QualityCore®

Course Description and Syllabus
Geometry

Description

By the time students enroll in a rigorous Geometry course, they have explored several elementary concepts of geometry. They have discovered, for example, that the sum of the interior angles of a triangle is 180° and that parallel lines do not intersect. They have not explored, however, how or why that knowledge matters. Their understanding of elementary geometry concepts needs to be reinforced and deepened, organized into an axiomatic system and made relevant to the world. According to the National Research Council (2002), a rigorous Geometry course succeeds when it

- creates a supportive environment that fosters questioning, investigation, and collaboration;
- emphasizes higher-order reasoning, relevant learning, and logical thinking; and
- asserts that process teaches content and vice versa.

Students in a rigorous Geometry course discover the fundamental concepts of geometry in much the same ways that René Descartes and Euclid before him may have discovered them: through logical exploration and thorough investigation. Such work develops students' deep understanding and, consequently, increases their chances for success.

A rigorous Geometry course begins with the basics: it names certain undefined terms from which all other terms are later defined (e.g., points, lines, planes); it identifies axioms or postulates; it then investigates problems and relationships that lead to theorems that must be proved. With these basic concepts, the course studies the properties of plane figures from line segments to rays, angles, polygons, and circles; the properties of solids; perimeter, area, and volume; as well as similarity, congruence, and symmetry. A rigorous course presents these geometric concepts through several approaches to geometry (e.g., Euclidean, coordinate, transformational), and it introduces students to trigonometry. Throughout a rigorous course students are asked to justify their reasoning and to construct formal proofs using the language and structure of mathematics, always building upon what they know. In other words, the skills students need to think logically are emphasized. Meanwhile, students learn by becoming familiar with tools that enhance conceptual understanding and aid in problem solving, from the low-tech (e.g., straightedge, protractor, compass) to the high-tech (e.g., graphing calculators, The Geometer's Sketchpad) for investigations.

What most distinguishes a rigorous Geometry course, however, is its relevant, thorough approach to the field. The course recognizes the value of context. Some topics, for example, are explored via the natural progression from Algebra I to Geometry and even on to Algebra II. If Algebra I introduced students to similar triangles as a way to practice solving proportions, then a rigorous Geometry course would build upon their understanding and ask them to discover postulates or theorems that determine how two triangles are similar. When students understand that all 30°-60°-90° triangles are similar and have side lengths in the ratio 1:2:3 , they can then discuss how sine and cosine values of 30° and 60° angles are employed in trigonometry—concepts usually introduced in Algebra II.

In addition to connecting students to their previous studies, a rigorous Geometry course connects geometry to the real world. Many significant problems in history were solved with geometry, not because mathematicians wanted to create abstract line drawings in textbooks, but because geometry helped people to understand the world around them. Students in a rigorous Geometry course not only are introduced to the history of a problem but also are asked to discover its solution. When studying parallel lines and angle pairs, students may be given the tools and the circumstances of Eratosthenes' measurement of Earth's circumference, and then allowed to discover the mathematician's solution. Students' understanding is further developed through analysis and discussion of Eratosthenes' calculations. Building upon the history of geometric concepts deepens students' awareness of geometry's continuing application in the real world.

A rigorous Geometry course also connects geometry to students' lives by emphasizing real-world problems with realistic solutions. Such problems help to reinforce fundamental mathematical concepts and to teach the significance and value of geometry itself. A problem that asks students both to find the best deal when ordering pizza and to justify their choice, for example, emphasizes by way of a familiar context the logical thought processes involved in justification. A problem in which students use a 3-4-5 triangle to plan the construction of a patio invites them to connect a concrete application to its abstract concept, the converse of the Pythagorean theorem. Through these and other relevant, real-world problems, students learn both process and content.

How a teacher facilitates students' learning is as important as real-world relevance. Students achieve a deep understanding of geometry when they are empowered and responsible for their learning. Students practice routine skills on a daily basis to hone their ability to recall basic concepts. They also are encouraged to think deeply, to conjecture, and to justify their claims. When studying congruent triangles, for example, students may be asked to predict the least amount of information necessary to prove that two triangles are congruent. Then they will investigate their predictions and arrive, finally, at proofs for the triangle congruence theorems. In a rigorous course, significant class time is spent developing higher-order reasoning such as analyzing and interpreting information and generalizing from patterns. Teachers facilitate these skills using questioning techniques, and they encourage students to discuss, both as a class and in groups, geometry concepts and plausible solutions to problems. Teachers also assign long-term projects that encourage students to plan strategically and reason through complex, multifaceted problems. Allowing students to test their ideas and to learn from their own and each other's errors helps the students to internalize the logical thinking that geometry requires.

