Groton Public Schools
Curriculum Map

INTRODUCTION
Course Title: College Geometry
Curriculum Area and Grade: Geometry Grade 10

Course Purpose:
Students will study geometry with a focus on basic geometric figures and ideas, congruence, similarity, transformations, right triangles, coordinate geometry, circles, area and volume. Students will use exploratory tools such as the compass, straightedge, and dynamic geometry software to provide interactive learning and develop deductive reasoning skills. Students will investigate geometric probability and statistical analysis, as well as solving problems on and off the coordinate plane, and applying algebraic skills to geometric problems. Real-world problem solving, spatial reasoning, and methods of proof will be threaded throughout the course. It is expected that most knowledge and skills from prior courses will be retained and applied. Some difficult concepts will be reviewed. Students will be expected to clearly communicate their processes, proofs, and solutions both orally and in writing.

Major Learning Goals and Understandings:
FHS Student Learning Expectation(s): SE1 Apply effective analysis, synthesis, and evaluative processes that enable productive problem solving. SE2 Communicate information clearly and effectively using a variety of tools/media in varied contexts and for a variety of purposes. SE3 Work independently and collaboratively to solve problems and accomplish goals. SE4 Use real-world digital and other research tools to access, evaluate and effectively apply information appropriate for authentic tasks. SE5 Demonstrate innovation, flexibility and adaptability in thinking patterns, work habits, and working/learning conditions. SE6 Value and demonstrate personal responsibility, character, cultural understanding, and ethical behavior. Course Specific Goals: Students will: ● Use geometric characteristics and properties to analyze and solve problems. ● Describe geometric models by equations for geometric understanding, modeling, and proof. ● Create, justify and defend geometric arguments and communicate mathematical ideas using visual and verbal models.

Units & Concepts	
Unit 1: Transformations and Building Blocks	**Unit 5:** Polygons and Quadrilaterals
Unit 2: Parallel Lines	**Unit 6:** Circles
Unit 3: Triangles and Congruence	**Unit 7:** Area, Surface Area and Volume
Unit 4: Similarity, Right Triangles and Trigonometry	

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Date Approved: ____

Unit 1: Transformations and Building Blocks			
Grade: 10	**Subject:** Geometry	**Course:** College Geometry	**Length of Unit:** 1 Quarter

Common Core State Standards (Priority)

CCSS.MATH.CONTENT.HSG.CO.A.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

CCSS.MATH.CONTENT.8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

CCSS.MATH.CONTENT.HSG.CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

Supporting Standards

CCSS.MATH.CONTENT.8.G.7. Apply the Pythagorean Theorem to determine the unknown side lengths in right triangles in real-world mathematical problems in two and three dimensions.

CCSS.MATH.CONTENT.HSG.CO.A.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).

CCSS.MATH.CONTENT.HSG.CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

CCSS.MATH.CONTENT.HSG.CO.A.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.

CCSS.MATH.CONTENT.HSG.CO.B.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.

Key Content Knowledge and Concepts/Skills		**Bloom's Taxonomy Levels** Creating, Evaluating, Analyzing, Applying, Understanding, and Remembering
The students will know: 1. The relationship between the distance formula and the Pythagorean Theorem. 2. The definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. 3. The relationship between the Pre-Image and Image after	The students will be able to: 1. Use the Pythagorean theorem to solve for a given side of a right triangle. 2. Use the Distance Formula to find the distance between any two points in the coordinate plane. 3. Perform a single translation, reflection and rotation on an object. 4. Determine the result of performing a sequence of transformations on an object	During this unit of study, all levels will be used for multiple learning experiences.

performing a series of transformations on it. 4. How a transformation affects a set of coordinates. 5. The essential characteristic of an isometry	5. Describe a set of transformations on an object using mapping rules.	

