IMPROVING LITERACY IN GEOMETRY

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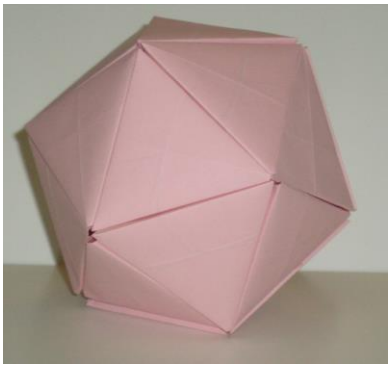

ITEM: This is a hands-on activity to use in improving literacy in geometry by illustrating over 80 geometry terms and concepts and constructing of a model of the icosahedron (the Platonic Solid with twenty faces)

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USE: With elementary level students, only the basic terms should be reviewed; however, there are concepts appropriate for university and graduate level students also.
The icosahedron is the shape used by protein for packing and is the shape of the Herpes viruses. Students can do research on this connection between Biology and Mathematics.

SOME MATHEMATICS TO DISCUSS:

During the activity, all of the following terms or concepts can be defined and illustrated.

- Rectangle
- Area = ½bh (Triangle)
- Quadrilateral
- Pythagorean theorem
- Parallelogram
- Trapezoid
- Parallel lines
- Parallel vs not parallel
- 90 degree angle
- Polygon
- Plane
- Isosceles trapezoid
- Measure
- Rhombus
- Area=length x width (Rectangle)
- Length
- Perimeter
- Similar
- Circle
- Congruent
- Two dimensional disk
- Fractions
- Area= r^2 (Circle)
- Pyramid
- Circumference= d (Circle)
- Tetrahedron

- Circumference=2 r (Circle)
- Platonic solid
- Line segment
- Surface area
- Diameter
- Pentagon
- Semicircle
- Regular Polygon
- Center of circle
- Hexagon
- Radius
- Central angles of polygons
- Chord
- Sum of the measures of the interior angles of a polygon
- Triangle
- Equilateral triangle
- Truncated tetrahedron
- Isosceles triangle
- Common denominator
- Equiangular triangle
- Arithmetic of fractions
- Sum of measures of the angles in a triangle = 180 degrees
- Icosahedron
- Closed set
- Base
- Bounded set
- Vertex
- Compact set
- Point
- Interior of a set
- Altitude
- Quadrants
- Median
- Secant line
- Circumcenter
- Arc of a circle
- Incenter
- Euler Line
- Orthocenter
- Sector of a circle
- Centroid
- Midpoint of a line segment
- Angle bisector
- Triangle inscribed in a circle
- Perpendicular bisector
- Inscribed angle
- Scalene triangle
- Central angle
- Right triangle
- Acute angle
- Hypotenuse
- Obtuse angle
- Leg of a right triangle
- 30 , 60, 90 right triangle

MATERIALS NEEDED: Twenty 8.5”x11” sheet of colored paper with as large a circle as possible drawn on one side; scissors; tape.

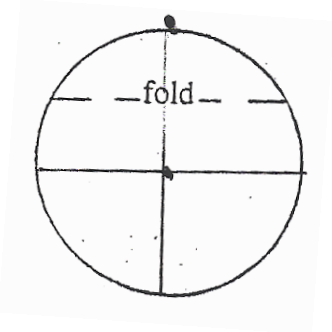
INSTUCTIONS:

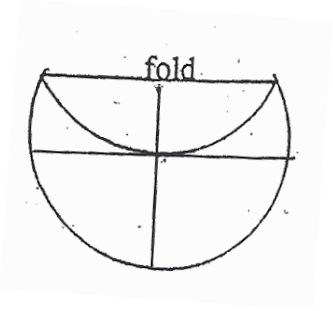
1. Discuss all mathematical terms and concepts which are illustrated by the blank side of the paper. (Polygon, rectangle, parallel line segments, right angle, diagonal, quadrilateral, area of a rectangle, perimeter of a rectangle, lines of symmetry, parallelogram)

2. Cut out the circular disk and discard the scrapes. (Circle, interior of the circle, exterior of the circle, disk, closed disk, open disk, compact set)