A rigorous Geometry course further engages students through reading and writing. When students keep class notebooks, they not only learn to take clear, precise notes that allow them to understand mathematical terminology or the processes used to solve various types of problems, but they also learn to revisit the notes they've taken and to revise them to better reflect later learning. Keeping journals encourages students to think reflectively and to develop their understanding of mathematical reasoning. Teachers empower students by engaging them in a variety of learning strategies that solidify conceptual understanding and develop reasoning.

A rigorous Geometry course takes advantage of a variety of ways to check for understanding. Through preassessments, question-and-answer sessions, in-class activities, homework assignments, quizzes, tests, and culminating projects, teachers discover students' misconceptions as well as what students are learning. As teachers assess students' work, they discover that they may need to modify instruction to better meet students' needs; moreover, they

identify students who may need extra help. In a rigorous Geometry course, teachers adjust to the demands of both the material and the students. Ongoing assessments not only inform teachers of students' progress, but also provide students with feedback about their level of understanding. Students, therefore, take responsibility for their own learning. Moreover, because the course is collaborative, they take responsibility for each other's learning, as well.

A rigorous Geometry course emphasizes a variety of instructional and assessment strategies in leading students to become independent learners, critical thinkers, and problem solvers. Through in-class assignments as well as homework, students are given numerous opportunities to apply the concepts or principles they are learning. At the beginning of a unit about right triangles, for example, students might visit a set of learning stations that explore triangle properties. For the remainder of the unit, they would return to each station's problems to analyze and revise their solutions in new and multiple ways. Students thus explore geometric concepts thoroughly, solidifying both the processes and the reasons behind those processes into a deep understanding of geometry.

From relevant instruction that both sets high standards and enables students to achieve those standards, to interactive and progressive instruction and assessment, a rigorous Geometry course is a vibrant learning environment. By emphasizing the fundamentals of geometry and encouraging learning through collaboration, problem solving, investigation, and proof, the course places students in the best position to achieve.

Model Course Syllabus—Geometry

On Course for Success (2004) revealed that rigorous Geometry syllabi share several important characteristics. Not only do they describe the course and identify the content it will cover, but also they outline policies to which teachers and students are held accountable. This model syllabus is a composite drawn from the syllabi studied in *On Course for Success.* As a model, it is addressed to students and should be used as a general guideline, adapted according to a particular district's, school's, or teacher's policies.

Course Overview

Welcome to Geometry! The roots of the word *geometry* mean "to measure the earth," but this course will be more than just measuring things. It will emphasize abstract concepts and logical thinking through inductive and deductive reasoning. Through the course of the semester, we will explore how lines, planes, polygons, circles, as well as spheres and other three-dimensional figures can be used to represent and solve a variety of abstract and real-world problems. We will use tools—from the basic, such as straightedges, compasses, and protractors, to the sophisticated, such as The Geometer's Sketchpad and graphing calculators—to help us solve problems and learn. The skills you learned in Algebra I will be revisited, reinforced, and applied throughout the year. Our work in this course will help you understand how all fields of mathematics are intertwined and how they depend on each other. I am committed to working with you to help you understand geometry and discover its beauty.

Course Content

- Mathematical Processes
- Logic and Proof
- Points, Lines, Planes, and Space

- Polygons
- Circles
- Solids
- Similarity and Congruence
- Area and Perimeter
- Lateral Area, Surface Area, and Volume
- Coordinate Geometry
- Introduction to Trigonometry

Course Materials

You will need to bring the following materials with you to class each day:

- Textbook
- Pencils, erasers, and marking pen
- Loose-leaf paper and binder (class notebook)
- Ruler with both inches and metric measurements
- Calculator
- Colored pencils

On occasion, you will also need these other materials:

- Protractor
- Compass
- Graph paper

Course Policies

Absences/Makeup Work: When you return from an absence, you will be responsible for the following:

- Turning in any homework that was due the day(s) of your absence
- Reading the textbook section or other material that was used as a resource during your absence
- Getting the homework assignment(s) you missed and updating your class notebook
- Turning in your makeup work

According to school policy, you have as many days as you were absent to turn in missed assignments. However, you should turn in at least one makeup assignment as well as the current assignment each day until you are caught up. If you are absent only on a test day, a note from your parents will be required, and you will be expected to make up the test on the day you return to class. If you are absent any more days, you will have as many days as you were absent to make up the test. Makeup tests may be taken only before school or during lunch.