Big Ideas and Essential Questions

- **Big Ideas**

1. The Distance Formula is derived from the Pythagorean Theorem.
2. Isometries are transformations that preserve both distances and angle measures.
3. Translations, rotations, reflections, and glide reflections are all isometries.

- **Essential Questions**

1. What are transformations?
2. What properties are preserved by various transformations?
3. What properties are common to all isometries?

Part 3 – Common Unit Assessments

- Pythagorean Spiral Project
- Building Blocks Summative Assessment
- Transformation Project

Part 4 – Common/Assured Learning Experiences

- Students will model the Pythagorean Theorem and Distance Formula in a variety of real-world situations.
- Students will identify, model and describe single-step and multi-step transformations on the coordinate plane (translations, reflections and rotations).

Part 5 – Teacher Notes

- Students may recall Pythagorean Theorem and some transformations from middle school math courses.
- Students should remember that a square root raised to the second power is just the radicand (ex: $\sqrt{7}^{\ 2} = 7$)
- Students may need visual aids (patty paper, web-based modules) to understand and visualize transformations.

Unit 2: Parallel Lines			
Grade: 10	**Subject:** Geometry	**Course:** College Geometry	**Length of Unit:** 1 Quarter

Common Core State Standards (Priority)

CCSS.MATH.CONTENT.HSG.CO.C.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*.

Supporting Standards

CCSS.MATH.CONTENT.HSG.GPE.B.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

Key Content Knowledge and Concepts/Skills		**Bloom's Taxonomy Levels** Creating, Evaluating, Analyzing, Applying, Understanding, and Remembering
The students will know: 1. The properties of vertical angles and linear pairs. 2. The relationship between pairs of angles when two parallel lines are intersected by a transversal. 3. The relationships of special angle pairs when two parallel lines are crossed by a transversal. 4. How to identify and justify if two lines are parallel or perpendicular	The students will be able to: 1. Apply properties of vertical angles and linear pairs to prove that two angles are congruent or supplementary 2. Identify angle relationships formed when two lines are crossed by a transversal 3. Apply relationships with angle pairs when two parallel lines are crossed by a transversal. 4. Apply the theorems involving parallel lines and angles formed with a transversal 5. Prove that two lines are parallel using special angle relationships (the converse statement).	During this unit of study, all levels will be used for multiple learning experiences.

Big Ideas and Essential Questions

- **Big Ideas**

1. When two parallel lines are cut by a transversal, there exist special angle pairs.
2. Angle theorems and relationships can be applied to solve algebraic equations.

- **Essential Questions**

1. How do types of angles relate to each other?
2. What is the relationship between parallel and perpendicular lines?
3. How do various angles relate to each other given a set of parallel lines?
4. How can we prove two lines are parallel?

Part 3 – Common Unit Assessments

- Parallel Line City Project
- Summative Unit Assessment

Part 4 – Common/Assured Learning Experiences

- Students will explore the relationships between the types of angles created when parallel lines are cut by a transversal and use these relationships to solve problems.
- Students will learn the importance of auxiliary lines to assist in solving problems.
- Students will solve problems involving vertical angles and linear pairs, in addition to supplementary and complementary angles.
- Students will recognize the differences between parallel and perpendicular lines with respect to the coordinate plane.

Part 5 – Teacher Notes

- Students may recall that parallel lines share the same slope, whereas perpendicular lines have opposite reciprocal slopes.
- Diagrams that contain multiple transversals may be difficult for some students to visualize. The use of colored pencils and highlighting the interior and exterior of a set of lines may be beneficial.

Unit 3: Triangles and Congruence

Grade:	**Subject:**	**Course:**	**Length of Unit:**
10	Geometry	College Geometry	1 Quarter

Common Core State Standards (Priority)

CCSS.MATH.CONTENT.HSG.CO.C.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.*

CCSS.MATH.CONTENT.HSG.CO.B.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.

Supporting Standards

CCSS.MATH.CONTENT.HSG.CO.B.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

CCSS.MATH.CONTENT.HSG.CO.B.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.

Key Content Knowledge and Concepts/Skills	**Bloom's Taxonomy Levels** Creating, Evaluating, Analyzing, Applying, Understanding, and Remembering

The students will know:	The students will be able to:	During this unit of study, all levels will be used for multiple learning experiences.
1. The relationship of the Pythagorean Theorem and its converse. 2. The relationship between the sides and angles of a triangle. 3. The meaning of congruence and apply it to solve problems. 4. Two triangles are congruent if and only if all 6 pairs of parts are congruent. 5. Understand that SAS, ASA, SSS, AAS and HL are sufficient conditions for establishing that two triangles are congruent	1. Classify triangles by properties of sides and angles 2. Use the converse of the Pythagorean Theorem to classify triangles. 3. Explain and apply the Isosceles Triangle Theorem and its converse 4. Apply the meaning of congruence to establish properties of congruent segments, angles, and circles and polygons. 5. Use postulate properties in formal proofs (SSS,SAS,ASA,AAS,HL) 6. Prove two triangles congruent based on given information 7. Prove that two triangles are congruent and then use this fact to show that pairs of corresponding sides or angles are also congruent.	

Big Ideas and Essential Questions

- **Big Ideas**

1. Angle relationships determine properties about triangles.
2. Two figures are congruent if and only if all corresponding parts are congruent.
3. We can apply knowledge of congruence to solve algebraic problems.

- **Essential Questions**

1. What are the properties of triangles?
2. What does it mean for figures to be congruent?
3. How do we prove geometric statements using a formal two-column proof?
4. How and why are corresponding parts of congruent figures congruent to one another?

Part 3 – Common Unit Assessments

- NCTM Triangle Inequality Spaghetti Activity
- Proofs Project

Part 4 – Common/Assured Learning Experiences

- Students will make conjectures from a set of examples and nonexamples, and justify or refine these claims by reasoning inductively.
- Students learn to prove their justifications more formally by reasoning deductively and writing formal proofs.
- Proof should be a manifestation of student sense-making and logical reasoning, not a procedure.

Part 5 – Teacher Notes

- "What Follows" exercises may be beneficial for students to understand the sequence of writing a proof and how given information may lead to necessary statements and reasons.
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Unit 4: Similarity, Right Triangles and Trigonometry			
Grade: 10	**Subject:** Geometry	**Course:** College Geometry	**Length of Unit:** 1 Quarter

Common Core State Standards (Priority)

CCSS.MATH.CONTENT.HSG.SRT.A.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.

CCSS.MATH.CONTENT.HSG.SRT.B.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

CCSS.MATH.CONTENT.HSG.SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*

CCSS.MATH.CONTENT.HSG.SRT.C.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.

Supporting Standards

CCSS.MATH.CONTENT.HSG.SRT.A.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

CCSS.MATH.CONTENT.HSG.SRT.B.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.

CCSS.MATH.CONTENT.HSG.GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

CCSS.MATH.CONTENT.HSG.SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles.

Key Content Knowledge and Concepts/Skills		**Bloom's Taxonomy Levels** Creating, Evaluating, Analyzing, Applying, Understanding, and Remembering
The students will know: 1. How to determine whether two figures are similar by definition of similarity. 2. By similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles	The students will be able to: 1. Identify similar triangles and their properties (via AA, SSS, and SAS Similarity Postulates) 2. Determine whether two figures are similar by applying ratios and scale factors in addition to comparing corresponding angles. 3. Use concepts of similarity to define trigonometric ratios for acute angles 4. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problem	1. During this unit of study, all levels will be used for multiple learning experiences.

3. The relationship between the sine and cosine of complementary angles.	5. Apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).	

Big Ideas and Essential Questions

- **Big Ideas**

1. Congruent corresponding angles and proportional corresponding sides are used to prove triangles are similar.
2. Trigonometric ratios are defined by similar triangles and the concept of side ratios as angle properties
3. Congruence and similarity criteria for triangles are used to solve problems and prove relationships of geometric figures.

