West Virginia math4life

Content and Timeline for Mathematics

Geometry

West Virginia DEPARTMENT OF EDUCATION

Geometry

The West Virginia College- and Career-Readiness Standards for mathematics emphasize key content, skills, and mathematical habits of mind at each grade level. The focus of instruction is placed on course standards; instruction should integrate content standards and mathematical habits of mind. Instruction should be attentive to learning across course domains and link major topics within domains. Instruction should develop conceptual understanding, procedural skill and fluency, and application.

Students in Geometry explore more complex geometric situations and deepen their explanations of geometric relationships, moving towards formal mathematical arguments. Important differences exist between this Geometry course and the historical approach taken in Geometry classes. For example, transformations are emphasized early in this course.

The following table highlights the content at the cluster level for Geometry standards. The bulk of instructional time should be given to the clusters and the standards within them. Standards should not be neglected; to do so would result in gaps in students' learning, including skills and understandings they may need in later grades. Instruction should reinforce standards within the clusters by including problems and activities that support natural connections between clusters. **Teachers and administrators alike should note that the standards are not topics to be checked off after being covered in isolated units of instruction;** rather, they provide content to be developed throughout the school year through rich instructional experiences presented in a coherent manner.

Connections in the Traditional Pathway

Because concepts such as *rotation, reflection,* and *translation* were treated in the grade-eight standards mostly in the context of hands-on activities and with an emphasis on geometric intuition, the Geometry course places equal weight on precise definitions. In kindergarten through grade eight, students worked with a variety of geometric measures: length, area, volume, angle, surface area, and circumference. In Geometry, students apply these component skills in tandem with others in the course of modeling tasks and other substantial applications.

The skills that students develop in Algebra I around simplifying and transforming square roots will be useful when solving problems that involve distance or area and that make use of the Pythagorean Theorem. Students in grade eight learned the Pythagorean Theorem and used it to determine distances in a coordinate system. In Geometry, students build on their understanding of distance in coordinate systems and draw on their growing command of algebra to connect equations and graphs of circles. The algebraic techniques developed in Algebra I can be applied to study analytic geometry. Geometric objects

can be analyzed by the algebraic equations that give rise to them. Algebra can be used to prove some basic geometric theorems in the Cartesian plane.

Although there are many types of geometry, school mathematics is devoted primarily to plane Euclidean geometry, studied both synthetically (without coordinates) and analytically (with coordinates). In the higher mathematics courses, students begin to formalize their geometry experiences from elementary and middle school, using definitions that are more precise and developing careful proofs. The standards for grades seven and eight call for students to see two-dimensional shapes as part of a generic plane (i.e., the *Euclidean plane*) and to explore transformations of this plane as a way to determine whether two shapes are congruent or similar. These concepts are formalized in the Geometry course, and students use transformations to prove geometric theorems. The definition of *congruence* in terms of rigid motions provides a broad understanding of this means of proof, and students explore the consequences of this definition in terms of congruence criteria and proofs of geometric theorems.

Students investigate triangles and decide when they are similar—and with this newfound knowledge and their prior understanding of proportional relationships, they define trigonometric ratios and solve problems by using right triangles. They investigate circles and prove theorems about them. Connecting to their prior experience with the coordinate plane, they prove geometric theorems by using coordinates and describe shapes with equations. Students extend their knowledge of area and volume formulas to those for circles, cylinders, and other rounded shapes. Finally, continuing the development of statistics and probability, students investigate probability concepts in precise terms, including the independence of events and conditional probability.

Geometry	West Virginia College- and Career-Readiness Standards
Congruence, Proof, and Constructions	
Clusters	
• Experiment with transformations in the plane. • Understand congruence in terms of rigid motions. • Prove geometric theorems. • Make geometric constructions.	• M.GHS.1-5 • M.GHS.6-8 • M.GHS.9-11 • M.GHS.12-13
Similarity, Proof, and Trigonometry	
Clusters	
• Understand similarity in terms of similarity transformations. • Prove theorems involving similarity. • Define trigonometric ratios and solve problems involving right triangles. • Apply trigonometry to general triangles.	• M.GHS.14-16 • M.GHS.17-18 • M.GHS.19-21 • M.GHS.22-24
Extending to Three Dimensions	
Clusters	
• Explain volume formulas and use them to solve problems. • Visualize the relation between two dimensional and three-dimensional objects. • Apply geometric concepts in modeling situations.	• M.GHS.25-26 • M.GHS.27 • M.GHS.28
Connecting Algebra and Geometry Through Coordinates	
Clusters	
• Use coordinates to prove simple geometric theorems algebraically. • Translate between the geometric description and the equation for a conic section.	• M.GHS.29-32 • M.GHS.33

