Introduction

The *Geometry for Elementary School Teachers* is a staff development training program designed to assist teachers in implementing the Virginia Standards of Learning for mathematics. This staff development program provides a sample of meaningful and engaging activities correlated to the geometry strand of the K-5 mathematics Standards of Learning.

The purpose of the staff development program is to enhance teachers' content knowledge and their use of instructional strategies for teaching the geometry Standards of Learning. Teachers will learn about the van Hiele model for the development of geometric thought and how this can be used to guide instruction and classroom assessment. Through explorations, problem solving, and hands-on experiences, teachers will engage in discussions and activities that address many of the dimensions of geometry including spatial relationships, properties of geometric figures, constructions, geometric modeling, geometric transformations, coordinate geometry, the geometry of measurement, informal geometric reasoning, and geometric connections to the physical world. Teachers will explore two- and three-dimensional shapes, paper folding and origami, tessellations and geometric designs, and the use of other manipulatives to develop geometric understanding. Through these activities, it is anticipated that teachers will develop new techniques that are sure to enhance student achievement in their classroom.

Designed to be presented by teacher trainers, these staff development program include directions for the trainer, as well as the black line masters for overhead transparencies and handouts. In some instances, related student activities are included. Trainers should adapt the materials to best fit the needs of their audience; adding materials that may be more appropriate for their audience and eliminating materials that have been used in previous training sessions. All materials in this document may be duplicated and distributed as desired for use in Virginia.

The training programs are organized into five three-hour modules that may be offered by school divisions for recertification points or for a one-credit graduate course, when university credit can be arranged.

The *Geometry for Elementary School Teachers* training program is being provided to school divisions through an appropriation from the General Assembly and in accordance with the Virginia Department of Education's responsibility to develop and pilot model teacher, principal, and superintendent training activities geared to the Standards of Learning content and assessments, and to technology applications.

Acknowledgments

The Virginia Department of Education wishes to express sincere appreciation to the following individuals who have contributed to the writing and editing of the activities in this document.

GLOSSARY

Acute Angle An angle that is smaller than a right angle.
An acute angle measures less than 30 degrees.

Acute Triangle A triangle that has three acute angles.

Adjacent Sides Each pair of sides that have a common vertex.

Angle A geometric figure consisting of two rays or line segments that have the same endpoint. The size of an angle measures the amount of rotation from one side to another.

Arc Part of a curve. In particular, part of the circumference of a circle.

Area The amount of surface in a region or enclosed within a boundary. Area is usually measured in square units such as square feet or square centimeters.

Attribute A characteristic possessed by an object. Characteristics include shape, color, size, length, weight, capacity, area, etc.

Base The bottom side or bottom surface of a shape.

Centimeter A metric unit of length equal to one-hundredth of one meter.

Circle A two-dimensional shape formed by a set of points that are all the same distance from a fixed point called the center.

Circumference The boundary of a circle, or the length of that boundary. The circumference can be computed by multiplying the diameter by *pi* (π), a number a little more that 3.14.

Concentric Circles Two or more circles that have the same center and different radii.

Cone A three-dimensional shape with a base (usually a circle) joined to a vertex by a curved surface.

Congruent Relating to geometric figures that have the same size and shape.

Coordinate System   A reference system for locating and graphing points. In two dimensions, a coordinate system usually consists of a horizontal axis and a vertical axis, which intersect to give the origin. Each point in the plane is located by its horizontal distance and vertical distance from the origin. These distances, or coordinates, form an ordered pair of numbers.

Cube   A solid shape in which every face is a square and every edge is the same length.

Cubic Foot   The volume of a cube that is one foot wide, one foot high, and one foot deep.

Cubic Unit   A unit with length, width, and height that is used to measure volume.

Cylinder   A can shape. A solid shape with congruent parallel circles (or other shapes) joined by a curved surface.

Decagon   A polyon with 10 sides. A regular decagon has10 equal sides.

Diagonal   A line segment that joins two non-adjacent vertices of a polygon or polyhedron.

Diameter   A line segment passing through the center of a circle or sphere and connecting two points on the circumference.

Diamond   (See Rhombus)

Dimension   The number of coordinates used to express a position.

Dodecagon   A polygon with twelve sides. A regular dodecagon has twelve equal sides.

Dodecahedron   A polyhedron with twelve faces. All faces of a regular dodecahedron are congruent regular pentagons.

Edge   A line segment where two faces of a three-dimensional shape meet.

Endpoint   The point(s) at the end of a ray or line segment.

Equilateral Triangle   A triangle with equal sides. Each angle measures 60 degrees.

Face	A flat side of a polyhedron.
Flip	(See Reflection)
Geometry	The branch of mathematics that deals with the position, size, and shape of figures.
Grid	A network of horizontal and vertical lines that intersect to form squares or rectangles.
Hemisphere	Half of a sphere, formed by making a plane cut through the center of a sphere.
Heptagon	A polygon with seven sides. A regular heptagon has seven equal sides.
Hexagon	A polygon with six sides. A regular hexagon has six equal sides.
Hexahedron	A polyhedron with six faces. A regular hexahedron is a cube.
Hypotenuse	The side opposite the right angle of a right triangle. The hypotenuse is the longest side of a right triangle.
I*cosahedron*	A polyhedron with 20 faces. All faces of a regular icosahedron are congruent equilateral triangles.
Isosceles Triangle	A triangle with two equal sides and two equal angles. (An equilateral triangle is a special case of an isosceles triangle.
Kite Shape	A quadrilateral with two pairs of equal adjacent sides.
Line	A set of points that form a straight path extending infinitely in two directions. Lines are often called "straight lines" to distinguish them from curves, which are often called "curved lines." Part of a line is called a line segment.
Line of Symmetry	A line dividing a two-dimensional figure into two parts that are mirror images of each other.
Line Segment	A part of a line. A line segment has two endpoints and a definite length.

Network	A diagram consisting of arcs (branches) connecting points or nodes (junctions). A network may represent a real-world situation, such as road system or electronic circuit. Sometimes the nodes are called vertices.
Node	A point in a network at the end of an arc or at the junction of two or more arcs.
Nonagon	A polygon with nine sides. A regular nonagon has nine equal sides.
Obtuse Angle	An angle that is greater than 90 degrees but less than 180 degrees; that is, between a right angle and a straight line.
Obtuse Triangle	A triangle that has one obtuse angle.
Octagon	A polygon with eight sides. A regular octagon has eight equal sides.
Octahedron	A polyhedron with eight faces. All faces of a regular octahedron are congruent equilateral triangles.
Opposite Angles	In a quadrilateral, angles that do not have a common line segment.
Parallel Lines	Two or more lines that are always the same distance apart.
Parallelogram	A quadrilateral with opposite sides parallel and equal in length. Opposite angles are equal.
Pentagon	A polygon with five sides. A regular pentagon has five equal sides.
Perimeter	The boundary of a plane shape or the length of a boundary.
Perpendicular	At right angles.
pi (π)	The ratio of the circumference of a circle to its diameter. This ratio is the same for every circle. Its value, which is found by dividing the circumference by the diameter, is a little more than 3.14.

Pie graph	A circle marked into sectors. Each sector shows the fraction represented by one category of data. Pie graphs are also called circle graphs.
Plane	A flat surface.
Plane Shape	In geometry, a closed two-dimensional figure that lies entirely in one plane. (Polygons and circles are examples of plane figures. An arc is not a plane figure because it is not closed.)
Point	The smallest geometric unit. A position in space, often represented by a dot.
Polygon	A plane shape bounded by straight sides.
Polyhedron	A solid shape bounded by flat faces,
Prism	A polyhedron with at least one pair of opposite faces that are parallel and congruent. Corresponding edges of these faces are joined by rectangles or parallelograms.
Pyramid	A polyhedron with any polygon for its base. The other faces are triangles that meet at a point or vertex.
Quadrilateral	A polygon with four sides.
Ray	One-half of a line. A set of points that form a straight path extending infinitely in one direction. A ray has one endpoint.
Rectangle	A quadrilateral with four right angles. Opposite sides are equal and parallel.
Rectangular Prism	A box shape. A prism with three pairs of parallel opposite faces.
Reflection	A transformation of a point, line, or geometric figure that results in a mirror image of the original.
Regular Polygon	A polygon that has equal sides and equal angles.
Regular Polyhedron	A polyhedron with congruent faces that are regular polygons.

Rhombus	A parallelogram with four equal sides. Opposite angles are equal.
Right Angle	An angel that has one-fourth of a full turn. A right angle measures 90 degrees.
*Right Triangle*a	A triangle that has one right angle.
Scalene Triangle	A triangle with sides of unequal length.
Semicircle	One-half of a circle, bounded by a diameter and one-half of the circumference. Sometimes, one-half of the circumference is called a semi-circle.
Similar	Figures that have the same shape but are different sizes.
Slide	(See Translation)
Solid Shape	A closed, three-dimensional figure.
Sphere	A ball shape. A three-dimensional shape formed by a set of points that are all the same distance from a fixed point called the center. Also, the solid shape enclosed by that set of points.
Square	A rectangle with equal sides.
Square Unit	A unit that has length and width used to measure area. Examples are square inches, square centimeters, acres, etc.
Surface	Part or all of the boundary of a solid. A surface may be flat or curved. (For example, a cone has one flat surface and one curved surface.) The surfaces of a polyhedron are called faces.
Symmetry	
	a. When one side of a shape is a mirror image of the other side, the shape is said to have line of symmetry.
	b. When a shape can be turned through a fraction of a full rotation and still look the same, it is said to have turning symmetry or rotational symmetry.
Tessellation	An arrangement of plane shapes (usually congruent shapes) to cover a surface without overlapping or leaving any gaps.

Tetrahedron   A polyhedron with four triangular faces. A tetrahedron is a triangular pyramid.

Three-Dimensional Relating to objects that have length, width, and depth. Solid figures such as polyhedra, cones, and spheres are three-dimensional.

Transformation   The changing of a geometric figure from one position to another, according to some rule. Examples of transformations are reflection, rotation, and translation.

Translation   A transformation in which a geometric figure is moved in a line. Each point of the figure moves the same distance.

Trapezoid   A quadrilateral with one pair of parallel sides of unequal length.

Triangle   A polygon with three sides.

Triangular Prism   A prism in which the parallel opposite faces is triangles.

Two-Dimensional   Relating to objects that have length and width but not depth. Plane shapes such as polygons and circles that are two-dimensional.

Vertex   A point, or corner, where the sides of shape, the rays of an angle, or the edges of a solid meet. The plural vertex is vertices.