Teacher's Guide

Geometry

Semester B

PLATO COURSEWARE

Contents

Overview

Plato Courses are developed to give the instructor a variety of ways to engage different learning modalities and to give the student an opportunity to experience a range of standards and objectives to ensure academic success.

Plato Courses integrate Plato online curriculum, electronic Learning Activities, and supporting interactive activities. An array of assessment tools allows the instructor to correctly place students at the appropriate learning level, to evaluate strengths and needs, to create individualized learning goals, and to determine proficiency. Reports assist the student in understanding where he or she needs to focus to be academically successful as measured against objectives. Guidelines and tools are provided to track student progress and to determine a final course grade.

Plato Courses give the instructor control over the instructional choices for individual students as well as for the classroom. The instructor may use all of the components as sequenced or select specific activities to support and enhance instruction. Plato Courses can be used in a variety of ways to increase student achievement.

Course Components

Learning Activities
Four types of learning activities form the building blocks of active learning for this course: lessons, activity-only lessons, Unit Activities, and Online Discussions.

- **Lessons**. Each lesson in this course contains one or more learning components. All contain an interactive tutorial and a Lesson Activity.
    - **Tutorials.** Tutorials provide direct instruction and interactive checks of understanding. Practice interactions include drag-and-drop matching, multiple-choice questions, and fill-in-the-blank questions. Tutorials also often include links to informational websites, interactions, and videos, which enable students to broaden their understanding.
    - **Lesson Activities**. Lesson Activities are multipart problem-based activities that allow students to develop new learning in a constructivist way or to apply learning from the tutorial in a significant way. Lesson Activities are designed to be an authentic learning and assessment tool. Most Lesson Activities throughout the course employ a dynamic geometry tool, GeoGebra, helping learners to explore properties of geometric shapes and to test conjectures.
- **Activity-Only Lessons.** Unlike traditional lessons, activity-only lessons are designed to address math standards that focus on narrow performance objectives. Students will demonstrate the ability to perform a specific task. Resembling regular Lesson Activities, activity-only lessons are multipart exercises and usually require students to use the geometry application GeoGebra.
- **Unit Activities**. The Unit Activity at the end of each unit aims to deepen understanding of key unit objectives and tie them together or tie them to other course concepts. Unit Activities are similar to Lesson Activities but are intended to combine and leverage concepts developed throughout the unit.
- **Online Discussions**. Online discussion with instructors and other students is a key activity, based on 21st-century skills, that allows for higher-order thinking about terminal objectives. An online threaded discussion mirrors the educational experience of a classroom discussion. Instructors can initiate a discussion by asking a complex, open-ended question. Students can engage in the discussion by responding both to the question and to the thoughts of others. Each unit in a course has one predefined discussion topic; instructors may include additional discussion topics. A rubric for grading discussion responses is included in this guide.

Learning Aids

These learning aids assist students within the courseware activities:

- **GeoGebra.** GeoGebra is an interactive software application that allows learners to construct and modify geometric figures, take measurements, and describe geometric shapes algebraically. GeoGebra tools allow students to
  - create elements such as points, line segments, polygons, circles, and other curves either by direct placement in the graphics view or by inputting coordinates and equations;
  - set or define relationships between elements, such as defining a line parallel to another;
  - measure distances, angles, areas, and perimeters; and
  - determine the results of transformations.

  GeoGebra allows users to adjust the numerical accuracy of displayed measurements to a desired number of decimal places. However, in some cases, the values users see may not match the theoretical values precisely. In such cases, it is safe to assume a small margin of error due to rounding.

  Students can learn more about GeoGebra through online help from the manufacturer or the instructions contained in this user guide. Students will find links to both resources within the lessons.
- **Scientific Calculator (Tutorials)**. The Scientific Calculator is available in case students do not have access to a handheld calculator.
- **Data Tools (Probability and Statistics lessons only)**. Online data tools allow students to plot data using four widely accepted tools: histograms, box plots, scatter plots, and stem-and-leaf plots. Students can link to instructions for using these tools within the applicable lessons.
- **Reader Support (Tutorials and Mastery Tests)** enhances learning by enabling students to highlight text in the lesson and
  - play audio narration for the selected text (text to speech);
  - see a translation to another language for the selected text; and
  - see a dictionary definition in English or Spanish for a selected word.

Assessment and Testing

Best practices in assessment and testing call for a variety of activities to evaluate student learning. Multiple data points present a more accurate evaluation of student strengths and needs. These tools include both objective and authentic learning tools.

- **Objective Assessments**. There is a specific learning objective associated with each lesson. Each lesson objective is assessed through objective assessments at three different points during the course: at the end of the specific lesson, at the end of the unit, and at the end of the semester. In addition, pretests based on these objectives are available at the beginning of each unit, if desired by the teacher.
    - **Mastery tests** at the end of each lesson provide the instructor and the student with clear indicators of areas of strength and weakness. These multiple-choice tests are taken online.
    - **Unit pretests** are optional assessments, typically designed for credit recovery use. If a student shows mastery of a lesson's objective (80% proficiency), the student may be automatically exempted from that lesson in the upcoming unit. Courses for first-time credit typically do not employ unit pretests. The tests are multiple-choice and are provided online.
    - **Unit posttests** help instructors track how well students have mastered the unit's content. The tests are multiple-choice and are provided online.
    - **End-of-semester tests** assess the major objectives covered in the course. By combining the unit pretest and unit posttest information with the end-of-semester test results, the instructor will gain a clear picture of student progress. The tests are multiple-choice and are provided online.
- **Authentic Learning Assessment**. Of the assessment tools available in this course, three are designed specifically to address higher-level thinking skills and operations: Lesson Activities, Unit Activities, and Discussions. These authentic learning activities allow students to develop deep understanding and provide data for the teacher to assess knowledge development. These three types of activities are described in the Learning Activities section above. The following comments address their use for assessment.
    - **Lesson Activities** immerse the student into one or more in-depth problems that center on developing a deep understanding of the learning objective. They also provide a tool for assessing identified Common Core mathematical practices, inquiry skills, STEM skills, and 21st century skills. Most Lesson Activities in this course are self-checked by the student; however, it is possible to submit this work for teacher grading on paper, by email, or by creating a drop box activity in the course learning path.

      In this course, activity-only lessons are teacher-graded Lesson Activities submitted through the drop box. These lessons allow the instructor to score work on a scale of 0 to 100. A 10-point suggested rubric is provided to both

the student and the teacher for this purpose. Teachers can find rubrics and sample answers for activity-only lessons in the Edmentum Support Center.

- **Unit Activities** are similar to Lesson Activities, but are more time intensive and require a more integrative understanding of the unit's objectives. They also provide a tool for assessing identified Common Core mathematical practices, inquiry skills, STEM skills, and 21st century skills. Unit activities are teacher graded and are submitted through the drop box. These activities allow the instructor to score work on a scale of 0 to 100. A 10-point suggested rubric is provided to both the student and the teacher for this purpose.
- **Discussions** encourage students to reflect on concepts, articulate their thoughts, and respond to the views of others. Thus, discussions help teachers assess students' critical-thinking skills, communication skills, and overall facility with the unit concepts. Each unit in this course has one predefined discussion topic. Instructors can customize the course, however, to include additional discussion topics. Online discussions may use whatever rubric the instructor sets. A suggested rubric is provided here for reference.

Online Discussion Rubric				
	D/F 0–69 Below Expectations	C 70–79 Basic	B 80–89 Proficient	A 90–100 Outstanding
Relevance of Response	The responses do not relate to the discussion topic or are inappropriate or irrelevant.	Some responses are not on topic or are too brief or low level. Responses may be of little value (e.g., yes or no answers).	The responses are typically related to the topic and initiate further discussion.	The responses are consistently on topic and bring insight into the discussion, which initiates additional responses.
Content of Response	Ideas are not presented in a coherent or logical manner. There are many grammar or spelling errors.	Presentation of ideas is unclear, with little evidence to back up ideas. There are grammar or spelling errors.	Ideas are presented coherently, although there is some lack of connection to the topic. There are few grammar or spelling errors.	Ideas are expressed clearly, with an obvious connection to the topic. There are rare instances of grammar or spelling errors.
Participation	The student does not make any effort to participate in the discussion.	The student participates in some discussions but not on a regular basis.	The student participates in most discussions on a regular basis but may require some prompting to post.	The student consistently participates in discussions on a regular basis.

Course Implementation Models

Plato Courses give instructors the flexibility to define implementation approaches that address a variety of learning needs. Instructors can configure the courses to allow individual students to work at their own pace or for group or class learning. Furthermore, the courses can be delivered completely online (that is, using a virtual approach) or can include both face-to-face and online components (that is, using a blended approach). Depending on the learner grouping and learning approach, instructors can choose to take advantage of peer-to-peer interaction through Online Discussions. Similarly, if students have prior knowledge of the concepts taught in certain lessons, instructors can decide to employ unit pretests to assess students' prior knowledge and exempt them from taking the lessons. Note, however, that this feature is primarily designed for credit recovery purposes. For first-time credit, students are typically not allowed to "test out" of course lessons. Following are two common implementation models for using Plato Courses, along with typical (but not definitive) implementation decisions.

- **Independent Learning**
  The student is taking the course online as a personal choice or as part of an alternative learning program.

Learner grouping	independent learning
Learning approach	blended or virtual
Discussions	remove from learning path
Unit pretests	students do not take pretests

- **Group or Class Learning**
  The online course is offered for a group of students. These students may not be able to schedule the specific course at their local school site, or they may simply want the experience of taking an online course.

Learner grouping	group interaction
Learning approach	blended or virtual
Discussions	use; additional discussion questions may be added
Unit pretests	students do not take pretests

Geometry B Overview

Course Structure
Geometry B is a one-semester course organized into units and lessons. The typical audience for this course is students at the high school level.

Pedagogical Approach
This course is designed to enable all students at the secondary level to develop a deep understanding of the geometry objectives identified in the course Pacing Guide detailed below. It is also based on the Common Core State Standards Initiative and on a modern understanding of student learning in mathematics and STEM disciplines.

In addition to content standards, the Common Core State Standards Initiative makes these key points about CCSS high school mathematics curricula:

- They include rigorous content and application of knowledge through high-order skills.
- They call on students to practice applying mathematical ways of thinking to real-world issues and challenges, preparing students to think and reason mathematically.
- They set a rigorous definition of college and career readiness by helping students develop a depth of understanding and ability to apply mathematics to novel situations, as college students and employees regularly do.
- They emphasize mathematical modeling and the use of mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions.

Lesson Activities and Unit Activities in this course exercise learning objectives that require ongoing attention throughout the student's education. These global learning objectives are specifically called out at the beginning of each Lesson Activity. They are organized into four useful categories:

- **Mathematical Practices** objectives address the eight Standards for Mathematical Practice identified by the Common Core State Standards Initiative.
- **Inquiry** objectives support skills associated with investigation, experimentation, analysis, drawing conclusions, and communicating effectively.
- **STEM** objectives stress activities that combine mathematics and other technical disciplines or that provide insight into careers in science, technology, engineering, and math.

- **21st Century Skills** objectives call for using online tools, applying creativity and innovation, using critical-thinking and problem-solving skills, communicating effectively, assessing and validating information, performing large-scale data analysis, and carrying out technology-assisted modeling.

Online Discussions require students to apply some similar skills to an interesting problem, with the added advantage that they enable communication and collaboration among students. This is a critical aspect of the course, especially in fully online implementations, where peer-to-peer interaction may be limited.

Taken together, the elements of this course are designed to help students learn in a multifaceted but straightforward way. Finally, the curriculum is clearly relevant and highly engaging for students while being straightforward for teachers to manage.

Geometry B Curriculum Contents and Pacing Guide

This course is divided into units and is designed to be completed in one semester. The Pacing Guide provides a general timeline for presenting each unit. This guide is adjustable to fit your class schedule. It is based on a typical 180-day school year schedule with 90 days per semester.

