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Chapter 1

This chapter is designed to accomplish several objectives:

• To interest students in the study of geometry and to give them an overall view of the concepts they will learn about in this course.
• To help enable Mr. Marsh to establish classroom norms, such as working in teams, explaining thinking, writing reflections in a Learning Log, and investigating mathematics.
• To introduce students to the concepts of transformations and shapes.

Chapter 1 provides a foundation for students’ study of geometry by giving them multiple experiences with shapes. Shapes—in particular describing them, finding relationships between them, and answering questions about them—motivate and focus study throughout the course.

Transformations will be used in later chapters to understand angle relationships, to motivate the study of similarity, and to investigate the special relationships in the sides and angles of quadrilaterals in Chapter 7.

Chapter 1 also begins the development of investigation and justification that grows in future chapters. This builds throughout the first half of the course, leading to formal proof in the second half of the course.

These lessons are only meant as an introduction to geometry! By no means are students expected to have proficiency or mastery of these concepts by the end of this chapter. Instead, each day students will need to apply their knowledge from previous math courses to solve the new problems and later in the course they will learn new strategies to approach these problems.

A strand of investigation and justification is developed through the course. This strand prepares students to engage interactively in formulating and investigating questions about geometry topics, and to create logical and convincing arguments to support their findings. In Chapter 1, this strand is started through a focus on questioning and pattern finding in the Möbius Strip activity in Lesson 1.1.2. Students are encouraged to formulate “What if…?” questions to advance an investigation (such as “What if I cut the Möbius strip 1/3 of the way from the edge of the strip?”). Then, in Lesson 1.1.4, students analyze how to shape a convincing argument as they use facts to determine someone’s guilt or innocence in a fictional story.

Students will continue to review and apply algebra throughout this course. In Chapter 1, the algebra thread begins with a focus on three concepts:

• Solving linear equations
• Graphing an equation or relationship
• Using a table to organize information

Solving linear equations will help students prepare for solving problems involving geometric relationships in Chapter 2. For example, when students are given a diagram, such as the one at right, they will need to be able to write and solve the equation $5x + (3x + 20^\circ) = 180^\circ$. This is not limited to linear equations. Students will also need to write quadratic equations based on the relationship of the lengths of the
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sides of a right triangle, such as \((x + 3)^2 + 5^2 = 13^2\).

Algebra is spiraled throughout the course to include topics such as writing and solving linear and quadratic equations, graphing, using slope, and writing and solving proportional equations.

All of the CCSS Standards for Mathematical Practice will be addressed in the Geometry course. In this chapter students will: make sense of problems and learn to persevere, construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically, and attend to precision.

**Chapter 2**

In Chapter 1, students studied the general attributes of many basic geometric shapes. In this chapter, students will focus on measurement of shapes by examining different types of units (such as units for measuring angles, lengths, and areas) and by using tools to approximate the measure of an object. Additionally, students will develop algorithms to find exact areas of triangles, parallelograms, and trapezoids when given measurements of base and height. Often, students will be asked to look for more than one way to do these problems and will appreciate that different approaches can lead to the same result.

This chapter also focuses on angle relationships. Students will broaden their understanding of angle, begun in the Kaleidoscope activity (Lesson 1.1.5), to recognize that certain angles have equal measure or are supplementary, by virtue of their relationship in a diagram. Connections are made to transformations as students translate parallelograms to determine that corresponding angles have equal measure and as students rotate angles to form congruent, alternate interior angles.

Lastly, in order to find the perimeter of non-rectangular polygons, students will need to use the Pythagorean Theorem. The development of the Pythagorean Theorem relies on the understanding of slope (perpendicular lines), rotation, and area. Thus, Section 2.3 enables students to find the perimeters of new shapes and solve non-geometric application problems while it ties together student understanding of algebraic concepts from Chapter 1 and the area and perimeter ideas from Section 2.2.

