# Unit 01: Essentials of Geometry

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **5 Weeks**
Status: **Published**

## Unit 1: Essentials of Geometry

### Unit Rationale

In prior learning, students wrote and solved linear equations. They have used some geometric terms, and they have used the Pythagorean Theorem. In this unit, students will learn about the building blocks of geometry, including undefined terms, defined terms, axioms, and theorems. They will learn to measure and construct segments and angles, and then write and solve equations about segments and angles. They will find area and perimeter of polygons, then area and perimeter or irregular shapes. They will connect the Pythagorean Theorem with the distance formula to find distances on the coordinate plane. Then, they will learn about conditional and biconditional statements and inductive and deductive reasoning so that they can prove theorems, involving segments and angles. In later units, they will use this knowledge to transform geometric figures in the coordinate plane. They will also explore more proofs involving parallel and perpendicular lines and triangle congruence.

## Essential Questions

- How do we use the basic building blocks and tools of geometry to enhance further learning of geometric concepts?
- How can you use the coordinates of points to find the midpoint and distance between the points, and how can they help you classify polygons?
- What are the fundamental properties that define geometric shapes?
- How can geometric constructions with a compass and straightedge be used to explore properties of angles and lines?
- In what ways can the formulas for perimeter and area be generalized or applied to irregular polygons?
- How do we prove statements about lines and angles?

## Pre-Assessments

- Into Geometry: Are you ready?

## Instructional Plan

## Points, Lines, and Planes (1.1)

**Student Learning Intentions or We are learning to … (WALT)**

- We are learning to understand precise geometric notation, bisect a segment using a compass and straightedge, and apply the Midpoint Formula to solve problems in the coordinate plane involving distance.

**Student Success Criteria … "I can statements"**

- I can identify defined and undefined terms
- I can draw and name lines, line segments, and planes.
- I can copy and add segments

**Instructional Strategies and Activities**

- Into Geometry Spark Your Learning- TE p. 5D
- Guided Notes-
    - Vocabulary
    - Measure and add segments
    - Bisect a segment to find midpoint
    - Identify points and segments on the coordinate plane
- DeltaMath practice assignment
- Into Geometry Practice- TE p. 10

**Formative Assessments**

- Into Geometry Check Understanding- online activity

**Instructional Materials and Resources**

- Into Math resources
- DeltaMath
- Desmos

**Reflections and Suggested Modifications**

## Define and Measure Angles (1.2)

**Student Learning Intentions or We are learning to … (WALT)**

- We are learning to name and classify angles, measure and draw angles using a protractor, construct an angle bisector using a compass, and write and solve equations so that we can solve mathematical problems involving angle relationships.

**Student Success Criteria … "I can statements"**

- I can measure, draw, and name angles that meet certain given criteria.
- I can find the measure of a missing angle using concepts of angle relationships.
- I can copy and measure angles.

**Instructional Strategies and Activities**

- Into Geometry Spark Your Learning- TE p. 13D
- Guided Notes
    - Draw and name angles
    - Measure and classify angles
    - Bisect an angle
    - Analyze angle relationships
- DeltaMath practice assignment
- Into Geometry Practice- p. 18

**Formative Assessments**

- Into Geometry Check Your Understanding Interactive Lesson

**Instructional Materials and Resources**

- Into Math resources
- DeltaMath
- Desmos

**Reflections and Suggested Modifications**

## Polygons and Other Figures in the Plane (1.3)

**Student Learning Intentions or We are learning to … (WALT)**

- Find the perimeter and area of polygons so that I can solve real world applications.

**Student Success Criteria … "I can statements"**

- I can identify a closed figure in the plane.
- I can identify and draw polygons and non-polygons.
- I can identify and measure a polygon.