- **Essential Questions**

1. What relationships exist between the sides and angles of similar triangles?
2. How do we use similarity to prove relationships between and within figures?
3. What is the difference between similarity and congruence?
4. Are all congruent triangles similar and is the converse true also?

Part 3 – Common Unit Assessments

- Summative Assessment
- Right Triangle Trig Project

Part 4 – Common/Assured Learning Experiences

- Students will describe in writing the definition of similarity in terms of similarity transformations and decide if they are similar.
- Students will explain in writing and orally similarity transformations and the meaning of similarity for triangles as the equality of all corresponding pairs of angles.
- Students will define trigonometric ratios in order to solve problems involving right triangles.
- Trigonometric concepts will be used to solve real world applications.

Part 5: Teacher Notes

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Unit 5: Polygons and Quadrilaterals			
Grade: 10	**Subject:** Geometry	**Course:** College Geometry	**Length of Unit:** 1 Quarter

Common Core State Standards (Priority)

CCSS.MATH.CONTENT.HSG.CO.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.

CCSS.MATH.CONTENT.HSG.GPE.4. Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*

Supporting Standards

CCSS.MATH.CONTENT.HSG.GPE.5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

Key Content Knowledge and Concepts/Skills		**Bloom's Taxonomy Levels** Creating, Evaluating, Analyzing, Applying, Understanding, and Remembering
The students will know 1. The different types of quadrilaterals and their individual properties 2. The relationship between different quadrilaterals 3. How the distance formula, Pythagorean Theorem and slope can be used to classify a quadrilateral on the coordinate plane.	The students will be able to: 1. Investigate the relationship between the diagonals of a quadrilateral and its other characteristics 2. Prove that a quadrilateral is a parallelogram 3. Apply properties of different quadrilaterals to solve problems. 4. Use coordinate proofs to prove each type of quadrilateral	During this unit of study, all levels will be used for multiple learning experiences.

Big Ideas and Essential Questions

- **Big Ideas**

1. Polygons are classified in several ways.
2. Quadrilaterals all share common qualities but each have special attributes that differentiate them from each other.
3. We can use coordinates to prove a geometric relationship.

- **Essential Questions**

1. What is the importance of classifying polygons?
2. How do different quadrilaterals relate to each other?
3. Given a set of coordinates, can we prove a geometric relationship?

Part 3 – Common Unit Assessments

- Polygonians and Geometarians
- Instagram Project
- Summative Assessment

Part 4 – Common/Assured Learning Experiences

- Students will learn how to properly classify a polygon and generalize a formula determining the measures of angles in a regular polygon.

- Students will describe the relationships between different types of quadrilaterals in the structure of a "family tree", explaining the hierarchy principles and shared characteristics.
- Students will justify the type of quadrilateral on a coordinate plane using concepts of slope, distance and midpoint formula.

Part 5: Teacher Notes

- Students will utilize prior knowledge of slope, distance, midpoint and parallel/perpendicular lines in the coordinate geometry lessons with respect to quadrilaterals.
- The Quadrilateral Family Tree provides a visual representation of the relationships between different types of quadrilaterals. The hierarchy structure exhibits the shared characteristics of quadrilaterals that stem from above, but not below.

Unit 6: Circles			
Grade: 10	**Subject:** Geometry	**Course:** College Geometry	**Length of Unit:** 1 Quarter

Common Core State Standards (Priority)

CCSS.MATH.CONTENT.HSG.C.A.2 Identify and describe relationships among inscribed angles, radii, chords, tangents, and secants. 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.

Supporting Standards

CCSS.MATH.CONTENT.HSG.C.A.1 Understand that all circles are similar.

CCSS.MATH.CONTENT.HSG.C.A.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

CCSS.MATH.CONTENT.HSG.C.A.4 Construct a tangent line from a point outside a given circle to the circle.

