinet. Ask the student to trace around the polygons in her/his journal.
- Ask older students to label them "Regular Polygons."



Tracings of regular polygons

Extensions

- Working independently or with a classmate, practice matching up the Nomenclature Cards for regular and irregular polygons. Check your answers against the control set.
- Look for examples of polygons in the classroom, playground, home, or elsewhere. Examples: Stop sign, surface of a desk, cupboard door. List at least six polygons in your journal, with at least two regular and two irregular.

CIRCLES AND OTHER CLOSED CURVED FIGURES

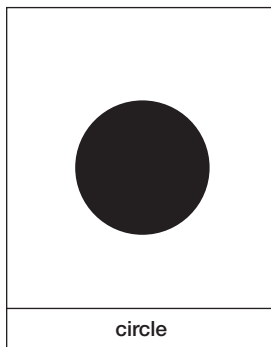
Background Information

This Background Information section describes some common types of closed curved figures and describes the parts of a circle. New terms related to circles and other closed figures are illustrated at the end of this section as well as on the NAMC blackline masters for Nomenclature Cards.

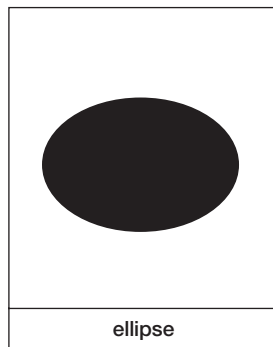
Types of closed curved figures

In the activities that follow, the students will learn to name and recognize five closed curved figures:

Nomenclature Cards for types of closed curved figures

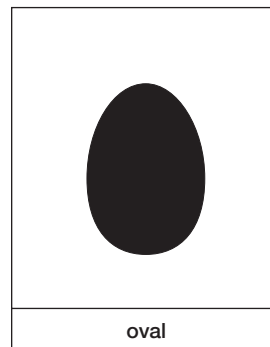


- **Circle:** A circle is a closed curved figure having every point the same distance from the center.
- **Ellipse:** An ellipse looks like a flattened circle. Both ends are the same shape.

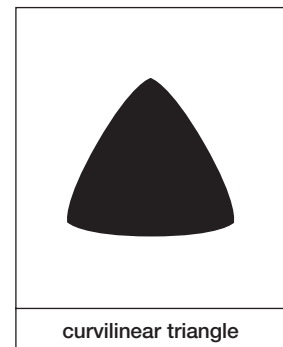


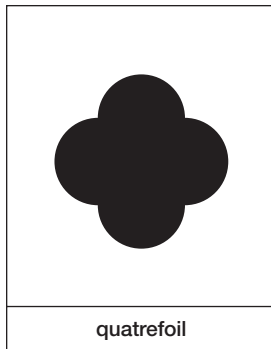
Origins of names of curved figures

- **Ellipse:** This word is from the Greek word *elliptikos*, meaning “something missing.” An ellipse is like a circle with a part missing from each of the flattened sides.
- **Oval:** This word is from the medieval Latin word for egg, *ovum*.
- **Curvilinear triangle:** The name sounds like what it is, a triangle made from curvy lines. The word *curvilinear* is made from the Latin words for curve and line.
- **Quatrefoil:** This four-leaf shape is made from the French words for four (*quatre*) and leaf (*feuille*).



- **Oval:** An oval is a closed curved figure shaped like an egg. One end is pointier than the other.
- **Curvilinear Triangle:** A curvilinear triangle is a triangle that has curved sides.



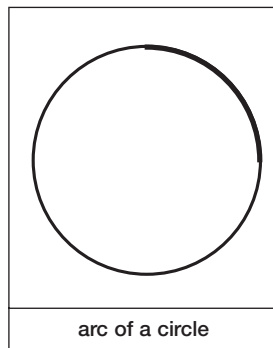
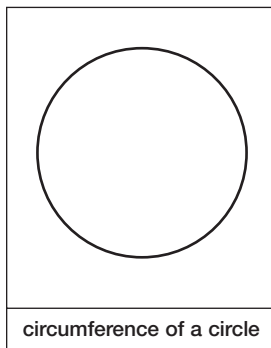


- **Quatrefoil:** A quatrefoil is a four-part figure in which each part looks like a flower petal or leaf.