Class Participation: At times we will all be geometry teachers; therefore, be willing to share your ideas with others and to support your reasoning to help each other understand new ways to solve problems. In other words, participate fully in all class activities. Be “on the court” playing the game, not “in the stands” watching what is going on.

Classroom Rules/Expectations

- Be responsible for your work. Bring supplies and homework every day.
- Be in your assigned seat ready to work when the tardy bell rings.
- Seek additional help immediately if a topic seems difficult or requires alternative approaches.

Homework Policy: Homework will be assigned almost every school day (including over weekends) to allow you to explore and practice what you are learning. Unless otherwise specified, homework will be due at the beginning of the period the following school day.

- Show all calculations and work, even if you do it in your head or on a calculator.
- Explain your reasoning at the conclusion of each solved problem.
- When you get stuck on a problem, solve it as far as you can, then write a short explanation of your difficulty.
- Review the textbook discussion of new topics prior to beginning your homework assignment.
- Use your class notebook as a resource.
- Late assignments will be accepted, but a penalty will be incurred.
- No homework or makeup work will be accepted after a test day.

In addition, be proactive about creating study groups, using outside resources such as dictionaries and websites, and discussing problems with each other and with me. Any and all of these strategies can help you understand more thoroughly the concepts we will be studying.

Grading Policy

Grade Distribution: Quarter grades will be calculated as follows:

Tests	40%
Quizzes	20%
Assignments	20%
Investigations/projects	10%
Class notebooks	10%

Eighty percent of semester grades will be determined by an average of two quarters' grades; the remaining 20% will be determined by the semester exam.

Types of Assessments: Tests will be given every 2–3 weeks. Quizzes will be given every 3–4 days. For most assignments, I will provide the rubrics or explain the expectations. Several projects will be assigned throughout the course of the year. Rubrics and additional expectations will be provided and explained for most of the assignments.

Progress Reports: You will be advised of your progress and will be given a partial grade every 2–3 weeks.

Course Procedures

Work Requirements: A heading should appear in the upper right-hand corner of the page and should consist of the following:

- Your name
- Class name and period number
- Textbook page number and assignment numbers OR the name of the assignment
- Date

Class Notebook: You will be required to keep a notebook (or binder) containing definitions, explanations, and examples given in class; paperwork; investigations and other long-term projects; quizzes (which are valuable in studying for tests) and tests; and a journal. Your class notebook will be turned in for a grade. It should be clearly organized, with each section labeled clearly. For example:

- Notes (includes vocabulary)
- Homework (in chronological order)
- Investigations and Projects
- Quizzes and Tests (in chronological order)
- Journal

Personal Statement

It is very important that you review your notes and homework frequently! This is especially true when homework has a purpose. Most homework has one or more of the following aims:

- *Practice* reinforces the learning of material already presented in class and helps you master specific skills.
- *Preparation* provides information—history, skills, definitions—for forthcoming information; it is intended to allow you to benefit when the new material is covered in class.
- *Extension* or elaboration involves the transfer of previously learned skills to new situations.
- *Integration* asks you to apply skills and concepts to produce a single product (e.g., book report, science project).

I will make every effort to communicate the purpose of homework assignments to you. If you are having difficulties with any of the topics covered in this course, see me as soon as possible. Times when I am available for extra help are included below. In addition, keep the following thoughts in mind:

- When you worry “I can’t do it,” tell yourself, “I can do it, and I just need to figure it out.”
- You can always ask for help.
- Set goals every week and recognize your accomplishments.
- Bring a positive attitude to class.

Additional Information

Extra Help: Get extra help when you need it. I am usually available after school from 2:40 to 3:30 p.m. on Mondays and Wednesdays. I will be happy to arrange extra help sessions for anyone who requests them.

Contact information

School telephone number:
Best time to call:
E-mail:

Signature(s): Discuss this course syllabus with your parent(s) or guardian(s). You were given two copies—the blue one is for you and your parent/guardian to sign, and the yellow one is for you to keep. Please return the blue copy to me by (insert date). I am looking forward to working with you this year.

I, _____ (Student), have read and understand the Geometry course syllabus and the course expectations.

I, _____ (Parent/Guardian), have read and understand the Geometry course syllabus and the course expectations.

Student Signature: _____ Date: _____

Parent/Guardian Signature: _____ Date: _____

References

ACT, Inc., and The Education Trust. (2004). *On course for success: A close look at selected high school courses that prepare all students for college.* Iowa City, IA: Author.

National Research Council. (2002). *Learning and understanding: Improving advanced study of mathematics and science in U.S. high schools.* Washington, DC: National Academy.