Unit 1: Extending to Three Dimensions

Summary

This unit focuses on a single CCSS domain that relates to geometric ideas in three dimensions:

- G.GMD: Geometric Measurement and Dimension

	Unit 1: Extending to Three Dimensions		
Day	**Activity/***Objective*	**Common Core State Standard**	**Type**
1 day: 1	**Syllabus and Plato Student Orientation** *Review the Plato Student Orientation and Course Syllabus at the beginning of this course.*		Course Orientation
3 days: 2–4	**Explaining Volume Formulas** *Give an informal argument for the formulas for the circumference of a circle, the area of a circle, and the volumes of a cylinder, pyramid, and cone.*	**G.GMD.1** Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.	Lesson
3 days: 5–7	**Using Volume Formulas** *Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*	**G.GMD.3** Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.	Lesson

2 days: 8–9	**Cross Sections of Three-Dimensional Objects** *Identify the shapes of two-dimensional cross sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.*	**G.GMD.4** Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	Lesson
4 days: 10–13	**Unit Activity and Discussion—Unit 1**	*Includes applications or extensions of concepts from the following standards:* **G.MG.1.** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). **G.MG.2.** Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).	Unit Activity Discussion
1 day: 14	**Posttest—Unit 1**		Assessment

Unit 2: Connecting Algebra and Geometry through Coordinates

Summary

This unit focuses on a single CCSS domain that relates to the use of algebra in geometry:

- G.GPE: Expressing Geometric Properties with Equations

	Unit 2: Connecting Algebra and Geometry through Coordinates		
Day	**Activity/***Objective*	**Common Core State Standard**	**Type**
3 days: 15–17	**Equation of a Circle** *Derive the equation of a circle of given center and radius, and complete the square to find the center and radius of a circle given by an equation.*	**G.GPE.1** Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	Lesson
3 days: 18–20	**Use Coordinates to Prove Geometric Theorems** *Use coordinates to prove simple geometric theorems algebraically, including proofs involving circles.*	**G.GPE.4** Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).	Lesson
3 days: 21–23	**Slope Criteria for Parallel and Perpendicular Lines** *Prove the slope criteria for parallel and perpendicular lines, and use them to solve geometric problems.*	**G.GPE.5** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).	Lesson
3 days: 24–26	**Dividing a Line Segment Based on a Ratio** *Find the point on a directed line segment between two given points that partitions the segment in a given ratio.*	**G.GPE.6** Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	Lesson
3 days: 27–29	**Using Coordinates to Compute Perimeters and Areas** *Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.*	**G.GPE.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.	Lesson

2 days: 30–31	**Equation of a Parabola Based on Its Focus and Directrix** *Derive the equation of a parabola given a focus and directrix.*	**G.GPE.2** Derive the equation of a parabola given a focus and directrix.	Lesson
4 days: 32–35	**Unit Activity and Discussion—Unit 2**	*Includes applications or extensions of concepts from the following standards:* **G.GPE.7** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. **G.GPE.2** Derive the equation of a parabola given a focus and directrix.	Unit Activity Discussion
1 day: 36	**Posttest—Unit 2**		Assessment

Unit 3: Circles With and Without Coordinates

Summary

This unit focuses on a single CCSS domain that relates to circles:

- G.C: Circles

	Unit 3: Circles With and Without Coordinates		
Day	**Activity/***Objective*	**Common Core State Standard**	**Type**
1 day: 37	**Proving That All Circles Are Similar** *Prove that all circles are similar.*	**G.C.1** Prove that all circles are similar.	Lesson
3 days: 38–40	**Relationships Among Inscribed Angles, Radii, and Chords** *Identify and describe relationships among inscribed angles, radii, and chords.*	**G.C.2** Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.	Lesson
3 days: 41–43	**Inscribed and Circumscribed Circles** *Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.*	**G.C.3** Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	Lesson
1 day: 44	**Constructing a Tangent Line to a Circle** *Construct a tangent line from a point outside a given circle to the circle.*	**G.C.4** Construct a tangent line from a point outside a given circle to the circle.	Lesson
3 days: 45–47	**Relating Arc Length and Area to Radius** *Use similarity to derive the fact that the length of the arc intercepted by an angle is proportional to the radius. Derive the formula for the area of a sector.*	**G.C.5** Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.	Lesson

4 days: 48–51	**Unit Activity and Discussion—Unit 3**	*Includes applications or extensions of concepts from the following standards:* **G.MG.1.** Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). **G.C.5** Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.	Unit Activity Discussion
1 day: 52	**Posttest—Unit 3**		Assessment

Unit 4: Independent and Conditional Probability

Summary

This unit focuses on a single CCSS domain that relates to independent and conditional probability:

- S.CP: Conditional Probability and the Rules of Probability

	Unit 4: Independent and Conditional Probability		
Day	**Activity/***Objective*	**Common Core State Standard**	**Type**
2 days: 53–54	**Sample Space** *Describe events as subsets of a sample space (the set of outcomes).*	**S.CP.1** Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").	Lesson
3 days: 55–57	**Applying the Addition Rule for Probability** *Apply the addition rule,* P*(*A *or* B*)* = P*(*A*)* + P*(*B*)* – P*(*A *and* B*), and interpret the answer in terms of the model.*	**S.CP.7** Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model.	Lesson
3 days: 58–60	**Applying the Multiplication Rule for Probability** *Apply the general Multiplication Rule in a uniform probability model, and interpret the answer in terms of the model.*	**S.CP.8** Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B\|A) = P(B)P(A\|B)$, and interpret the answer in terms of the model.	Lesson
2 days: 61–62	**Independent Events** *Understand how to determine if two events are independent of each other.*	**S.CP.2** Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent.	Lesson
3 days: 63–65	**Using Counting Techniques to Determine Probabilities** *Use permutations and combinations to compute probabilities of compound events and to solve problems.*	**S.CP.9** Use permutations and combinations to compute probabilities of compound events and solve problems.	Lesson

3 days: 66–68	**Conditional Probability** *Understand the conditional probability of event* A *given event* B, *and interpret the independence of events* A *and* B*.*	**S.CP.3** Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*.	Lesson
4 days: 69–72	**Unit Activity and Discussion—Unit 4**	*Includes applications or extensions of concepts from the following standard:* **S.CP.9** Use permutations and combinations to compute probabilities of compound events and solve problems.	Unit Activity Discussion
1 day: 73	**Posttest—Unit 4**		Assessment

Unit 5: Applying Probability

Summary

This unit focuses on two CCSS domains that relate to the applications of probability:

- S.CP: Conditional Probability and the Rules of Probability
- S.MD: Using Probability to Make Decisions

	Unit 5: Applying Probability		
Day	**Activity/***Objective*	**Common Core State Standard**	**Type**
2 days: 74–75	**Interpreting Two-Way Frequency Tables** *Use a two-way table as a sample space to decide whether events are independent and to approximate conditional probabilities.*	**S.CP.4** Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.	Lesson
2 days: 76–77	**Using Probability to Make Fair Decisions** *Apply counting rules to determine probabilities, and use them to make fair decisions.*	**S.MD.6** Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).	Lesson
2 days: 78–79	**Using Probability to Analyze Decisions and Strategies** *Apply counting rules to analyze decisions and strategies using probability concepts.*	**S.MD.7** Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).	Lesson
2 days: 80–81	**Applying Conditional Probability and Independence** *Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.*	**S.CP.5** Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.	Lesson
2 days: 82–83	**Interpreting Conditional Probability** *Find the conditional probability of event* A *as it relates to event* B, *and interpret the answer in terms of the model.*	**S.CP.6** Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model.	Lesson

4 days: 84–87	**Unit Activity and Discussion—Unit 5**	*Includes applications or extensions of concepts from the following standards:* **S.CP.4** Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. **S.CP.6** Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model.	Unit Activity Discussion
1 day: 88	**Posttest—Unit 5**		Assessment
1 day: 89	**Semester Review**		
1 day: 90	**End-of-Semester Test**		Assessment