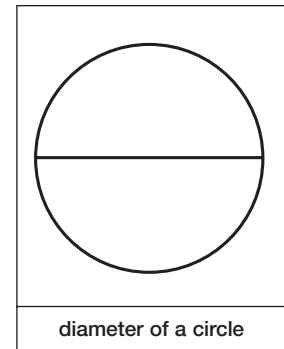
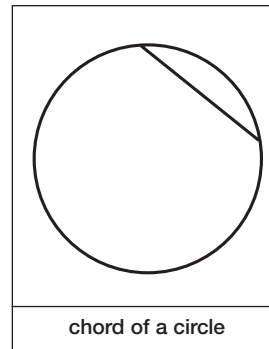
Parts of a circle

In Years 1–3, students learn five parts of the circle:

Nomenclature Cards for parts of a circle

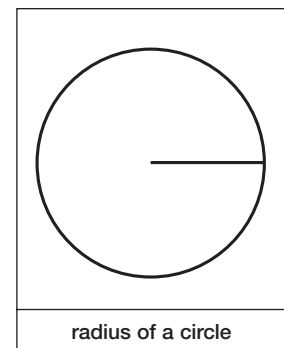


- **Circumference of a Circle:** The circumference of a circle is the boundary line around the circle. The circumference is also the length of the boundary line.
- **Arc of a Circle:** An arc of a circle is a segment of the circle's circumference.
- **Chord of a Circle:** A chord of a circle is a line segment that has both its endpoints on the circumference.



- **Diameter of a Circle:** A diameter of a circle is a chord that passes through the center of the circle. The diameter is also the length of this chord.

- **Radius of a Circle:** A radius of a circle is a line segment that extends from the center of a circle to its circumference. The radius is also the length of this line segment.



Resources

Some resources that address circles and/or other closed figures:

Caron, Lucille, and Philip M. St. Jacques. *Geometry*. Berkeley Heights, NJ: Enslow, 2001.

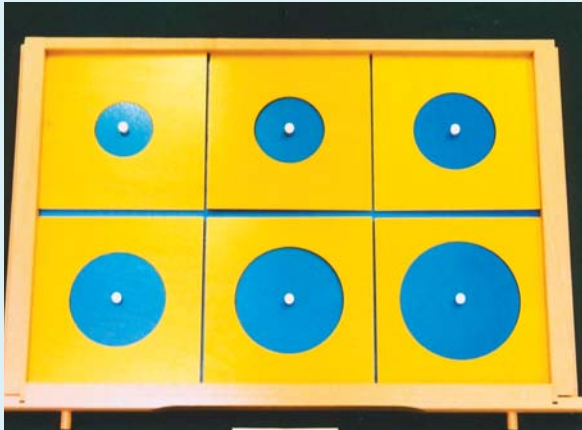
Cusick, Thomas. *Mathematics Made Simple*. New York, NY: Broadway Books, 2003.

<<http://www.teachers.ash.org.au/jeather/maths/dictionary.html>>

<<http://www.themathlab.com/dictionary/awords/awords.htm>>

ACTIVITY 1

Learning Some Closed Curved Figures



Circles are a familiar type of closed curved figure

Purpose

To learn to recognize and name the circle, ellipse, oval, curvilinear triangle, and quatrefoil.

Material

Geometric Cabinet — circles drawer and curved figures drawer.

Nomenclature Cards for closed curved figures.

Math journals and pencils.

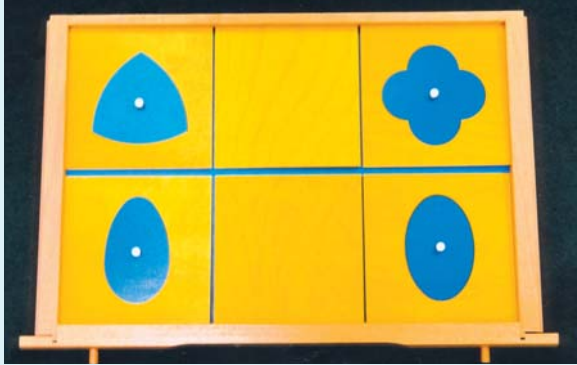
Presentation

- Most Montessori teachers present this concept in Year 1.
- Invite a student to come to a table or mat where you have the material already set out.
- Announce that today the student is going to learn about circles and other curved figures.