Key Content Knowledge and Concepts/Skills		**Bloom's Taxonomy Levels** Creating, Evaluating, Analyzing, Applying, Understanding, and Remembering
The students will know: 1. The relationships among angles, radii, segments, lines, arcs and chords as related to circles. 2. The relationships between central and inscribed angles. 3. The properties of angles for an inscribed quadrilateral. 4. The relationship of angles and segments within and exterior to circles.	The students will be able to: 1. Understand and apply theorems about circles. 2. Find arc lengths and areas of sectors of circles. 3. Calculate various angles of a circle formed by chords, tangents, secant and radii. 4. Apply proportions to calculate segments of chords, tangents and secants.	During this unit of study, all levels will be used for multiple learning experiences.

5. How ratios and proportions can be used to determine lengths of segments within and exterior to circles.	5. Use coordinates to prove simple geometric theorems algebraically. 6. Apply theorems related to circles to solve real life problems.	

Big Ideas and Essential Questions

- **Big Ideas**

1. A circle is uniquely defined in the coordinate plane using its center and radius.
2. There is a constant proportional relationship between an angle and its arc measures on a circle.

- **Essential Questions**

1. How does geometry apply to circles in the coordinate plane?
2. What is the relationship between angles, lines and segments in circles?
3. What are the properties of inscribed and circumscribed triangles and inscribed quadrilaterals?

Part 3 – Common Unit Assessments

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Part 4 – Common/Assured Learning Experiences

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Part 5: Teacher Notes

Unit 7: Area, Surface Area and Volume

Grade:	**Subject:**	**Course:**	**Length of Unit:**
10	Geometry	College Geometry	1 Quarter

Common Core State Standards (Priority)

CCSS.MATH.CONTENT.6.G.A.4 Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

CCSS.MATH.CONTENT.7.G.B.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

CCSS.MATH.CONTENT.8.G.C.9 Know the formulas for the volumes of cones, cylinders and spheres and use them to solve real-world and mathematical problems.

CCSS.MATH.CONTENT.HSG.GMD.A.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Supporting Standards

CCSS.MATH.CONTENT.HSG.GMD.A.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.

CCSS.MATH.CONTENT.HSG.GMD.A.2 Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

CCSS.MATH.CONTENT.HSG.GMD.A.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

CCSS.MATH.CONTENT.HSG.MG.A.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).

CCSS.MATH.CONTENT.HSG.MG.A.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*

CCSS.MATH.CONTENT.HSG.MG.A.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

Key Content Knowledge and Concepts/Skills		**Bloom's Taxonomy Levels** Creating, Evaluating, Analyzing, Applying, Understanding, and Remembering
The students will know: 1. The difference between 1-D, 2-D and 3-D objects. 2. The relationship between area, surface area and volume formulas. 3. How nets represent three dimensional objects and their surface area.	The students will be able to: 1. Explain perimeter, area, surface area and volume formulas and use them accurately to solve problems. 2. Calculate compound area and area of shaded regions. 3. Visualize relationships between 2-D and 3-D objects. 4. Apply principles of surface area and volume to prisms, pyramids, cylinders, cones and spheres. 5. Use geometric shapes and their properties to describe and model a real world situation.	During this unit of study, all levels will be used for multiple learning experiences.

Big Ideas and Essential Questions

- **Big Ideas**
  1. Physical objects can be described using 1-D, 2-D and 3-D geometric objects.
  2. Three dimensional objects are composed of several two-dimensional shapes.

- **Essential Questions**
  1. How are midpoint and distance relevant to calculating the perimeter, circumference, and area?
  2. How do two-dimensional and three-dimensional objects relate to each other?
  3. How can we use geometric relationships to model the world and solve problems?

Part 3 – Common Unit Assessments

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Part 4 – Common/Assured Learning Experiences

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Part 5: Teacher Notes—UNIT 7