**Instructional Strategies and Activities**

- Into Geometry Spark Your Learning- TE p. 21 D
- Guided Notes
    - Understand the definition of a polygon
    - Classify polygons by the number of sides
    - Construct a regular polygon
    - Model to estimate area and perimeter
    - Prove the Pythagorean Theorem
- DeltaMath practice assignment
- Into Geometry Practice- p. 26

**Formative Assessments**

- Into Geometry Check Your Understanding Interactive Lesson

**Instructional Materials and Resources**

- Into Math resources
- DeltaMath
- Desmos

**Reflections and Suggested Modifications**

## Apply the Distance Formula (1.4)

**Student Learning Intentions or We are learning to … (WALT)**

- We are learning to find the perimeter and the area of a figure on the coordinate plane using the Distance Formula, and model irregular figures with simple polygons so that we can estimate perimeter and area.

**Student Success Criteria … "I can statements"**

- I can decompose figures into smaller shapes to find the area of a figure.
- I can estimate the area of irregular shapes on a coordinate grid.
- I can measure the distance between two points on the coordinate plane.

**Instructional Strategies and Activities**

- Into Geometry Spark Your Learning- TE p. 29D
- Guided Notes
    - Find area on the coordinate plane
    - Find length on the coordinate plane
    - Model area on the coordinate plane
- DeltaMath practice assignment
- Into Geometry Practice p. 33

**Formative Assessments**

- Into Geometry Check Your Understanding Interactive Lesson

**Instructional Materials and Resources**

- Into Math resources
- DeltaMath
- Desmos

**Reflections and Suggested Modifications**

## Write Conditional Statements (2.1)

**Student Learning Intentions or We are learning to … (WALT)**

- We are learning to write a conditional statement and related conditional statements, and determine whether the statements are true so that we can complete proofs.

**Student Success Criteria … "I can statements"**

- I can use counterexamples to prove a statement is false.
- I can identify the hypothesis and the conclusion of a statement.
- I can write conditional statements and related conditional statements.

**Instructional Strategies and Activities**

- Into Geometry Spark Your Learning- p. 41D
- Guided Notes
    - Make sketches from descriptions
    - Write related conditional statements

    - Write definitions as biconditional statements
    - Apply conditional statements in the real world
- DeltaMath practice assignment
- Into Geometry Practice p. 45

**Formative Assessments**

- Into Geometry Check Your Understanding Interactive Lesson

**Instructional Materials and Resources**

- Into Math resources
- DeltaMath
- Desmos

**Reflections and Suggested Modifications**

## Use Inductive and Deductive Reasoning (2.2)

**Student Learning Intentions or We are learning to … (WALT)**

- We are learning to differentiate between inductive and deductive reasoning so that we can apply deductive reasoning in the context of geometric proofs.

**Student Success Criteria … "I can statements"**

- I can understand the definitions of deductive reasoning and inductive reasoning.
- I can apply deductive reasoning in a mathematical context.

**Instructional Strategies and Activities**

- Into Geometry Spark Your Learning- p. TE 47D
- Guided Notes
    - Compare inductive and deductive reasoning
    - Apply properties of equality
    - Write a two column proof
- DeltaMath practice assignment
- Into Geometry Practice- TE p. 51

**Formative Assessments**

- Into Geometry Check Your Understanding Interactive Lesson

**Instructional Materials and Resources**

- Into Math resources
- DeltaMath
- Desmos

**Reflections and Suggested Modifications**

## Write Proofs about Lines (2.3)

**Student Learning Intentions or We are learning to … (WALT)**

- Use congruence and the Segment Addition Postulate to complete proofs about segments.

**Student Success Criteria … "I can statements"**

- I can recognize segment congruence in diagrams.
- I can use properties of segments to show congruence.

**Instructional Strategies and Activities**

- Into Geometry Spark Your Learning- TE p. 55D
- Guided Notes
    - Investigate properties of congruence
    - Use segment congruence in real world problems
    - Use the Segment Addition Postulate
    - Prove Segment Congruence
    - Apply algebra to ensure segment congruence
- DeltaMath practice assignment
- Into Geometry Practice

**Formative Assessments**

- Into Geometry Check Your Understanding Interactive Lesson

**Instructional Materials and Resources**

- