Geometry

Number and Operations

Enduring Understandings:

Every point on a line corresponds to a Real Number.

Properties of the Real Number System may or may not hold in other mathematical systems.

Solutions to problems call for estimates, approximations to an appropriate degree of precision or exact answers.

Mental computations are the basis for making reasonable estimates and sensible predictions.

Essential Questions:

What does it mean to be "computationally fluent"?

1. What is a mathematical system?
2. How do you know when an estimate, approximation or exact answer is appropriate?
3. How are mental calculations useful?

Outcomes:

The student will:

A. Understand how to compute fluently and make reasonable estimates
   1. **Recognize the plausibility of results found. Specifically that measurement of geometric figures must be positive; that there are relative relationships in physical spaces and that the geometric figure in questions can actually be created.**
   2. Determine when it is appropriate to use an approximation versus an actual numerical value and how many decimal places should be used.
   3. **Judge the reasonableness of numerical results**

Algebra

Enduring Understandings:

Modeling involves identifying and selecting features of a real-world situation, representing those features symbolically, analyzing and reasoning about the model and the characteristics of the situation, and considering the accuracy and limitations of the model.

Linear, exponential, polynomial, periodic, step and absolute value functions can be represented verbally, numerically, graphically, and analytically to understand patterns and relationships.

Algebraic properties govern the fluent manipulation of symbols in expressions, equations, and inequalities.

Rates of change can be represented mathematically.

Essential Questions:

1. How do we analyze and understand patterns, relations and functions?
2. How can verbal, numerical, graphical and analytical representations be used to analyze and solve problems?
3. What does it mean to be "symbolically fluent"?

Outcomes:

The student will:

A. Understand how to use algebraic symbols to represent and analyze mathematical situations and structures

1. Recall and use the properties of algebra to solve equations representing parts of geometric figures.
2. Fluently solve equations, inequalities and systems of equations representing parts of geometric figures mentally, with paper and pencil and with technology when appropriate

B. Understand how contextual situations can be modeled quantitatively

1. **Construct suitable mathematical models to represent a geometric situation**
2. Draw conclusions about a geometric situation using a mathematical model

Geometry

Enduring Understandings:

Representation of geometric ideas and relationships allows multiple approaches to geometric problems and connects geometric interpretations to other contexts.

Judging, constructing, and communicating mathematically appropriate arguments are central to the study of geometry.

Essential Questions:

1. How is visualization essential to the study of geometry?
2. How does geometry explain or describe the structure of our world?
3. How can deductive reasoning be used to establish or refute conjectures?

Outcomes:

The student will:

A. Understand geometric relationships inherent in two-and three-dimensional shapes.

1. Analyze properties and attributes of shapes

a. Identify characteristics of and draw polygons including but not limited to number of sides, number of diagonals, lines of symmetry, angle measure.

b. Identify characteristics of and draw circles including but not limited to radius, diameter, chords, tangents, central and inscribed angles.

c. Analyze lines cut by a transversal naming the angle pairs formed.

d. Determine when lines are parallel and identify the relationships of the angle pairs.

e. Identify attributes of and model polyhedra including shapes of faces, number of faces, edges, vertices, planes of symmetry and cross-sections.

2. Explore congruence and similarity

a. Prove shapes congruent and similar using deductive reasoning.

b. Identify corresponding parts and their measure relationships.

c. Solve for corresponding parts of congruent and similar shapes.

3. Use properties of right triangles to determine length and angle measures of right triangles.

a. Apply Pythagorean Theorem.

b. Apply of sine, cosine and tangent ratios.

4. Compute standard measurements of two-and three-dimensional shapes

a. Determine perimeter and area of two-dimensional shapes.

b. Calculate surface area and volume of three-dimensional shapes.

B. Understand the components and geometric relationships on the Cartesian Plane.

1. Represent geometric figures.

2. Calculate distance, midpoint, slope and slope relationships of figures.

3. Investigate conjectures, determine relationships and solve problems involving objects represented with Cartesian coordinates.

4. Relate geometry and algebra by connecting physical lines to their algebraic form ax + by = c.

C. Understand conditional statements and theorems.

1. Write conditional statements and their various forms.

2. Specify the validity of the different forms of conditional statements.

3. Develop and justify theorems through pattern analysis and reasoned argument.

D. Understand transformations in mathematical situations.

1. Represent and apply translations, reflections, rotations and dilations of objects in the plane and on a coordinate axis.

2. Use various representations to illustrate the effects of transformations of objects (including but not limited to vertex-edge graphs, matrices, vectors and coordinates)

Measurement

Enduring Understandings:

Use of calculation and computer technologies for gathering and displaying data requires making strategic choices for selection of scale and viewing window.

Reasonable estimates and sensible judgment about the precision and accuracy of measurement values is important.

Unit analysis can be helpful in keeping track of measurement conversions.

Essential Questions:

1. How are accuracy and precision in measurement determined?
2. How can measurement tools be utilized most effectively and efficiently?

Outcomes:

The student will:

A. Understand measurable attributes of objects and units, systems and processes of measurement

1. Make sound decisions about how quantities should be measured (direct or indirect) and represented, depending on the situation under consideration (e.g. make decisions concerning direct and indirect measurement to find parts of similar figures).
2. Select appropriate units in a situation; utilize and convert as needed.

B. Understand appropriate techniques, tools and formulas to determine measurements

1. **Apply formulas for the area, surface area, and volume of geometric shapes and figures**
2. Use informal concepts of limits in measurement situations
3. Use unit analysis to convert measurement and to check reasonableness of results

Data Analysis and Probability

(not done in Geometry class)

Problem Solving

Enduring Understandings:

Problem solving requires:

- knowledge of mathematical content
- knowledge of problem-solving strategies
- effective self-monitoring and
- a disposition for posing and solving problems.

Essential Questions:

What do you do when you don't know what to do?

1. How do you identify strategies to use when solving problems?
2. How do you know you have solved the problem?

Outcomes:

The student will:

A. Understand that there are multiple ways to solve a problem
   1. Employ appropriate method(s) for solving a problem
   2. Apply a variety of appropriate strategies
   3. Adapt a previous strategy to a new problem-solving situation

B. Understand how to monitor problem solving
   1. Recognize when a problem solving strategy is not working
   2. Compare and contrast strategy efficiency
   3. **Determine when the problem has been solved and the solution is reasonable.**

C. Understand that they can pose their own problems
   1. Formulate interesting extensions to a problem
   2. Propose problems to be solved

Reasoning and Proof

Enduring Understandings:

Proof is a way to explain, justify, and communicate mathematics.
Informal observations lead to specific examples that are generalized and then proven.

Essential Questions:

1. How do we develop mathematical conjectures?
2. How do you construct a convincing argument?
3. How do you know you have a convincing argument?

Outcomes:
The student will:

A. Understand mathematical conjectures
   1. Make mathematical conjectures
   2. Investigate mathematical conjectures that have already been proposed

B. Understand mathematical arguments and proof
   1. Evaluate written proofs
   2. Develop mathematical arguments and proof

C. Understand multiple methods of proof
   1. Utilize deductive reasoning, indirect proof and inductive reasoning to defend and justify one's ideas

Communication

Enduring Understandings:

Quality mathematical thinkers develop clear and coherent communication using appropriate mathematical language, notation and representation while considering their audience.

Writing is a valuable way of reflecting on and solidifying what one knows.

Essential Questions:

What is the language of mathematics?
Why do I need to explain my thinking when I solve problems?

1. How do you "show what you know" mathematically?

Outcomes:

The student will:

A. Understand the language of mathematics
   1. Convey mathematical ideas orally
   2. Convey mathematical ideas in written form

B. Understand that mathematics is a language unto itself
   1. Utilize mathematical language and symbols to communicate correctly and coherently to peers, teachers and others

Representation

Enduring Understandings:

Mathematics is the "science of patterns" and representations are the means by which those patterns are recorded and analyzed.

Mathematical representations ***illustrate*** essential features of a situation and clarify mathematical relationships.

Essential Questions:

1. Why is mathematics considered the "science of patterns"?
2. How do we use mathematical representations to illustrate patterns?
3. How do mathematical representations model situations?

Outcomes:

The student will:

A. Understand that mathematical representations facilitate communication of ideas
   1. **Create multiple representations that organize, record and communicate mathematical ideas**
   2. Use pattern recognition to generalize mathematical ideas

B. Understand that there are common mathematical structures across different contexts
   1. **Select, apply and translate among mathematical representations to solve problem**
   2. Use representations to model and interpret, physical, social and mathematical phenomena

Connections

Enduring Understandings:

Linking mathematical ideas, within mathematics and across content areas, develops robust understanding of problems.

Essential Questions:

1. What is the big picture in mathematics?
2. Why does mathematics matter to society?

Outcomes:

The student will:

A. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole

1. Recognize and use connections among mathematical ideas
2. Develop multiple approaches to the same problem leading to equivalent results
3. Use insights gained in one context to prove or disprove conjectures generated in another context

B. Understand that mathematics exists in contexts outside of the mathematics classroom

1. **Connect mathematics problems to real world situations**
2. Apply mathematical thinking in problems they encounter outside of the mathematics classroom