West Windsor-Plainsboro Regional School District
Geometry Honors
July 2022

Unit 1: Foundations of Geometry	
Content Area: Mathematics	
Course & Grade Level: Geometry Honors, Grades 9 & 10	
Summary and Rationale	
Students study geometry in order to better understand the world around them. In this unit, students will learn to see how a real-world situation can be represented by an axiomatic system. In order to develop this ability, students will need to learn the following: (1) axioms, how to make arguments, and how to draw conclusions; (2) different types of geometry: Euclidean, synthetic, and analytic; (3) definitions; and (4) the difference between using inductive and deductive reasoning. Building on their work with the Pythagorean theorem to find distances, students will use a rectangular coordinate system to verify geometric relationships, including properties and slopes of parallel and perpendicular lines. Students should be encouraged to focus on the validity of the underlying reasoning while exploring a variety of formats for expressing that reasoning. Constructions can enhance understanding of geometric properties.	
Recommended Pacing	
24 days	
New Jersey Student Learning Standards for Mathematics	
Standards for Mathematical Practice	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Make sense of problems and persevere in solving them.
2	Reason abstractly and quantitatively.
3	Construct viable arguments and critique the reasoning of others.
4	Model with mathematics.
5	Use appropriate tools strategically.
6	Attend to precision.
7	Look for and make use of structure.
8	Look for and express regularity in repeated reasoning.
Standard: G-CO.A Experiment with transformations in the plane	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
Standard: G-CO.C Prove geometric theorems	
CPI #	**Cumulative Progress Indicator (CPI)**
9	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints
Standard: G-CO.D Make geometric constructions	
CPI #	**Cumulative Progress Indicator (CPI)**
12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
Standard: G-GPE.B Use coordinates to prove simple geometric theorems algebraically	
CPI #	**Cumulative Progress Indicator (CPI)**

6	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
Standard: G-MG.A Apply geometric concepts in modeling situations	
CPI #	**Cumulative Progress Indicator (CPI)**
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).
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Standard: Science Craft and Structure	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 10-11 texts and topics.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
New Jersey Student Learning Standards for Computer Science and Design Thinking	
CPI #	**Cumulative Progress Indicator (CPI)**
8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.
Instructional Focus	
Unit Enduring Understandings	
● Understand the foundation for the development of Euclidean geometry as a formal, rigorous study of mathematical relationships. ● Empirical verification is an important part of the process of proving, but it can never, by itself, constitute a formal proof. ● Deductive reasoning is a tool to create a valid argument and determine the validity of someone else's argument. ● A diagram is a sophisticated mathematical drive for thinking and communicating.	
Unit Essential Questions	
● How does Geometry model the real world? ● How is visualization essential to the study of geometry? ● What is inductive and deductive reasoning? ● How do counterexamples refute inductive reasoning? ● What are the characteristics of a valid argument? ● How does one create a series of logical arguments that lead to a conclusion? ● How do you deductively prove an argument?	

Content Understandings

- The basic but important elements of geometry: points, lines, planes, segments, and angles
- Draw and interpret diagrams
- The intersections of lines and planes
- Congruence versus equality
- Inductive vs Deductive reasoning; arguments and logic building
- Proof development
- Different Segment and angle relationships enhanced with appropriate constructions
- Measure distances and compute midpoints on number lines and coordinate planes

Content Questions

- How are points, lines, and segments used to model the real world?
- What is logic and reasoning?
- How does deductive reasoning lead to writing proofs?
- What information can you use to develop different segment and angle relationships?
- How do constructions enhance understanding of segment and angle relationships?

Objectives

Students will know:

- Undefined terms: point, line, plane
- Defined Terms: parallel lines, parallel planes, transversal, alternate interior angles, same side interior angles, corresponding angles, corollary, triangle, equidistant, distance, collinear, coplanar, intersection, segment, ray, angle, length, congruent, midpoint, bisector, postulate, theorem
- Postulates: Segment and Angle Addition Postulate, Point-Line-Plane Postulates and postulates dealing with parallel lines and proving lines parallel
- Theorems: Line Theorems, Parallel and Perpendicular Line Slope Theorems and theorems dealing with parallel lines and proving lines parallel.

