Geometry Overview 2019-2020

This document is designed to provide parents/guardians/community an overview of the curriculum taught in the FBISD classroom. Included, is an overview of the Mathematics Instructional Model and Pacing, TEKS, Unit Overview, Big Ideas, Essential Questions, and Concepts for each unit.

Definitions:

**Overview** – The content in this document provides an overview of the pacing and concepts covered in a subject for the year.

**TEKS** – Texas Essential Knowledge and Skills (TEKS) are the state standards for what students should know and be able to do.

**Process Standards** – The process standards describe ways in which students are expected to engage in the content. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use knowledge learned efficiently and effectively in daily life.

**Unit Overview** – The unit overview provides a brief description of the concepts covered in each unit.

**Big Ideas and Essential Questions** - Big ideas create connections in learning. They anchor all the smaller isolated, facts together in a unit. Essential questions (questions that allow students to go deep in thinking) should answer the big ideas. Students should not be able to answer Essential Questions in one sentence or less. Big ideas should be the underlying concepts, themes, or issues that bring meaning to content.

**Concept** – A subtopic of the main topic of the unit

**Instructional Model** – The structures, guidelines or model in which students engage in a particular content that ensures understanding of that content.

Parent Supports:

The following resources provide parents with ideas to support students in mathematical understanding

- Advice for Parents: Helping Children with Math
- How Math Should be Taught
- The Most Important Mathematical Habit of Mind
- Math: Why Doesn’t Yours Look Like Mine?
**Instructional Model:**

The instructional model for mathematics is the Concrete-Representational-Abstract Model (CRA). The CRA model allows students to access mathematics content first through a concrete approach (“doing” stage) then representational (“seeing” stage) and then finally abstract (“symbolic” stage). The CRA model allows students to conceptually develop concepts so they have a deeper understanding of the mathematics and are able to apply and transfer their understanding across concepts and contents. The CRA model is implemented in grades K-12 in FBISD.

**Adopted Resources:**

High School: [https://www.fortbendisd.com/Page/93927](https://www.fortbendisd.com/Page/93927)

**Supplemental Resource and Tool Designation**

The TI Nspire CX calculator is a standardized technology integration tool used for Mathematics and Science in FBISD.

**Mathematical Process Standards:**

The student uses mathematical process to acquire and demonstrate mathematical understanding. The student is expected to:

- G.1A Apply mathematics to problems arising in everyday life, society, and the workplace
- G.1B Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution
- G.1C Select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems
- G.1D Communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate
- G.1E Create and use representations to organize, record, and communicate mathematical ideas
- G.1F Analyze mathematical relationships to connect and communicate mathematical ideas
- G.1G Display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication

**Grading Period 1**

**Unit 1: Foundations of Logical Reasoning**

Estimated Date Range: Aug. 14 – Sept. 10

**Unit Overview:** In this unit, students will build the foundation for logical reasoning beginning with examples from prior knowledge. Students will learn to write and speak using conditional statements, and later biconditional statements. Students often confuse the validity and sequencing of statements so they will learn to separate the conditional statement from its converse, inverse and contrapositive. Students will form the habit of searching for counterexamples to disprove and verify, using geometric diagrams and constructions, as well as algebraic reasoning. Students will begin formal logic with Euclid’s postulates, followed by construction of congruent segments and perpendicular bisectors. Two column proofs will be introduced by solving algebraic equations in the context of segment addition and midpoint. This unit includes the following concepts: Conditional Statements and Counterexamples. Developing Logical Arguments, and Exploring Segments.
Big Ideas:
- Students can determine the validity of the conditional statement, converse, inverse and contrapositive using logical reasoning to provide either biconditionals, when possible, or counterexamples, when statements are false.
- Students can apply logical reasoning using basic geometric vocabulary to verify conjectures through constructions, theorems, definitions, and postulates, or prove conjectures are false with counterexamples.
- Constructions, diagrams, two-column proofs and other tools provide new sources of imagery as well as specific ways of thinking about geometric objects and processes.