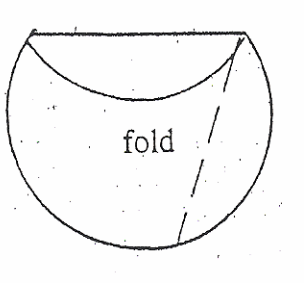
3. Approximate the center of the circular disk with a pencil. Fold the disk in half. Fold in half again to determine the true center. What angle was formed? Unfold the circle. Discuss center of the circle, radius, diameter, chord, rectangular coordinate system, sector of a circle, area and circumference of the circle, central angle)

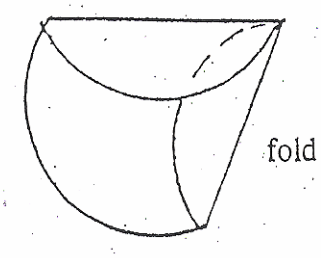
4. Mark a point on the circle at the end of one of the radii formed in step 3. Fold the point to the center, folding the radius on itself and crease. Discuss chord, parallel line segments, alternate interior angles, alternate exterior angles, corresponding angles, angles on the same side of a transversal, transversal.





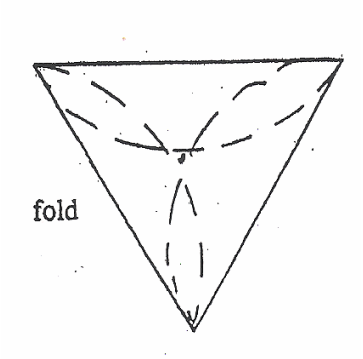
. 5. Form a new chord by using one endpoint of the chord formed in step 4 as an endpoint and folding the circle to the center as pictured below. Crease. Discuss inscribed angle.



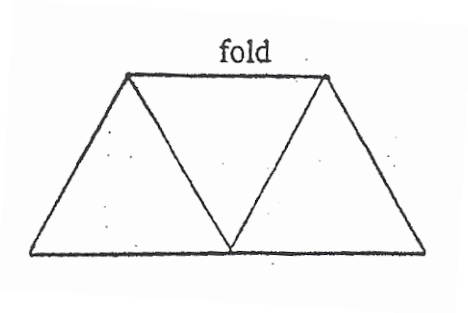


6. Fold the remaining arc of the circle to the center and crease. **Throughout the rest of this activity suppose that the area of the triangle is one square unit**. Discuss triangle, equilateral triangle, equiangular triangle, isosceles triangle, altitude of a triangle, median, bisector of the angle formed by two congruent sides of an isosceles triangle, perpendicular bisector of a side of the triangle, centroid, circumcenter, orthocenter, and incenter of a triangle.

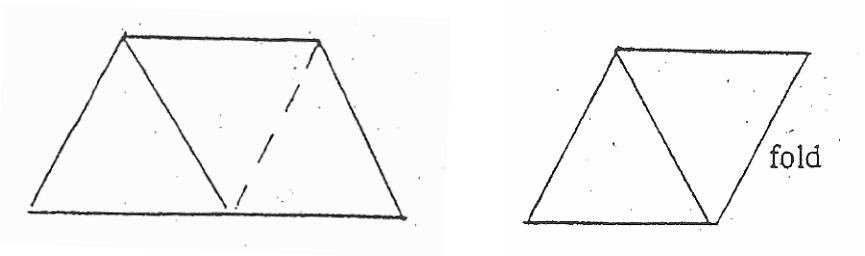
Euler line (why does this triangle not have an Euler line), 30-60-90 triangle, sum of the measures of the interior angles of a triangle.



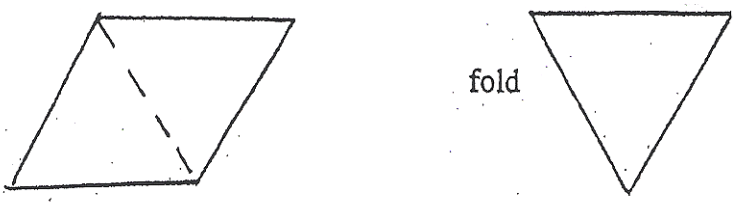
7. Find the midpoint of one of the sides of the triangle. Fold the opposite vertex to the midpoint and crease. What is the area of this isosceles trapezoid if the area of the original triangle is one unit? Discuss trapezoid, isosceles trapezoid.