We are learning to/that:

- Apply definitions, notation, and postulates of geometry
- Name, describe, and draw models for points, lines and planes; be able to use these terms to define basic relationships
- Find the distance between two points using absolute value
- Apply segment addition postulate
- Name angles, find their measure and apply the angle addition postulate
- Apply the definitions of congruent segments and angles
- Apply relationships of segments with midpoints and segment bisectors
- Apply relationships with angles and angle bisectors
- Distinguish between intersecting lines, parallel lines
- State and apply the theorem about the intersection of two parallel planes by a third plane
- State and apply the postulates and theorems about parallel lines
- State and apply the theorems about a parallel and a perpendicular to a point outside the line

Evidence of Learning

Assessment

Assessment plan may include teacher designed formative and summative assessments, a district common assessment, analysis of PSAT and NJSLA data.

Resources

Core Text: Reveal Geometry by McGraw Hill

Unit 2: Transformations & Triangle Congruence	
Content Area: Mathematics	
Course & Grade Level: Geometry Honors, Grades 9 & 10	
Summary and Rationale	
Students will establish the foundation for figure congruence which relies on the definition of transformations. Students will build an understanding of rigid motions, including translations, reflections and rotations, in order to develop an understanding about what it means for two objects to be congruent. Rigid motions are at the foundation of the definition of congruence, and students should recognize that they preserve distance and angle measure. Students will be encouraged to use a variety of tools, in order to transform given figures to prove congruence. Students will use their knowledge of congruence to build an understanding of congruent triangles. Students will explore properties and relationships of sides and angles of triangles. They will apply the SSS, SAS, ASA, AAS and HL Triangle Congruence Postulates/Theorems to solve problems and prove various theorems about triangles throughout the unit, including those pertaining to congruence, mid-segments, perpendicular bisectors, angle bisectors, medians, altitudes, and special right triangles. Constructions can enhance understanding of geometric properties.	
Recommended Pacing	
30 days	
New Jersey Student Learning Standards for Mathematics	
Standards for Mathematical Practice	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Make sense of problems and persevere in solving them.
2	Reason abstractly and quantitatively.
3	Construct viable arguments and critique the reasoning of others.
4	Model with mathematics.
5	Use appropriate tools strategically.
6	Attend to precision.
7	Look for and make use of structure.
8	Look for and express regularity in repeated reasoning.
Standard: G-CO.A Experiment with transformations in the plane	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
2	Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

5	Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
Standard: G-CO.B Understand congruence in terms of rigid motions	
CPI #	**Cumulative Progress Indicator (CPI)**
6	Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
7	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
8	Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
Standard: G-CO.C Prove geometric theorems	
CPI #	**Cumulative Progress Indicator (CPI)**
9	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
10	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
11	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.
Standard: G-CO.D Make geometric constructions	
CPI #	**Cumulative Progress Indicator (CPI)**
12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
Standard: G-SRT.A Understand similarity in terms of similarity transformations	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
Standard: G-MG.A Apply geometric concepts in modeling situations	
CPI #	**Cumulative Progress Indicator (CPI)**
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).
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	
CPI #	**Cumulative Progress Indicator (CPI)**

RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Standard: Science Craft and Structure	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 10-11 texts and topics.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
New Jersey Student Learning Standards for Computer Science and Design Thinking	
CPI #	**Cumulative Progress Indicator (CPI)**
8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.
Instructional Focus	

Unit Enduring Understandings

- Understand the foundation for the development of Euclidean geometry as a formal, rigorous study of mathematical relationships.
- Empirical verification is an important part of the process of proving, but it can never, by itself, constitute a formal proof.
- Deductive reasoning is a tool to create a valid argument and determine the validity of someone else's argument.
- A diagram is a sophisticated mathematical drive for thinking and communicating.

Unit Essential Questions

- What is transformational geometry?
- What is symmetry?
- What is congruence?
- What is rigid motion?

Content Understandings

- Extend algebraic skills to problem solving with geometric concepts.
- The processes of proving include a variety of activities, such as developing conjectures, considering the general case, exploring with examples, looking for structural similarities across cases, searching for counterexamples, and using deductive reasoning.
- Coordinate geometry can be used to represent and verify geometric/algebraic relationships.

Content Questions

- How do we analyze figures to identify the types of rigid motions?
- How is coordinate geometry helpful to define different transformations?
- How do we analyze compositions of transformations?
- How can we use geometric reasoning to prove statements about triangles?
- What is the criteria for triangles to be congruent/similar? How does this relate to transformations?
- What are the relationships between sides and angles of a triangle? How do we use these relationships to solve problems?

- How do we apply theorems to solve problems?
- What are the different constructions within triangles and their properties?

Objectives

Students will know:

- **Terms:** reflection, rotation, translations, corollary, corresponding parts, isosceles triangle, equilateral triangle, parts of an isosceles and equilateral triangle, parts of a right triangle, median, altitude, perpendicular bisector, angle bisector
- **Theorems:** SSS, SAS, ASA, AAS, HL Theorem, Isosceles Triangle Theorem, Converse of Isosceles Triangle Theorem, Pythagorean Theorem, converse of the Pythagorean Theorem, theorems about the lengths of the sides of an acute/obtuse triangle, theorems about Inequalities
- Concepts of rigid versus non-rigid motion
- Properties of transformations

We are learning to/that:

- Perform rigid motions to transform figures, and to predict the effect of a given rigid motion on given figures
- Use the definition in terms of rigid motions to decide if figures are congruent
- Identify the corresponding parts of congruent figures
- Apply SSS Theorem, the SAS Theorem, the ASA Theorem, and the AAS Theorem, HL Theorem to prove triangles congruent
- Deduce information about segments and angles after proving that two triangles are congruent.
- Apply the theorems about isosceles triangles.

Evidence of Learning

Assessment

Assessment plan may include teacher designed formative and summative assessments, a district common assessment, analysis of PSAT and NJSLA data.

Resources

Core Text: Reveal Geometry by McGraw Hill

Unit 3: Relationships in Quadrilaterals	
Content Area: Mathematics	
Course & Grade Level: Geometry Honors, Grades 9 & 10	
Summary and Rationale	
In this unit, students will build on their knowledge of quadrilaterals from middle school. Students will re-explore properties and conditions of special quadrilaterals such as parallelograms, rhombuses, rectangles, squares, kites and trapezoids. They will combine prior knowledge with their new knowledge of quadrilaterals gained throughout this course to apply theorems and solve complex problems involving quadrilaterals. Additionally, they will revisit coordinate proofs using distance and slope involving different types of quadrilaterals.	
Recommended Pacing	
13 days	
New Jersey Student Learning Standards for Mathematics	
Standards for Mathematical Practice	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Make sense of problems and persevere in solving them.
2	Reason abstractly and quantitatively.
3	Construct viable arguments and critique the reasoning of others.
4	Model with mathematics.
5	Use appropriate tools strategically.
6	Attend to precision.
7	Look for and make use of structure.
8	Look for and express regularity in repeated reasoning.
Standard: G-CO.C Prove geometric theorems	
CPI #	**Cumulative Progress Indicator (CPI)**
11	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.
Standard: G-GPE.B Use coordinates to prove simple geometric theorems algebraically	
CPI #	**Cumulative Progress Indicator (CPI)**
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.
Standard: G-MG.A Apply geometric concepts in modeling situations	
CPI #	**Cumulative Progress Indicator (CPI)**
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).
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Standard: Science Craft and Structure	

CPI #	Cumulative Progress Indicator (CPI)
RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 10-11 texts and topics.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
New Jersey Student Learning Standards for Computer Science and Design Thinking	
CPI #	**Cumulative Progress Indicator (CPI)**
8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.

Instructional Focus

Unit Enduring Understandings

- Understand the foundation for the development of Euclidean geometry as a formal, rigorous study of mathematical relationships.
- Empirical verification is an important part of the process of proving, but it can never, by itself, constitute a formal proof.
- Deductive reasoning is a tool to create a valid argument and determine the validity of someone else's argument.
- A diagram is a sophisticated mathematical drive for thinking and communicating.

Unit Essential Questions

- How can we use the general and specific properties of quadrilaterals to reason effectively?
- Why study quadrilaterals?

Content Understandings

- Quadrilaterals have a hierarchy of properties.
- The processes of proving include a variety of activities, such as developing conjectures, considering the general case, exploring with examples, looking for structural similarities across cases, and searching for counterexamples.
- Making sense of others' arguments and determining their validity are proof-related activities.

Content Questions

- How can the properties of geometric figures be verified using a coordinate plane or formal proof?
- What minimum conditions are necessary to prove a quadrilateral is a special quadrilateral?

Objectives

Students will know:

- **Terms**: parallelogram, rectangle, rhombus, square, trapezoid, isosceles trapezoid, kite, midpoint quadrilateral, median of a trapezoid
- **Theorems**: Theorems about the properties of a parallelogram, theorems about the ways to prove a quadrilateral is a parallelogram, theorems about the properties of a rectangle and rhombus, theorems about the ways to prove a parallelogram is a rectangle or rhombus, theorems about the properties of a trapezoid/isosceles trapezoid, theorems about properties of kites

We are learning to/that:

- Apply the definition of a parallelogram and the theorems about the properties of a parallelogram
- Prove using coordinate geometry and formal proof that quadrilaterals are special quadrilaterals

● Apply the definitions then identify and prove the special properties of a rectangle, a rhombus, a square, a kite, a trapezoid, and an isosceles trapezoid
Evidence of Learning
Assessment
Assessment plan may include teacher designed formative and summative assessments, a district common assessment, analysis of PSAT and NJSLA data.
Resources
Core Text: Reveal Geometry by McGraw Hill

Unit 4: Similarity and Right Triangle Trigonometry	
Content Area: Mathematics	
Course & Grade Level: Geometry Honors, Grades 9 & 10	
Summary and Rationale	
Dilations are at the foundation of the definition of similarity, and students should recognize that they preserve angle measure. Students will use dilations to show that figures are similar. They will use similarity transformations to establish the AA and other Triangle Similarity Theorems. Students will make connections between similarity and congruence, establishing that that congruence is a special case of similarity, where the ratio of side lengths is 1:1. Students will use their knowledge of similarity of right triangles to establish an understanding of the trigonometric ratios of angles in these triangles. They will explore the interrelationships between the trigonometric functions and use these ratios, along with the Pythagorean theorem to solve right triangles, given different initial information.	
Recommended Pacing	
21 days	
New Jersey Student Learning Standards for Mathematics	
Standards for Mathematical Practice	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Make sense of problems and persevere in solving them.
2	Reason abstractly and quantitatively.
3	Construct viable arguments and critique the reasoning of others.
4	Model with mathematics.
5	Use appropriate tools strategically.
6	Attend to precision.
7	Look for and make use of structure.
8	Look for and express regularity in repeated reasoning.
Standard: G-SRT.A Understand similarity in terms of similarity transformations	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
2	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
3	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
Standard: G-SRT.B Prove theorems involving similarity.	
CPI #	**Cumulative Progress Indicator (CPI)**
4	Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
Standard: G-SRT.C Define trigonometric ratios and solve problems involving right triangles.	

CPI #	Cumulative Progress Indicator (CPI)
6	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
7	Explain and use the relationship between the sine and cosine of complementary angles.
8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
Standard: G-MG.A Apply geometric concepts in modeling situations	
CPI #	**Cumulative Progress Indicator (CPI)**
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).
3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Standard: Science Craft and Structure	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
New Jersey Student Learning Standards for Computer Science and Design Thinking	
CPI #	**Cumulative Progress Indicator (CPI)**
8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.
Instructional Focus	
Unit Enduring Understandings	
● Understand the foundation for the development of Euclidean geometry as a formal, rigorous study of mathematical relationships. ● Empirical verification is an important part of the process of proving, but it can never, by itself, constitute a formal proof. ● Deductive reasoning is a tool to create a valid argument and determine the validity of someone else's argument. ● A diagram is a sophisticated mathematical drive for thinking and communicating.	
Unit Essential Questions	
● How can trigonometry be applied to real world situations? ● What are the criteria for triangles to be similar? How does this relate to transformations?	

- How does congruence relate to similarity?
- How can similarity be used to solve problems and/or prove statements about or properties of triangles?
- How are the values of the trigonometric functions of right triangles connected to the similarity of the right triangles?
- How are the sine, cosine and tangent ratios related?
- What relationships exist between the trigonometric functions and the Pythagorean theorem?
- How can right triangles be solved?

Content Understandings

- Algebraic skills can be used to prove facts about geometric figures in a plane.
- 6We prove figures similar so that we can measure geometric objects indirectly.
- The tangent ratio is a proportion that holds true for all angles of the same value in a right triangle.

Content Questions

- How are similar polygons related?
- What proportionality relationships exist when a special segment or line intersects a triangle?
- How are the values of the trigonometric functions of right triangles connected to the similarity of the right triangles?
- What is the main difference between the trigonometric function and their inverses?
- How can the trigonometric and inverse functions be used to solve right triangles and find unknown measurements in real world applications?

Objectives

Students will know:

- **Terms:** ratio, proportion, means, extremes, similar, scale factor (similarity ratio), geometric mean, sine, cosine, tangent, angle of depression, angle of elevation, arcsine, arccosine
- **Postulate:** AA Similarity Postulate
- **Theorems:** SAS Similarity Theorem, SSS Similarity Theorem, Triangle Proportionality Theorem, Theorem about the similar triangles formed by the altitude to the hypotenuse, Pythagorean Theorem, converse of the Pythagorean Theorem, theorems about the lengths of the sides of an acute/ obtuse triangle, 45˚ - 45˚ - 90˚ Theorem, 30˚- 60˚ - 90˚ Theorem, Theorem dealing with parallel lines and proportional segments, theorems about the altitude drawn to the hypotenuse of a right triangle and the geometric mean
- The dilation of a line segment is longer or shorter in the ratio given by the scale factor

We are learning to/that:

- Transform figures in the coordinate plane using dilations
- Verify experimentally the properties of dilations given by a center and a scale factor
- Use dilations to show that two figures are similar
- Identify the corresponding parts of similar figures
- Prove two triangles similar by using AA Postulate, the SAS ~ Theorem and the SSS ~ Theorem
- Deduce information about segments and angles after proving that two triangles are similar
- Apply the Triangle Proportionality Theorem and its converse
- Determine the geometric mean between two numbers
- State and apply the relationships that exist when the altitude is drawn to the hypotenuse of a right triangle
- State and apply the Pythagorean Theorem
- State and apply the converse of the Pythagorean Theorem and related theorems about obtuse and acute triangles
- Determine the lengths of two sides of a 45˚ - 45˚ - 90˚ or a 30˚ - 60˚ - 90˚ triangle when the length of the third side is known
- Solve right triangle problems by using the sine, cosine and tangent ratios

Evidence of Learning
Assessment
Assessment plan may include teacher designed formative and summative assessments, a district common assessment, analysis of PSAT and NJSLA data.
Resources
Core Text: Reveal Geometry by McGraw Hill

Unit 5: Circles	
Content Area: Mathematics	
Course & Grade Level: Geometry Honors, Grades 9 & 10	
Summary and Rationale	
The purpose of this unit is to have students experience mathematics as a language for understanding and explaining phenomena; not just a way to solve specific problems. Students will build on their understanding of congruence and similarity to investigate relationships between circles. In addition, students will explore and prove relationships between parts of circles. Students should understand how these parts relate to segment lengths and angle measures, and how this relates back to similarity. Students will use the knowledge from this section in conjunction with quadrilaterals and other polygons to problem solve for missing dimensions and areas.	
Recommended Pacing	
18 days	
New Jersey Student Learning Standards for Mathematics	
Standards for Mathematical Practice	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Make sense of problems and persevere in solving them.
2	Reason abstractly and quantitatively.
3	Construct viable arguments and critique the reasoning of others.
4	Model with mathematics.
5	Use appropriate tools strategically.
6	Attend to precision.
7	Look for and make use of structure.
8	Look for and express regularity in repeated reasoning.
Standard: G-CO.A Experiment with transformations in the plane	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
Standard: G-C.A Understand and apply theorems about circles.	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Prove that all circles are similar.
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.
3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
Standard: G-C.B Find arc lengths and areas of sectors of circles.	
CPI #	**Cumulative Progress Indicator (CPI)**
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.
Standard: G-GPE.A Translate between the geometric description and the equation for a conic section	
CPI #	**Cumulative Progress Indicator (CPI)**

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.
Standard: G-MG.A Apply geometric concepts in modeling situations	
CPI #	**Cumulative Progress Indicator (CPI)**
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).
3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
Standard: G-CO.A Experiment with transformations in the plane	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
Standard: G-C.A Understand and apply theorems about circles.	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Prove that all circles are similar.
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
Standard: Science Craft and Structure	
CPI #	**Cumulative Progress Indicator (CPI)**
RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 10-11 texts and topics.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
Instructional Focus	
Unit Enduring Understandings	
● Understand the foundation for the development of Euclidean geometry as a formal, rigorous study of mathematical relationships. ● Empirical verification is an important part of the process of proving, but it can never, by itself, constitute a formal proof. ● Deductive reasoning is a tool to create a valid argument and determine the validity of someone else's argument ● A diagram is a sophisticated mathematical drive for thinking and communicating. ● Because of its unique properties, a circle is considered by some to be a perfect figure.	
Unit Essential Questions	

- What is a circle?
- How are circles used to understand our planet?
- Can we ever know the area or circumference of a circle exactly?
- What makes a circle perfect?
- How can we apply circles and their properties to model various applications?

Content Understandings

- We use similarity and congruence to investigate and justify the relationships between circles.
- All circles are similar and there are relationships between circles, chords and radii that can be used to find measures of segments and angles.

Content Questions

- How are segments within circles, such as radii, diameters, and chords, related to each other?
- What is the relationship of their measurements?
- How do inscribed, circumscribed, and central angles relate to each other?
- How can various figures be inscribed in a circle using various tools?
- How do the properties of these figures relate to the parts of a circle?
- What relationships exist between segments and angles formed by tangents, secants and chords?

Objectives

Students will know:

- **Terms:** circle, center, radius, chord, diameter, secant, tangent, point of tangency, congruent circles, concentric circles, inscribed and circumscribed circles, great circle, common tangents, tangent circles, central angle, arc, minor and major arc, semicircle, measure of an arc, adjacent arcs, congruent arcs, inscribed angle, intercepted arc, arc length, sector, segment
- **Postulate:** Arc Addition Postulate
- **Theorems:** Theorems dealing with tangents and chords (and their converses), same circles and congruent circles, inscribed angles, tangent-tangent angles, tangent-chord angles, chord-chord angles, tangent-secant angles. Theorems dealing with segments of a circle including chord-chord segments, tangent-secant segments, secant-secant segments, Theorems dealing with tangents and inscribed angles

We are learning to/that:

- Define a circle and related terms such as tangents, chords, secants, arcs, sector.
- Prove that all circles are similar
- Identify and describe relationships among inscribed angles, radii, and chords
- Recognize inscribed (circumscribed) polygons and circumscribed (inscribed) circles
- Construct the inscribed and circumscribed circles of a triangle, and prove the properties of angles for a quadrilateral inscribed in a circle
- Understand by using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius
- Apply theorems about chords, tangents, and secants of a circle
- Solve problems and apply statements involving inscribed angles and angles formed by chords, secants and tangents of a circle
- Solve problems involving lengths of chords, secant segments and tangent segment
- Find, graph, and apply the equation of a circle in problem solving and modeling real-life application problems.

Evidence of Learning

Assessment

Assessment plan may include teacher designed formative and summative assessments, a district common assessment, analysis of PSAT and NJSLA data.

Resources

Core Text: Reveal Geometry by McGraw Hill

Unit 6: Area, Surface Area and Volume	
Content Area: Mathematics	
Course & Grade Level: Geometry Honors, Grades 9 & 10	
Summary and Rationale	
Surface area and volume problems offer great opportunities for students to explore all the skills they have learned in the course. Students' experience with two-dimensional and three-dimensional objects is extended to include informal explanations of area, and volume formulas. Students will model problems with three dimensional figures and will consider the shapes of the two-dimensional cross-sections of those figures. In addition, students will consider the figures created by the rotation of two-dimensional figures about a line. Students will use formulas for circumference and area to explore and derive the formula for arc length and area of a sector then apply this knowledge to find the area of a segment of a circle. Students will use the knowledge from this section in conjunction with quadrilaterals and other polygons to problem solve for missing dimensions and areas.	
Recommended Pacing	
19 days	
New Jersey Student Learning Standards for Mathematics	
Standard: Standards for Mathematical Practice	
CPI #	**Cumulative Progress Indicator (CPI)**
1	Make sense of problems and persevere in solving them.
2	Reason abstractly and quantitatively.
3	Construct viable arguments and critique the reasoning of others.
4	Model with mathematics.
5	Use appropriate tools strategically.
6	Attend to precision.
7	Look for and make use of structure.
8	Look for and express regularity in repeated reasoning.
Standard: G-GMD.A Explain volume formulas and use them to solve problems.	
CPI #	**Cumulative Progress Indicator (CPI)**
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.
3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
Standard: G-GMD.B Visualize relationships between two-dimensional and three-dimensional objects.	
CPI #	**Cumulative Progress Indicator (CPI)**
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.
Standard: G-MG.A Apply geometric concepts in modeling situations.	
CPI #	**Cumulative Progress Indicator (CPI)**
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).
2	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
New Jersey Student Learning Standards for English Language Arts Companion Standards	
Standard: Science Key Ideas and Details	

CPI #	Cumulative Progress Indicator (CPI)
RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills	
CPI #	**Cumulative Progress Indicator (CPI)**
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
New Jersey Student Learning Standards for Technology	
CPI #	**Cumulative Progress Indicator (CPI)**
8.1	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
Interdisciplinary Standards: NGSS	
HS.ESS2	Earth's Systems Science example: When coastal erosion is measured, what are its units? What does this tell you about what quantity is being measured? (p.33 NGSS Crosswalk)

Instructional Focus

Unit Enduring Understandings

- Understand the foundation for the development of Euclidean geometry as a formal, rigorous study of mathematical relationships.
- Empirical verification is an important part of the process of proving, but it can never, by itself, constitute a formal proof.
- Deductive reasoning is a tool to create a valid argument and determine the validity of someone else's argument.
- A diagram is a sophisticated mathematical drive for thinking and communicating.

Unit Essential Questions

- How do you describe the size of a three-dimensional figure?
- Can we ever know the area or circumference of a circle exactly?

Content Understanding

- Pi is a ratio used to determine area and circumference.
- The process of calculating surface area and volume of 3-dimensional solids includes a variety of dimensions, such as height, slant height, radius, base edge length, and so forth.
- Changing the diameter or radius will affect the area and circumference of a circle differently.

Content Questions

- How are circular arcs and area of sectors/segments calculated?
- How can the formulas for area and volume be explained using various tools and visual or tactile representations?
- How can surface area and volume be used to solve real world applications of 3D solids?
- How can the formulas for surface area of volume of 3D figures help calculate the area of volume of composite solids?
- What will be the three-dimensional result of rotating a two-dimensional figure about a line?

Objectives

Students will know:

- **Terms:** prism, base, altitude, lateral face, lateral edge, right prism, oblique prism, lateral area, surface area, cube, volume, regular pyramid, vertex, slant height, cylinder, cone, sphere, similar solids
- **Theorems:** Theorems dealing with lateral area, total area and volume of prisms, pyramids, cylinders and cones, theorems with area and volume of spheres, theorems involving ratios of two similar solids

We are learning to/that:

- Identify the parts of prisms, pyramids, cones, cylinders, and spheres
- Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects
- Find the lateral areas, total areas and volumes of right prisms, regular pyramids, right cylinders, right cones
- Find the area and volume of a sphere
- State and apply the properties of similar solids
- Derive the formula for the area of a sector

Evidence of Learning

Assessment

Assessment plan may include teacher designed formative and summative assessments, a district common assessment, analysis of PSAT and NJSLA data.

Resources

Core Text: Reveal Geometry by McGraw Hill