Essential Questions:
- How are the conditional, converse, inverse and contrapositive related to each other?
- How can counterexamples be used to verify conjectures and clarify definitions?
- How can a biconditional help to develop a good definition?
- What is the distinction between "defined" and "undefined" terms in geometry?
- How are the basic geometric postulates tied to the undefined terms?
- What additional conjectures or ideas can we learn by creating a diagram compared to only looking at a figure?
- How can we use ordinary objects to bisect and duplicate lines in real-world applications?
- How can we prove equidistance and congruency without specific measurement?
- Why are formal proofs important and how are they tied to logical reasoning?

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<td>Concept #2: Developing Logical Arguments</td>
<td>G.4A, G.4C</td>
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Unit 2: Angular and Linear Relationships
Estimated Date Range: Sept. 11 – Oct. 2

Unit Overview: In this unit, students will continue applying conditional statements, logic, and constructions in the context of angle pairs and parallel and perpendicular lines. Students should gain experience in both solving for missing measurements with algebraic proofs and writing formal proofs of conjectures they learned in 8th grade (parallel lines cut by transversals). Proofs with scaffolds are still appropriate in this unit, and the teacher can adjust based on the proficiency of the class. This unit will also use the coordinate plane to review the slopes of parallel and perpendicular lines. Students will explore the relationship between the endpoints of a segment and points on its perpendicular bisector through coordinate geometry and construction.

Concept 1: Exploring Angles and Constructions
Concept 2: Parallel Lines and Angle Pairs
Concept 3: Lines on the Coordinate Plane
Concept 4: Perpendicular Lines

Big Ideas:
- Creating constructions and verifying theorems establishes connections of geometric relationships to real world situations.
- Exploring on the coordinate plane and verifying theorems establishes connections of geometric relationships to real world situations.

Essential Questions:
- Why is it necessary to construct and conjecture in geometry?
- Why is it necessary to explore geometric figures and properties on the coordinate plane?
## Concepts within Unit #2

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<td>Concept #2: Parallel Lines and Angle Pairs</td>
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<td>G.2A, G.2B, G.2C</td>
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<tr>
<td>Concept #4: Perpendicular Lines</td>
<td>G.4B, G.4C, G.5B, G.5C, G.6A</td>
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## Unit Overview:
In this unit, students will review and extend their knowledge of transformations. In 8th grade, students learn how to identify and perform translations, reflections, rotations, and dilations on the coordinate plane using algebraic notation. In this unit, students will review these properties with a focus on what preserves congruence, what preserves similarity, and what does neither. Students will also apply transformations off the coordinate plane, using constructions to explore and make further conjectures.

### Big Ideas:
- Rigid transformations preserve congruence, non-rigid may or may not preserve similarity.
- Compositions of transformations can change the location, orientation, and/or size of the figure.

### Essential Questions:
- What is the difference between rigid and non-rigid transformations?
- How do compositions of transformations affect geometric figures?

## Unit 3: Properties of Transformations

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<td>Concept #3: Compositions of Transformations</td>
<td>G.3A, G.3B, G.3C</td>
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## Grading Period 2

Unit 3: Properties of Transformations (Continued)

Note: This unit is continued from Grading Period 1. Please refer to Grading Period 1 for the Unit Overview, Big Ideas, and Essential Questions for this unit.

## Unit 4: Proofs of Triangle Congruence and Similarity

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<th>Concept #</th>
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<td>Concept #2: Non-Rigid Transformations</td>
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<tr>
<td>Concept #3: Compositions of Transformations</td>
<td>G.3A, G.3B, G.3C</td>
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## Unit Overview:
In this unit, students will take the established criteria of similarity, as well as the special case of congruency, and derive the minimum criteria needed to determine similar and congruent triangles. Students have background knowledge of Angle-Angle Similarity and CPCTC (corresponding parts of congruent triangles are congruent) from middle school, so the focus here is to formalize the criteria into theorems. Once the theorems are derived and established, students will culminate their logical reasoning practice into full proofs applying the triangle theorems.

### Big Ideas:
- Underlying any geometric theorem is an invariance – something that does not change while something else that does.
- Congruency is a special case of similarity because the ratio of corresponding sides of a figure is 1 to 1; therefore, congruent figures have all the same features as similar figures.

**Essential Questions:**
- Where should learners focus in order to derive and understand theorems?
- Why does the angle-angle criteria work for establishing similarity, but not for congruency?

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<th>Concepts within Unit #4</th>
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**Unit 5: Exploration of Triangle Properties**

Estimated Date Range: Nov. 15 – Nov. 22 and Dec. 2 – Dec. 19

Note: Includes 7 days for semester exams and review

**Unit Overview:** In this unit, students will use constructions to verify theorems associated with special segments, specifically those in triangles. They will investigate relationships among points along the perpendicular bisector of a segment and the distance from a point along the angle bisector to the rays of the angle. Additionally, they will investigate, discover and apply properties of special segments in triangles including angle bisectors, perpendicular bisectors, medians, altitudes and midsegments.

**Big Ideas:**
- Creating constructions and verifying theorems establishes connections of geometric relationships to real world situations.

**Essential Questions:**
- What conjectures can you make about points on an angle and perpendicular bisector? How can you prove the validity of those conjectures?
- What conjectures can you make about midsegments of triangles? How can you prove the validity of your conjecture?
- What conjectures can you make about the points of concurrency for angle and perpendicular bisectors, medians and altitudes? How can you prove the validity of those conjectures?
- How can you use constructions to prove the properties associated with special segments?

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<td>G.4C, G.5A, G.5C</td>
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Unit Overview: In this unit, students will investigate, discover, and apply properties associated with interior and exterior angles of polygons so that they can find the sum of the interior angles or the measure of each interior/exterior angle in a regular polygon. Next, they will investigate, discover, and apply the properties of quadrilaterals, specifically in reference to their angles and diagonals, so that they can verify that a quadrilateral is a parallelogram, rectangle, rhombus or square.

Big Ideas:
- Creating constructions and verifying theorems establishes connections of geometric relationships to real world situations.

Essential Questions:
- How does the number of sides of a polygon affect the sum of the interior angles?
- How does the number of sides of a polygon affect the measure of each interior angle of a polygon?
- How do properties of triangles help you find the sum of the interior angles/measure of each interior angle of a polygon?
- How do the number of sides of a polygon affect the sum of the exterior angles of a polygon?
- How can properties of parallel lines help you determine the properties of a parallelogram, rectangle, rhombus and square?
- How can the properties of triangles help you determine the properties of a parallelogram, rectangle, rhombus and square?
- How can you apply coordinate geometry to discover and apply the properties of quadrilaterals?

Concepts within Unit #6

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<td>Concept #2: Quadrilateral Proofs</td>
<td>G.4C, G.5A, G.6E</td>
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Unit Overview: In this unit, students will investigate, discover, and apply the properties associated with side lengths of special right triangles and extend those properties to non-special right triangles. Students will apply either the ratios found in special right triangles or trigonometric ratios in order to find unknown side lengths and measures in both mathematical and practical scenarios. The practical scenarios include angles of elevation and depression.

Big Ideas:
- Missing side lengths or right triangles can be found using the Pythagorean Theorem.
- Special right triangles have specific ratios of side lengths that can be used to find lengths of sides of triangles.
- Properties of similar right triangles have developed specific ratios of side lengths for every possible acute angles. Therefore, proportions can be used to measure out of reach objects.

Essential Questions:
- What are the minimum number of properties required to prove a quadrilateral a parallelogram, rectangle, rhombus or square?
- How can you apply Pythagorean Theorem to squares and their diagonals and equilateral triangles and their altitudes to find the ratios of the side lengths of 45°-45°-90° triangles and 30°-60°-90° triangles?
- What conjectures can you make about the ratios of side lengths of all triangles, whether they are matter whether or not they are special right triangles?
- How do sine, cosine and tangent ratios relate to each other?
- How can you apply trigonometric ratios to a triangle in order to find unknown lengths and measures?
- How can you apply trigonometric ratios to application scenarios involving angles of elevation and depression?
**Unit Overview:** In this unit, students will use proportional reasoning to find lengths of arcs and areas of sectors and segments. They will also investigate and apply the equation for circles in order to graph circles in the coordinate plane as well as identify attributes of circles. Finally, they will investigate, discover, and apply properties of angles and segments in circles in order to find unknown lengths and measures in both mathematical and real-world scenarios.

**Big Ideas:**
- The relationships between segments and angles of circles are used in constructions with a compass and straightedge to derive and justify theorems of other geometric figures.

**Essential Questions:**
- How can determine the length of a portion of a circle’s circumference by using an angle measure in the circle?
- How can you convert between degrees and radians by applying the relationship between the measure of an angle in a circle to the portion of its circumference?
- How can you determine the area of a portion of a circle by using an angle measure in the circle?
- How can you determine the radius length and center of a circle when given the equation?
- How can you determine the equation of a circle when given the center and radius length, the center and diameter length, the center and a point on the circle and the endpoints of a diameter?
- How can you use properties of intersecting lines, similar figures and congruent parts of circles to determine properties associated with special segments and angles in circles?
- How does arc measure relate to the measure of an angle based on where it is located in reference to a circle?
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**Unit Overview:** In this unit, students will apply formulas for various types of polygons and circles to find the areas of composite figures. They will also investigate and determine the relationships between the perimeter, area, and surface area of figures whose dimensions are changed both proportionally and non-proportionally.

**Big Ideas:**
- Connections can be made between the measurements of two-dimensional and three-dimensional shapes to solve real-life applications involving surface area.

**Essential Questions**
- How can the formula for the area of a rectangle help you determine the formulas associated with the areas of other polygons?
- How can you apply trigonometry to help find areas and perimeters?
- What relationships exist between the areas and perimeters of 2D figures when they are dilated both proportionally and non-proportionally?

**Concepts within Unit #9**

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<th>Unit 10: Dimensional Analysis of 3D Figures</th>
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<td>Estimated Date Range: April 2 – April 28</td>
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<td>Note: Includes 1 day for state testing</td>
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**Unit Overview:** In this unit, students will apply formulas for the volume and surface area of various 3D figures including prisms, pyramids, cones, cylinders, spheres, and composite figures, to solve problems in both mathematical and real world scenarios. They will also investigate and identify how both proportional and non-proportional changes in the dimensions of a 3D figure affect the figures volume and surface area.

**Big Ideas:**
- Connections can be made between the measurements of two-dimensional and three-dimensional shapes to solve real-life applications involving surface area and volume.

**Essential Questions:**
- How can you analyze 3D figures by using the relationships between the vertices, edges and faces?
- How do the areas of each face of a 3D figure relate to the surface area of the figure?
- How are volumes of prisms and pyramids/cylinders and cones related to each other?
- How do proportional and non-proportional changes in the dimensions of different 3D figures affect the figure's surface area and volume?
### Concepts within Unit #10

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<td>Concept #5: Spherical Geometry</td>
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**Unit 11: Applications of Probability**

**Estimated Date Range:** April 29 – May 28

**Note:** Includes 7 days for semester exams and review

**Unit Overview:** In this unit, students will extend their understanding of probability. In 7th grade, students studied representing sample spaces in multiple ways, using simulations and experiments to represent events, and determining experimental and theoretical probability for both simple and compound events. In Geometry, students will continue creating sample spaces, including the use of permutations and combinations. Students will also study geometric probability, independence of events and conditional probability. Students will continue the study of probability is subsequent courses they may choose to take, including MMA, AQR, Statistics and/or Statistics AP.

**Big Ideas:**
- The probability of an event is a number between 0 and 1 that report the long-term frequency of the event's occurrence.
- Probability can be used to make predictions about real-world situations.

**Essential Questions:**
- What is probability and how can we apply it to situations?

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