- Ask the student what he/she notices about these shapes. (They are all made of curved lines.)
- Explain that these figures are closed and they are made of curved lines, so they are called closed curved figures.

CIRCLE, OVAL, AND ELLIPSE

- Invite the student to pick up a circle. Ask the student whether the circle has any curved lines. (Yes. It is made of one curved line.)
- Ask the student the name of the figure. (Circle.) Ask her/him to put the circle down.
- Invite the student to pick up the shape that looks like an egg with one end narrower than the other.
- Tell the student this shape is called an oval because it looks like an egg. Explain that oval is from the Latin “ovum,” for egg. Ask the student to put the oval down.
- Invite the student to pick up the shape that looks like a squashed circle.
- Encourage the student to notice the difference between the oval and this squashed circle shape. Tell the student this shape is called an ellipse. Explain that ellipse means something missing, and the ellipse is like a circle with parts of its sides missing.

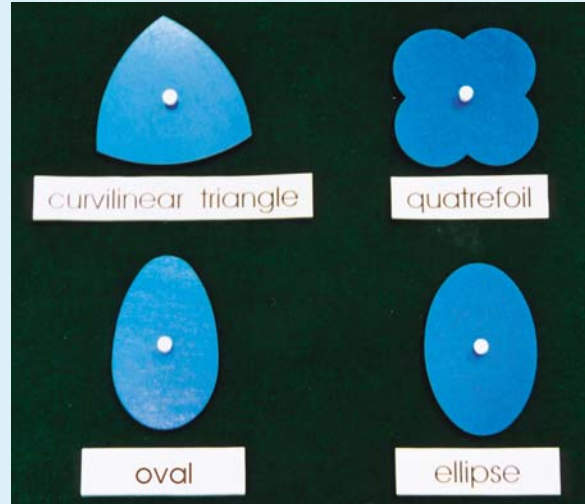


All closed curved figures are made of curved lines

- Conduct a three-period lesson for the circle, oval, and ellipse.
- Ask the student to trace around the figures of the circle, oval, and ellipse in his/her journal.

CURVILINEAR TRIANGLE AND QUATREFOIL

- Invite the student to pick up the shape that looks like a rounded triangle.
- State that this figure is called a curvilinear triangle, and explain the origin of the name. Ask the student to put it down.
- Invite the student to pick up the shape that looks like a leaf or flower.
- State that this figure is called a quatrefoil, and explain the origin of the name.
- Conduct a three-period lesson for the curvilinear triangle and the quatrefoil.



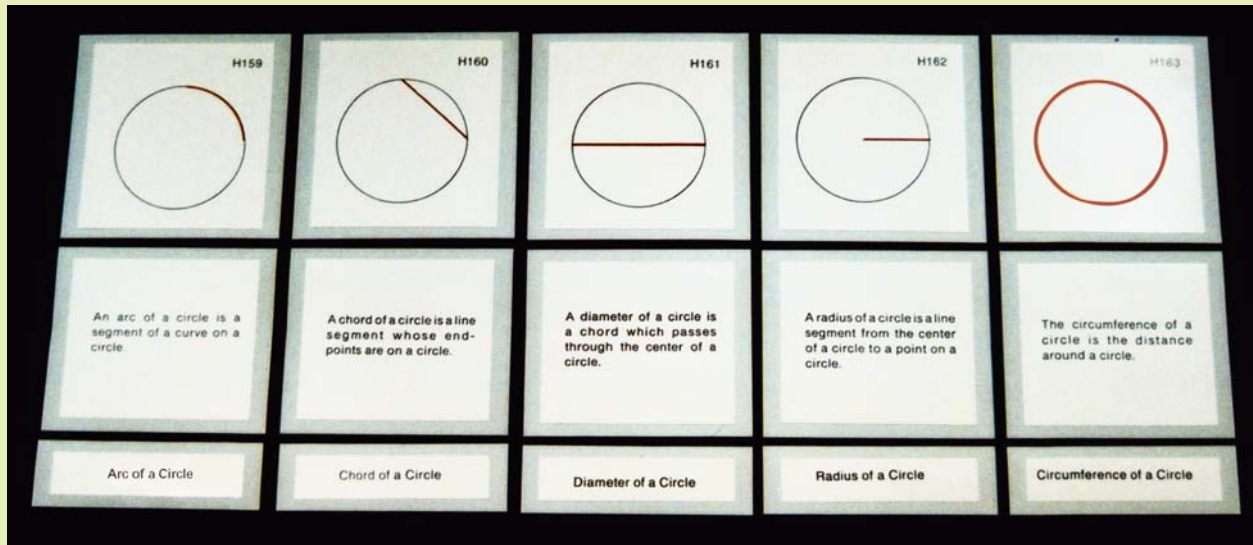
- Ask the students to trace around the figures of the curvilinear triangle and the quatrefoil in her/his journal.