**Algebra Thread**

A portion of this chapter will require students to apply their algebra skills, specifically:

- Solving systems of equations
- Finding the slope of a line when graphed
- Finding slopes of parallel and perpendicular lines.

These topics are all introduced with the expectation that students have had some prior experience but may need a review to refresh their understanding.

**Investigation and Justification (Proof) Thread**

Students are introduced to proof three times during this chapter. First, they are led through an argument to prove that the sum of the angles of a triangle is 180°. Then, in Lesson 2.1.5, students use a proof by contradiction to prove that if same-side interior angles have the same measure, then the lines cut by a transversal must be parallel. Finally, in Lesson 2.3.2, students are presented with a geometric proof of the Pythagorean Theorem. Students are not expected to generate these arguments on their own at this point, but instead are exposed to what a convincing mathematical
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argument looks like. Students continue to ask questions, investigate, and look for patterns as they develop most of the content of this chapter.

This chapter launches an investigation into angle measure that will continue as a thread through most of the course. In the first half of the course, students will develop a strong understanding of triangle interior angles to study triangle similarity, trigonometry, and triangle congruence. Angle relationships will also play an important role in the study of quadrilaterals, proof, polygons, and circles.

Where is this going?
This chapter also introduces a long thread of area and perimeter investigations that will later lead to the study of relationships among the areas of similar shapes. In Chapter 8, students will develop area algorithms for other shapes, such as regular polygons and circles. Students will also transfer their understanding of area and perimeter for two-dimensional shapes to the surface area and volume of three-dimensional shapes in Chapters 9 and 11.

The algebra topics that are reviewed in this chapter are important in solidifying students’ knowledge so that algebra can be used as a tool to investigate geometry topics later in the course. Specifically, facility with graphing and slope will be very important in Chapter 4, where students use similar slope triangles to develop the tangent ratio. A strong number sense of square roots will be useful for students to see if their answers make sense throughout the course, and specifically for understanding special right triangle patterns in Chapter 3. Finally, recognizing if lines are parallel or perpendicular on a graph, as well as finding the distance between two points with the Pythagorean Theorem, will be important skills when students continue their study of coordinate geometry in Chapter 7.

All of the CCSS Standards for Mathematical Practice will be addressed in this Geometry course. In this chapter students will particularly focus on: modeling with mathematics, using appropriate tools strategically, attending to precision, looking for and making use of structure, and looking for and expressing regularity in repeated reasoning.

Chapter 3

This chapter uses a transformation (dilation) to motivate a study of similar shapes. In Section 3.1, students explore various ways to create similar figures and then focus on the special relationships between corresponding angles and sides of similar figures. Section 3.2 then narrows the focus to similar triangles. A dynamic geometry tool is available to determine under what conditions two triangles are similar.

In this course, congruence is positioned as a special case of similarity. In fact, congruent figures can be defined as a pair of similar figures with a side ratio of one. Congruence is introduced this way to allow students time to understand the concept and the relationship between congruence and similarity.

One of the biggest barriers for students studying similarity is spatial visualization. For example, it will be challenging for some students to find corresponding sides and angles in figures that are reflections or rotations of each other. For others, it may be a challenge to recognize when figures are similar to each other.

Algebra Thread
This chapter includes many applications (geometric and non-geometric) for students to apply
proportionality. Students will need to use algebraic skills to solve proportional equations in these problems. Some students will use cross-multiplication while other students will apply other solving strategies, including multiplying to eliminate denominators and forming equivalent fractions.

Investigation and Justification (Proof) Thread
The justification thread, started in Lesson 1.1.4 with the Trial of the Century activity, is continued in Chapter 2 by helping students follow deductive lines of reasoning to prove the Triangle Angle Sum Theorem and the Pythagorean Theorem. In addition, students are introduced to a proof by contradiction to justify that if same-side interior angles are supplementary, then the lines cut by the transversal are parallel.

\[
\begin{array}{c}
\frac{8.4}{4.2} = 2 \\
\frac{16.4}{8.2} = 2 \\
m\angle R = m\angle C
\end{array}
\]

\[\triangle RUN \sim \triangle CAT \hspace{1cm} SAS \sim\]

Development of proof is continued in Section 3.2 with the use of flowcharts, like the one at right, to document and organize facts that lead to a conclusion. While short of a proof (because students are not yet providing reasons and justification for each fact), using flowcharts will help students get used to the idea of basing a conclusion on given facts. Students may also connect the arrows in the flowchart to the arrow diagrams they started using in Chapter 2.

Students will continue to develop flowcharts to document their work when finding two triangles are similar throughout Chapters 4 through 6. In Chapter 7, students will transition to proofs, which will require them to justify each statement.

Where is this going?
Introducing congruence as a special case of similarity allows students to look at congruence in multiple shapes before narrowing their focus to proving that triangles are congruent in Chapter 6. Similarity also leads directly to the study of similar slope triangles in Chapter 4, from which right triangle trigonometry is developed.

Justification skills will grow throughout the next few chapters as students explain their solutions and learn multiple ways to justify their answers. From this point forward, students will be asked, and should hear each other ask, “Are you convinced?” While they do not yet have all the tools needed for formal geometric proof, students will continue to develop their ability to organize a flowchart to show the logic that leads to a conclusion. Mathematical proof will be formalized in Chapter 7 as students discover more properties of quadrilaterals.

All of the CCSS Standards for Mathematical Practice will be addressed in this Geometry course. In this chapter students will: make sense of problems and learn to persevere, construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically, attend to precision, and look for and make use of structure.
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Chapter 4

Grounded in students' study of similar triangles in Chapter 3, students consider slope triangles in Chapter 4 to learn about the relationship between the angles and the side lengths of a right triangle.

Students return to their study of probability in Section 4.2, extending the understanding of simple probability that they developed in a previous course to include unions and intersections of events and sample spaces. Students use tree diagrams and area models as ways to represent probabilities and sample spaces. Students will formalize methods for computing probabilities of unions, intersections, and complements of events. In the final lesson of this section, students will find expected value in games of chance.

Algebra Thread
The equation writing and solving skills in this chapter are extended as students develop and apply the trigonometric ratio “tangent.” Students interpret real life situations, create diagrams to model those situations, and then use the diagrams to write equations. Algebra review of other topics, including applications involving area and perimeter, carries through the assignments in this chapter.

In addition, students review how to solve quadratic equations in assignments in preparation for solving geometric problems in which quadratic equations arise. This course assumes that students have some familiarity with solving quadratic equations. While factoring and using the Zero Product Property are viable and useful strategies to solve simple quadratics, this course will not focus on factoring. Instead, it provides the Quadratic Formula as a tool to solve quadratic equations.

Investigation and Justification (Proof) Thread
Students continue to develop their knowledge of how to investigate and draw reasoned conclusions through this chapter. Students consider the validity of given conjectures in Lesson 4.1.1 and create their own conjectures.

While they are not yet writing proofs or formal arguments to support their new conjectures, students should be justifying their thinking verbally with their teams and writing down explanations of their conclusions.

Where is this going?
This chapter continues to build on the question, “What can I figure out about a triangle?” that was introduced in Chapter 2 with the Pythagorean Theorem. This study continues into Chapter 5 where students use sine and cosine to solve right triangle problems involving a hypotenuse and use the Law of Sines and the Law of Cosines to find missing side lengths and angles for non-right triangles. Trigonometry is used throughout the rest of the course as students solve complex problems involving area, perimeter and surface area, and as students develop an algorithm for finding the area of regular polygons.

Probability is revisited and extended in Chapter 10, where lessons focus on conditional probability, independence, and counting using permutations and combinations.

All of the CCSS Standards for Mathematical Practice will be addressed in the Geometry course. In this chapter students will: make sense of problems and persevere in solving them, use appropriate tools strategically, attend to precision, look for and make use of structure, and look for and express
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regularity in repeated reasoning

Chapter 5

Section 5.1 revisits similar slope triangles, this time focusing on relationships between the legs and the hypotenuse of these right triangles in order to develop the sine and cosine ratios. Students continue to model real life situations using right triangles and to solve problems using all three trigonometric ratios. They are also introduced to inverse trigonometric ratios and learn to use side ratios to find missing angles in right triangles.

Section 5.2 extends what students know about right triangles to include special cases such as 30°-60°-90° and 45°-45°-90° triangles and those with side lengths that are Pythagorean Triples. This section has strong connections to work from Chapters 1 and 3, as students utilize the reflection symmetry of both equilateral triangles and squares to unlock the ratios of 30°-60°-90° and 45°-45°-90° triangles.

Section 5.3 focuses on completing a toolkit for finding missing parts of non-right triangles. This section begins by asking students to identify the types of information needed to find all of the missing sides and angles of a triangle. Through this exercise, students also identify triangles for which they do not yet have the tools to find missing parts. Students notice that they do have enough tools to find the angles and side lengths of right triangles. This leads to the question, “What if the triangle is not a right triangle?”

Students then develop the Law of Sines and Law of Cosines so that they have a complete set of tools to find the other missing parts of any triangle (when sufficient information is provided). The chapter concludes with students looking at different application problems using triangles and identifying which tools are most useful in each situation.

In addition, the optional Lesson 5.3.4 investigates the ambiguous case of triangles: SSA. This lesson is offered for accelerated classes or those that could benefit from a complete view of the relationships between the sides and angles of a triangle. It is highly recommended that you work through the problems of this lesson before you decide to use it with your students.

By the end of Chapter 5, your students will have six “triangle tools”: the Pythagorean Theorem (from Chapter 2), tangent (from Chapter 4), sine, cosine, Law of Sines, and Law of Cosines (from Chapter 5). These will be recorded on a Triangle Toolkit, which is introduced in Lesson 5.1.1. In addition, students will also know triangle shortcuts (for 30°-60°-90° and 45°-45°-90° triangles) and know how to use inverse trigonometric functions in order to solve for an angle of a right triangle.

Algebra Thread

The development of the Law of Sines and the Law of Cosines will require students to manipulate equations with multiple variables, substitute equivalent expressions, and simplify complex equations. Some students may feel uneasy working with equations that contain four or more variables or constants, and they will need to be reminded that the simplification steps that they use comfortably with numbers are still applicable to these equations.

Where Is This Going?

By the end of this chapter, students will have a complete set of tools to find missing sides and angles of triangles when sufficient information is given and the triangle is not ambiguous. In later chapters,
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students will use these tools as they investigate properties of regular polygons, calculate volume and surface area of prisms and pyramids, and solve different application problems.

All of the CCSS Standards for Mathematical Practice will be addressed in the Core Connections Geometry course. In this chapter students will: make sense of problems and persevere in solving them, model with mathematics, use appropriate tools strategically, attend to precision, look for and make use of structure, and look for and express regularity in repeated reasoning.

Chapter 6

Section 6.1 begins the study of congruent triangles, starting with congruence as a special case of similarity and progressing to the triangle congruence conjectures. Using similarity as a tool, students investigate the minimum amount of information needed to conclude that a pair of triangles must be congruent. They formalize these conditions in the triangle congruence theorems: SSS \(\cong\), SAS \(\cong\), ASA \(\cong\), AAS \(\cong\), and HL \(\cong\). Students then have the opportunity to practice using these conditions while learning how to organize information about congruent triangles into a flowchart. Lesson 6.1.5 introduces students to converses of conditional statements. It is a good opportunity for students to review some of the parallel line conjectures and to understand that once triangles are known to be congruent, all corresponding parts of the triangle must also be congruent.

Section 6.2 provides closure for Chapters 1 through 6 and offers practice with the major concepts studied so far. Section 6.2 is intended to wrap up the first semester of instruction. Activities in this section require students to weave together different threads of knowledge in order to solve complex problems. The activities in this section are independent of each other and may be used in any order. During the activities, students consolidate what they know, apply concepts in new ways, and identify questions for further exploration. The problems require students to identify with their teams the tools and strategies they will use to reach a solution.

Investigation and Justification Thread

Throughout the chapter, problems require students to justify their conclusions by stating which conjectures or geometric relationships they used. So far in this course, proofs have usually been presented to students as finding reasons for a chain of statements or through making a single deductive conclusion. However, in this chapter, Lesson 6.1.4 introduces flowcharts to show congruence arguments that require multiple intermediate arguments that lead to a desired conclusion. Students will examine the difference between justification for congruence and justification for similarity. In Lesson 6.1.5, students will investigate conditional statements and determine when certain converses of those statements are still true.

Where Is This Going?

Chapter 6 begins the study of congruent triangles, which continues in Chapter 7, where congruent triangles will be used as tool to investigate relationships between lengths and angles of quadrilaterals and other polygons.

This chapter also prepares students for work with proof in Chapter 7, when they will create a more complete argument with a flowchart by justifying each fact. At that point, the work with flowcharts will be extended to two-column proofs. Extensive work with justification and explanation in Chapters 6 and 7 allows two-column proofs to be presented as a formal structure for organizing explanations rather than as a new concept.
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All of the CCSS Standards for Mathematical Practice will be addressed in this Core Connections Geometry course. In this chapter students will: construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically, and attend to precision, and look for and express regularity in repeated reasoning.

Chapter 7

Since Chapter 7 often marks the beginning of a new semester, Section 7.1 acts as a launch to Chapters 7 through 12. In this section, students explore four activities that introduce them to some of the areas of focus that lie ahead. These lessons are intentionally challenging in order to motivate new teams to establish good communication and learning habits. They are designed to pique the interest of students so that they look forward to future lessons. In addition, they are organized to help Mr. Marsh establish classroom norms of investigation: make a prediction, create a model, collect data, share the results, find another way to solve the problem, etc.

Section 7.2 weaves together the concepts of congruent triangles, proof, and quadrilaterals to complete the work students started in Chapters 3 through 6. Unlike other courses, where congruent triangles are often treated as an “end” rather than as the “means,” this text challenges students from the beginning to use congruent triangles to discover new properties of quadrilaterals and to justify their reasoning. Lesson 7.2.1 begins by asking students to rotate a triangle and form a quadrilateral, analogous to what the students did in the Shape Factory in Chapter 1. Students then use the fact that the triangles are congruent to learn more about the quadrilateral. For example, when two congruent triangles are joined along a common side to form a parallelogram, the corresponding sides help to prove that the opposite sides of a parallelogram must be congruent.

While students investigate quadrilaterals using congruent triangles, they will further develop their justification skills by including reasons for facts stated in a flowchart, creating a flowchart proof. Students will then extend their understanding of proof to include two-column proofs.

Section 7.3 ties together work on coordinate axes that was started in Chapter 2. Students will now use algebraic tools to justify (or prove) statements about shapes, such as "ΔABC is a right isosceles triangle." Students will also learn how to find the midpoint of a line segment.

Theorem Toolkit

During Section 7.2, students learn many important properties about triangles and quadrilaterals. To help organize this information, students will use a Theorem Toolkit (Lesson 7.2.1A Resource Page). On this toolkit, students will record each theorem as they prove it. For example, they will prove that the diagonals of a rectangle are equal, and then they will record that theorem in the toolkit.

Investigation and Justification (Proof) Strand

In Chapters 3 through 6, students developed the ability to create a flowchart to show how facts lead to a particular conclusion. Now, in Section 7.2, students will be required to include justification for each fact in order to make the flowchart convincing, and therefore a proof. In addition, Lesson 7.2.5 introduces students to two-column proofs as another way to organize statements and reasons.

The section ends with Lesson 7.2.6, which sums up the investigative process that students have used throughout this course: Explore, Conjecture, and Prove. Students then use this process to learn new properties about shapes, such as the midsegments of triangles and the base angles of isosceles
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Algebra Thread
Section 7.3 will require students to apply their algebra skills, specifically:

- Graphing lines from a rule
- Finding the slope of a line when graphed
- Using slope to determine if lines are parallel or perpendicular
- Finding the solution to a system of linear equations

Therefore, these topics are found in each homework assignment leading up to Section 7.3. Use these assignments as an opportunity to assess where your students are with these skills.

Where Is This Going?
The lessons in Section 7.1 each lead to mathematical topics that the students will study later in this course. These topics include the study of circles (in Chapters 8, 10, and 11), regular polygons (in Chapter 8), and three-dimensional shapes (in Chapters 9, 11, and 12). In addition, the study of rhombi in this chapter will help students build constructions with a compass and straightedge in Chapter 10.

In addition, Section 7.2 completes students’ justification tools that will enable them to provide proofs for future geometric discoveries. With a thorough understanding of congruent triangles, students will be able to find the area of regular polygons and will be able to discover new facts about circles (such as the fact that a radius that passes through the midpoint of a chord is its perpendicular bisector). Students will also revisit congruent triangles while exploring constructions in Chapter 9.

All of the CCSS Standards for Mathematical Practice will be addressed in this Core Connections Geometry course. In this chapter students will: make sense of problems and learn to persevere, construct viable arguments and critique the reasoning of others, use appropriate tools strategically, and attend to precision.

Chapter 8
Chapter 8 extends students' work with quadrilaterals and triangles to focus on the angles, area and perimeter of polygons with any number of sides. Students will start the chapter by building pinwheels and polygons out of congruent triangles and developing vocabulary to describe these shapes. Students will then use ideas about triangle angle sums and other angle relationships to make discoveries about the interior and exterior angles of polygons. A Regular Polygon Angle Web is introduced in Lesson 8.1.4 to help students organize the connections between interior and exterior angles and the number of sides of a polygon. Finally, in Lesson 8.1.5, students develop a strategy to find the area of a regular polygon with any number of sides.

In Section 8.2, students examine the relationships between areas of similar figures. Students discover that the ratio of the areas between similar figures is equal to the square of the zoom factor (or linear scale factor).

In Section 8.3, students extend this generalization to finding the area and perimeter of a regular
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polygons with an infinite number of sides in order to develop the area and circumference formulas for a circle.

Throughout the chapter, there is an emphasis on the value of knowing multiple ways to solve a problem. Students are often encouraged to solve problems twice or more, using different strategies. Students use their new knowledge about polygons, similar figures, and circles in a variety of application problems that require students to reason through using their algorithms and formulas in different ways. Students are continually asked to reverse their reasoning to attack a problem from a different perspective. For example, when given information about the areas of two similar figures, students need to reverse their thinking to find the ratio of corresponding sides. Also, students are repeatedly asked to find angle measures of regular polygons (such as the measure of an exterior angle of a decagon) using multiple methods.

Review & Preview Section
In the previous chapter, the length and difficulty level of the Review & Preview Section was increased slightly—to 7 problems per lesson, up from 6 in the first half of the course. In addition, most assignments now have a multiple-choice question to help students become accustomed to this format. Students must show work for these problems as if they were not multiple choice.

Algebra Thread
Developing formulas and algorithms will require students to represent their solution strategies both descriptively and algebraically. As students solve problems, they will be asked to solve for different variables using a formula (e.g., number of sides of a polygon or degrees in one interior angle) when given different initial information. Students will practice their skills at simplifying and solving complex equations in a variety of contexts throughout the chapter.

Students are also presented with the difference between approximating answers and leaving them in exact form, using square roots and $\pi$.

Where Is This Going?
Work with polygons and circles will continue in Chapter 9, where students will look at three-dimensional shapes with polygonal and circular faces. Ratios between the lengths of sides of similar figures and the ratios of their areas will also be revisited in Chapter 9 when the ratios of the surface areas and volumes of similar solids are investigated.

All of the CCSS Standards for Mathematical Practice will be addressed in this Core Connections Geometry course. In this chapter students will: make sense of problems and learn to persevere, reason abstractly and quantitatively, attend to precision, look for and make use of structure, and look for and express regularity in repeated reasoning.

Chapter 9

This chapter includes two distinct sections, one focusing on three-dimensional solids, and the other applying knowledge developed throughout the course to construct geometric figures and relationships using a variety of tools.

In Section 9.1, students study solids, including polyhedra and cylinders. This investigation begins by looking at different ways to represent three-dimensional objects in two dimensions, including drawing mat plans and top and side views. Throughout this work, students use physical models built with
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Manipulatives to help determine two-dimensional representations. Later, they reverse the process to build the three-dimensional solid when given a two-dimensional representation. From their work with these different representations, students develop ways to find surface area and volume.

In Section 9.2, students transition back to working with two-dimensional shapes as they investigate constructions. This section provides a context for a wealth of review opportunities, including reflections, quadrilateral theorems, congruence, similarity, parallel line theorems, etc. Creating and justifying the constructions requires students to connect back to concepts from many of the earlier sections. Additionally, this section helps students to build a more concrete understanding of the role that a radius plays in a circle, which will help them in their continued study of circles, arcs, and chords in Chapter 10.

The section begins by having students use tracing paper as well as a compass and straightedge. Rather than following step-by-step instructions, the text asks students to reason through creating different constructions and to use their knowledge from previous sections to justify that a specific shape (such as a rhombus) has been constructed.

Note that the rhombus will become a key focus of construction. It can be quickly constructed using two interlocking circles, such as the circles at right. Once a rhombus is constructed, parallel lines exist. In addition, students can quickly construct perpendicular lines (because the diagonals of a rhombus are perpendicular), find a midpoint (because the diagonals bisect each other), and bisect an angle (because the diagonals bisect the angles of the rhombus).

Where Is This Going?
The work with constructions in this chapter reviews and reinforces prior knowledge about polygons, while it also prepares students for investigations of circles, chords, and arcs in Chapter 10. A strong understanding of a circle as the set of all points equidistant from another fixed point (developed through the use of the compass) will assist students in their investigations in the following chapter, as will the concrete use of radius and diameter. In addition, this concept will be the basis for generating the equation of a circle and the Pythagorean Trigonometric Identities, such as \( \sin^2 x + \cos^2 x = 1 \). Finally, the understanding of a circle as a set of points equidistant from another, fixed point will lay the foundation for future study of other conic sections such as ellipses and parabolas in Chapter 12.

Surface area and volume will be revisited and extended to a wider range of shapes in Chapter 11. At that time, students will extend their understanding of surface area of basic polyhedra and prisms to cones, pyramids, spheres, and more complicated polyhedra.

All of the CCSS Standards for Mathematical Practice will be addressed in the Core Connections Geometry course. In this chapter students will: construct viable arguments and critique the reasoning of others, use appropriate tools strategically, and attend to precision.

Chapter 10

Previously, students learned how to find the area and circumference of a circle and how to use circles to construct a variety of different shapes and relationships. However, up to this point they have been
dependent on knowing either the length of the radius or the diameter of the circle in order to use it to solve problems. In this chapter, students are introduced to angles, arcs, chords, and tangents of circles and how these pieces can be used to solve different kinds of circle problems.

Early in the chapter, students are introduced to the vocabulary of circles as they investigate relationships between arcs, chords, and inscribed angles. These investigations begin the development of a set of tools, including a method to find the center of a circle given an arc or a chord and a way to find the measures of arcs when provided certain angle measures. Students develop several methods for finding the lengths of chords, including using their prior knowledge of similar triangles to find relationships between the lengths of intersecting chords. The chapter also introduces lines tangent to a circle.

Throughout their investigations, students apply their new circle knowledge to solve application problems involving circles. These problems require students to identify which knowledge and/or tools may be useful in each context and to connect their new circle tools to their earlier work with similar and congruent triangles, probability, surface area, and volume.

Section 10.2 revisits probability with the study of conditional probability. Conditional probability leads to the formal definition of independence, that is, \( P(A \text{ given } B) = P(A) \), which students have only used intuitively in previous chapters. With this knowledge, students can then determine if two categorical variables are associated with each other. Students are introduced to two-way tables as another method of displaying probabilities. Then they investigate the Multiplication Rule, and a special case of the Multiplication Rule, which leads to an alternative definition for independence.

Probabilities involving large numbers of outcomes prompt the need to develop methods of counting. In Section 10.3 students develop systematic counting methods based on the Fundamental Principle of Counting, permutations, combinations, and methodical counting methods for situations where repetition of outcomes is allowed.

Algebra Strand
This chapter includes many opportunities for students to write and solve equations for specific situations and for generalized relationships (for example, the relationship between the measure of an arc and its associated inscribed angle).

Where Is This Going?
Looking at right triangle relationships inside of a circle is preparation for students’ work with the unit circle in future courses.

All of the CCSS Standards for Mathematical Practice will be addressed in the Core Connections Geometry course. In this chapter students will: construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically, and attend to precision.

Chapter 11

Chapter 11 starts with an investigation of polyhedra, where students generate all of the possible platonic solids (tetrahedron, cube, octahedron, dodecahedron, and icosahedron). This activity introduces students to interesting new structures, which helps launch the investigations of pyramids, cones, and spheres in Lessons 11.1.3 through 11.1.5. Then Section 11.2 uses the globe as a spherical context to drive an investigation of circles, tangents, and secants.
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All of the CCSS Standards for Mathematical Practice will be addressed in the Core Connections Geometry course. In this chapter students will: make sense of problems and learn to persevere, model with mathematics, use appropriate tools strategically, and attend to precision.

Chapter 12

Section 12.1 is an extension designed to introduce students to the connections between algebra and geometry through the study of two conic sections: the circle and the parabola. It is by no means an exhaustive look at conics, which students will study deeply in a later course. Certain vocabulary (such as “focus” and “directrix”) will be introduced to give students words for the geometric parts of a parabola that they are studying. Deeper investigations of other conic sections, however, such as the ellipse and hyperbola, are left for a later course.

Section 12.2 provides closure for Chapters 1 through 11 and offers practice with most of the major concepts studied in this course. The activities in this section require students to connect different strands of knowledge in order to solve complex problems. These activities are independent of each other and may be used in any order. In fact, if time is limited, most of the activities in Section 12.2 can be used at any point after Chapter 10 in order to help students review for an end-of-the-course final.

Through these activities, students will be able to consolidate what they know, apply concepts in new ways, and identify questions for further exploration. The problems require students to identify, with their teams, the tools and strategies they will use to reach a solution. A key component to these activities is requiring students to decide which tools, skills, and strategies to use in each situation. This section could take anywhere from one to five days or more, depending on how many activities are selected, the depth of investigations, and kinds of products a teacher expects. Before starting Section 12.2, you will need to make decisions about which projects and activities to use with your class based on time constraints and the needs of your students.

All of the CCSS Standards for Mathematical Practice will be addressed in the Core Connections Geometry course. In this chapter students will: use appropriate tools strategically, attend to precision, look for and make use of structure, and look for and express regularity in repeated reasoning.