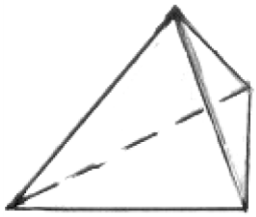
8. Notice that the trapezoid consists of three congruent triangles. Fold one of the triangles over the top of the middle triangle and crease. Discuss rhombus and find its area.



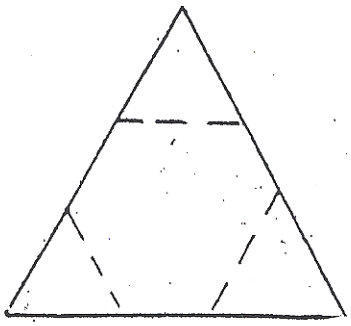
9. Fold the remaining triangle over the top of the other two and crease. What is its area? The triangle formed is similar to the unit triangle on step 6.

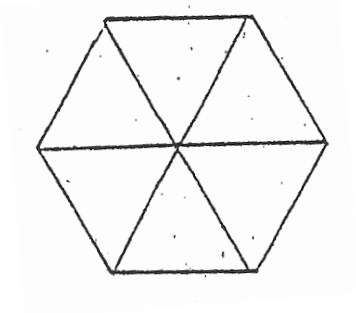


10. Open up the three folded over triangles until their corners meet forming a three dimensional figure. What is its surface area if the surface area of the triangle formed in step 6 is one square unit? Discuss tetrahedron and Platonic solids.

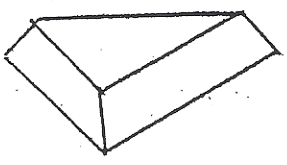


11. Open to the large equilateral triangle made in step 6. Fold each of the vertices to the center of the circle and crease. What is the area? Discuss hexagon, regular and irregular polygons.



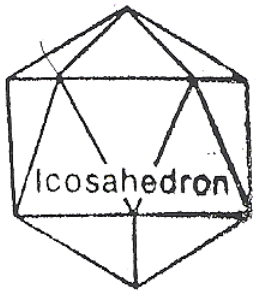


.12 Lift up and overlap the small triangles in the middle of the hexagon formed in step 11 so that they are on top of each other and a truncated tetrahedron is formed. What is its surface area of this truncated tetrahedron? What is the area of one of the trapezoidal sides?



13. Using only the fold lines already determined, create different polygonal figures and determine their areas. Then using only the existing fold lines, construct figures with the following areas: 1/4, 1/2, 19/36, 2/3, 3/4, 7/9, 8/9, 7/18, 23/36 square units. Remember that the area of the triangle formed in step 6 is one square unit

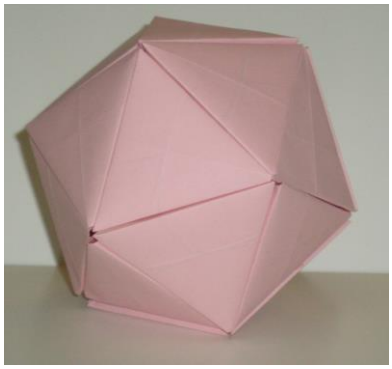
14. Tape the top of the truncated tetrahedron. **NOW REPEAT STEP 1-13 TO FORM NINETEEN MORE OF THESE TRUNCATAED TETRAHEDRONS.** Tape the twenty truncated tetrahedra together to make an icosahedron (the Platonic Solid which has twenty triangular faces). This is best done by taping five of the truncated tetrahedra together to form a "top", five to form a "bottom", and ten to form a "band" for the center. Then tape the top and bottom to the center band. Before taping the top to the center band, notice the regular pentagon formed by the edges on the underside of the top.



Assembled "top"/"bottom":

Assembled Band:

Assembled Icosahedron:



Sample Circle for Icosahedron: