Blackhawk School District

CURRICULUM

Course Title: Geometry
Grade Level(s): 9-11
Length of Course: Year
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COURSE DESCRIPTION:
Students will develop inductive and deductive reasoning and problem solving skills as they study topics such as congruence and similarity and applied properties of lines, triangles, quadrilaterals, and circles.

Common Core State Standards for Mathematics

Research studies of mathematics education have determined that mathematics curriculum must be more focused and coherent. The Common Core State Standards for Mathematics define what students should understand and be able to do in their study of math. The following Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important 'Processes and proficiencies" with longstanding importance in mathematics education.

1. **Make sense of problems and persevere in solving them.**
   Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.
2. **Reason abstractly and quantitatively.**
   Mathematically proficient students make sense of quantities and their relationships in problem situations. They bringtwo complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize – to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents – and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. **Construct viable arguments and critique the reasoning of others.**

   Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about date, making plausible arguments that take into account the context from which the date arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and – if there is a flaw in an argument – explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4. **Model with mathematics.**

   Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or us a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. **Use appropriate tools strategically.**

   Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. **Attend to precision.**

   Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. **Look for and make use of structure.**

   Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Late, students will see 7 x 8 equals the well-remembered 7 x 5 + 7 x 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 x 7 and the 9 as 2 +7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

8. **Look for and express regularity in repeated reasoning.**

   Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1)(x +1)$, $(x – 1)(x^3 + x^2 + x +1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Chapter Breakdown	Concepts	Common Core Standards	PSSA Standards
Essentials of Geometry	• Name and sketch geometric figures. • Use postulates to identify congruent segments in the coordinate plane. • Find lengths of segments in the coordinate plane. • Find the midpoint of a segment. • Name, measure, and classify angles.	• CC.9-12.G.CO.1 • CC.9-12.G.CO.7 • CC.9-12.G.CO.12 • CC.9-12.G.GPE.7 • CC.9-12.G.MG.1	• M11.C3-1-1 • M11.B.2.1.1 • M11B.2.2.4
Reasoning and Proofs	• Use inductive reasoning to make and test conjectures. • Analyze conditional statements and write the converse, inverse, and contrapositive of a conditional statement. • Use deductive reasoning, the Law of Detachment, and the Law of Syllogism to develop simple logical arguments. • Use properties of equality and the laws of logic to prove basic theorems.	• CC.9-12.A.REI.1 • CC.9-12.G.CO.1 • CC.9-12.G.CO.9 • CC.9-12.G.CO.10 • CC.9-12.G.CO.11	• M11.E.1.1.2
Parallel and Perpendicular Lines	• Classify angle pairs formed by three intersecting lines. • Study angle pairs formed by a line that intersects two parallel lines. • Use angle relationships to prove lines parallel. • Investigate slopes of lines and study the relationship between slopes of parallel and perpendicular lines. • Find equations of lines. • Prove theorems about perpendicular lines. • Find the distance between parallel lines on the coordinate plane.	• CC.9-12.A.CED.2 • CC.9-12.G.CO.1 • CC.9-12.G.CO.9 • CC.9-12.G.CO.12 • CC.9-12.G.GPE.5	• M11.D.3.2.1 • M11.B.2.1.1
Congruent Triangles	• Classify triangles. • Find measures of angles in triangles. • Identify congruent figures. • Prove triangles congruent. • Use theorems about isosceles and equilateral triangles. • Perform transformations.	• CC.9-12.G.CO.2 • CC.9-12.G.CO.5 • CC.9-12.G.CO.6 • CC.9-12.G.CO.7 • CC.9-12.G.CO.8 • CC.9-12.G.CO.10 • CC.9-12.G.CO.12	• M11.C.1.2.1

Relationships Within Triangles	• Use properties of midsegments to find lengths of segments in triangles. • Write a coordinate proof. • Explore perpendicular bisectors and use the concurrency of perpendicular bisectors of a triangle to solve problems. • Use angle bisectors to find distance relationships and explore the concurrency of angle bisectors of a triangle. • Use medians of a triangle to find the centroid and to find segment lengths. • Use altitudes of a triangle to find and explore the orthocenter. • Relate side lengths and angle measures of a triangle. • Find possible side lengths for the third side of a triangle. • Use inequalities to make comparisons in two triangles. • Use the Hinge Theorem and its converse to solve multi-step problems. • Write indirect proofs.	• CC.9-12.G.CO.9 • CC.9-12.G.CO.10 • CC.9-12.G.CO.12 • CC.9-12.G.C.3 • CC.9-12.G.GPE.4	• M11.C.1.2.1
Similar Triangles	• Use ratios, proportions, and geometric means to solve geometry problems. • Use ratios to find the scale of a drawing and then use the scale to find actual distances. • Use proportions to identify similar polygons and find the scale factor between two polygons. • Use the ASA Similarity Postulate, the SSS Similarity Theorem, or the SAS Similarity Theorem to determine whether two triangles are similar. • Use proportions and the Triangle • Proportionality Theorem or its converse to find the lengths of segments related to triangles or parallel lines. • Perform dilations that are reductions or enlargements and verify that a figure is similar to its dilation.	• CC.9-12.G.CO.2 • CC.9-12.G.SRT.1 • CC.9-12.G.SRT.2 • CC.9-12.G.SRT.3 • CC.9-12.G.SRT.4 • CC.9-12.G.SRT.5 • CC.9-12.G.C.1 • CC.9-12.G.GPE.4 • CC.9-12.G.GPE.6 • CC.9-12.G.MG.3	• M11.A.2.1.3 • M11.C.1.3.1

Right Triangles	• Investigate side lengths and angles in triangles. • Use the Pythagorean Theorem to find the length of the third side in a right triangle. • Use the Converse of the Pythagorean Theorem, and other theorems, to decide if three given side lengths form an acute, right, or obtuse triangle. • Explore ratios and lengths formed by an altitude to the hypotenuse of a right triangle. • Use the ratios of side lengths for 45º -45º -90º and 30º -60º -90º triangles. • Apply trigonometric ratios to find side lengths and angle measures in triangles.	• CC.8.G.6 • CC.8.G.7 • CC.9-12.G.SRT.4 • CC.9-12.G.SRT.5 • CC.9-12.G.SRT.6 • CC.9-12.G.SRT.8 • CC.9-12.G.SRT.9 • CC.9-12.G.SRT.10 • CC.9-12.G.SRT.11 • CC.9-12.G.GPE.7 • CC.9-12.G.MG.1	• M11.C.1.4.1 • M11.C.1.2.1 • M11.A.3.2.1
Quadrilaterals	• Find angle measures in polygons. • Investigate properties of parallelograms and learn what information is needed to conclude that a quadrilateral is a parallelogram. • Study special quadrilaterals such as rhombuses, rectangles, squares, trapezoids, and kites.	• CC.8.G.5 • CC.9-12.G.CO.11 • CC.9-12.G.SRT.5 • CC.9-12.G.GPE.4 • CC.9-12.G.GPE.7	• M11.C.1.2.2
Transformations	• Perform translations with vectors, algebra, and matrices. • Reflect figures in a given line. • Rotate figures about a point. • Identify line and rotational symmetry. • Perform transformations using drawing tools and matrices.	• CC.9-12.G.CO.2 • CC.9-12.G.CO.3 • CC.9-12.G.CO.4 • CC.9-12.G.CO.5 • CC.9-12.G.SRT.1 • CC.9-12.G.SRT.2	• M11.A.2.1.3
Circles	• Draw tangents to circles and see how a tangent to a circle is related to the radius at the point of tangency. • Use intercepted arcs of circles to measure angles formed by chords in a circle. • Measure angles formed by secants and tangents to a circle. • Explore relationships between segment lengths of chords that intersect in a circle. • Investigate relationships between segment lengths of secants and tangents to a circle. • Use the standard equation of a circle to graph and describe circles in a coordinate plane.	• CC.9-12.G.CO.1 • CC.9-12.G.CO.12 • CC.9-12.G.CO.13 • CC.9-12.G.C.2 • CC.9-12.G.C.3 • CC.9-12.G.C.4 • CC.9-12.G.C.5 • CC.9-12.G.GPE.1	• M11.C.1.1.1 • M11.C.1.1.2 • M11.A.3.2.1

Perimeter and Area	• Develop and use formulas for the area of triangles, parallelograms, trapezoids, and other polygons. • Use ratios to find areas of similar polygons. • Use ratios of areas to find missing lengths in similar figures. • Explore circles, relating arc length and circumference to areas of sectors. • Develop and use a formula for the area of a regular polygon. • Use lengths of segments and areas of regions to calculate probabilities.	• CC.9-12.N.Q.3 • CC.9-12.G.CO.13 • CC.9-12.G.SRT.8 • CC.9-12.G.C.5 • CC.9-12.G.GPE.7 • CC.9-12.G.GMD.1	• M11.A.3.2.1 • M11.A.2.1.3 • M11C.1.1.2
Surface Area and Volume	• Identify and name solids. • Use Euler's Theorem to relate the number of faces, vertices, and edges of solids. • Describe cross sections of solids. • Find the surface areas and lateral areas of prisms and cylinders. • Find the surface area and volume of prisms, cylinders, cones, pyramids, spheres, and composite solids. • Use scale factors in similar solids to compare the ratios of the surface areas and the ratios of the volumes of the solids.	• CC.9-12.7.G.6 • CC.9-12.G.GMD.1 • CC.9-12.G.GMD.3 • CC.9-12.G.GMD.4 • CC.9-12.G.MG.1 • CC.9-12.G.MG.3	• M11.B.2.2.1 • M11.B.2.2.2 • M11.C.1.3.1