Extensions

- Working independently or with a classmate, practice matching up the Nomenclature Cards for closed curved figures. Check your answers against the control set of Nomenclature Cards.
- Most people have much more experience with circles than with the other closed curved figures. Write at least four common uses or occurrences of the circle. Examples: wheels, rim of a glass, ripples that form when a stone lands in water, coins.

ACTIVITY 2

Learning the Parts of a Circle



Purpose

To learn the parts of a circle: circumference, arc, chord, diameter, and radius.

Material

Geometric Cabinet — circle drawer.

Geometry sticks

Coloring pencils (five colors).

Sheet of blank paper.

Ruler.

Nomenclature Cards for the parts of a circle.

Math journals and pencils.

Presentation

- Most Montessori teachers present this concept in Year 2 and review it in Year 3.



Drawing the circumference of a circle and two of its arcs

- Invite a student to come to a table or mat where you have the material already laid out. Have the sheet of paper tacked to the tack board.
- Announce that today the student is going to draw a circle and learn its parts.

CIRCUMFERENCE, ARC, AND CHORD

- Invite the student to choose any medium-length stick from among the Geometry Sticks.
- Invite the student to take a red tack and tack one end of the stick to the middle of the sheet of paper on the tack board. Tell the student that the tack will be at the center of the circle.
- Invite the student to choose a light-colored coloring pencil and place the point of the pencil in the hole at the other end of the stick. Encourage the student to draw a circle. Help the student if necessary.
- Tell the student that the line she/he has drawn is called the circumference of the circle. It goes all the way around the outside of the circle.
- Invite the student to choose a darker coloring pencil and repeat the exercise, this time drawing only part of the circumference. Tell the student the second line he/she has drawn is called an arc.
- Point out that one circle can have many different arcs of many different lengths. Invite the student to draw another arc.

- Invite the student to choose a new color and use the ruler to draw a straight line anywhere across the circle, not passing through the center.
- Tell the student a straight line that joins two points on the circumference is called a chord.



Chord

- Conduct a three-period lesson for the circumference, arc, and chord.

MAKING A DIAMETER AND RADIUS WITH GEOMETRY STICKS

- Add a second stick to the center of the circle and make a straight angle using the sticks. The sticks form a chord passing through the center of the circle.



Diameter

- Tell the student that a chord passing through the center is called a diameter.
- Point out that every circle can have many diameters. All the diameters are the same length.
- Rotate the straight angle around the center of the circle to show the student that many different diameters exist.
- Remove one of the sticks. Point out that what is left is half a diameter.
- Tell the student this kind of line is called a radius.



Radius

- Point out that every circle can have many radii and that all the radii are the same length.

- Conduct a three-period lesson for diameter and radius.

DRAWING THE PARTS OF A CIRCLE

- Ask the student to draw a circle in her/his journal. Ask the student to draw an arc on the circle in a second color. Ask the student to label the circumference and arc.
- Ask the student to draw another circle in his/her journal. Ask the student to draw and label a chord, diameter, and radius on the circle, using a different color for each.

Extension

- Lay a piece of string around the circumference of a plate or other circular object. Cut the string where the two ends meet, leaving no extra string. Lay the string in a straight line and measure its length. Write the measurement down. Now measure the diameter of the plate and write the measurement down. Divide the circumference by the diameter. What is the quotient? Repeat one or two more times using plates or other circles of different sizes. Compare the quotients.