Circles With and Without Coordinates	
Clusters	
• Understand and apply theorems about circles. • Find arc lengths and areas of sectors of circles. • Translate between the geometric description and the equation for a conic section. • Use coordinates to prove simple geometric theorems algebraically. • Apply geometric concepts in modeling situations.	• M.GHS.34-37 • M.GHS.38 • M.GHS.39 • M.GHS.40 • M.GHS. 41
Applications of Probability	
Clusters	
• Understand independence and conditional probability and use them to interpret data. • Use the rules of probability to compute probabilities of compound events in a uniform probability model. • Use probability to evaluate outcomes of decisions.	• M.GHS.42-46 • M.GHS.47-50 • M.GHS.51-52
Modeling with Geometry	
Clusters	
• Visualize relationships between two dimensional and three-dimensional objects and apply geometric concepts in modeling situations.	• M.GHS.53-55

Explanations

- **Domains** are broad components that make up a content area. Domains in mathematics vary by grade-level and by course. For example, the seven domains for mathematics of Geometry are Congruence, Proof, and Constructions; Similarity, Proof, and Trigonometry; Extending to Three Dimensions; Connecting Algebra and Geometry through Coordinates; Circles With and Without Coordinates; Applications of Probability; and Modeling with Geometry.
- **Clusters** are groups of standards that define the expectations students must demonstrate to be college- and career-ready.
- **Standards** are expectations for what students should know, understand and be able to do; standards represent educational goals.

Note of caution: Neglecting material will leave gaps in students' skills and understandings and will leave students unprepared for the challenges they face in later grades.

Geometry Content Plan

Teachers must provide students the opportunity to master each of the course content standards. **It is important to understand that neglecting grade-level or course content standards will leave gaps in students' skills and understandings and will leave students unprepared for the challenges they face in this and later courses**. Any content plan must demonstrate a means by which students can be provided the opportunity to address all course content standards and to revisit and practice skills and strengthen understandings throughout the school year. The information below is an example of how to address all Geometry standards in a school year.

DOMAIN TOPIC	**Geometry** *Transformations & Symmetry*	**Ratios and Proportional Relationships** *Congruence, Construction, and Proof*	**Ratios and Proportional Relationships** *Geometric Figures*	**The Number System** *Similarity and Right Triangle Trigonometry*	**The Number System** *Circles: A Geometric Perspective*	**Expressions and Equations** *Connecting Algebra and Geometry*	**Number System** *Modeling with Geometry*	**Statistics and Probability** *Probability*
SAMPLE TIMELINE	August/ September	October/ November	November/ December	January	February	March	April	May/ June
CONTENT STANDARDS	M.6.12 M.6.13 M.6.21 M.6.22 M.6.24	M.6.1 M.6.2 M.6.3	M.6.2 M.6.3	M.6.4 M.6.21 M.6.22	M.6.5 M.6.6 M.6.15	M.6.3 M.6.6 M.6.12 M.6.13 M.6.14 M.6.15 M.6.16 M.6.17 M.6.18 M.6.20	M.6.7 M.6.8 M.6.9 M.6.10 M.6.11 M.6.13 M.6.16 M.6.17 M.6.18 M.6.19 M.6.23	M.6.6 M.6.25 M.6.26 M.6.27 M.6.28 M.6.29
RATIONALE	In the sample above, Geometry begins with students reasoning about and extending their understanding of transformations and symmetry to congruence, construction, and proof. This format starts with a mathematical concept that is familiar to students and incorporates opportunities to practice and expand concepts and skills developed in prior years. In the plan, students can be provided opportunities to strengthen their ability in procedural fluency, conceptual understanding, and applications.							

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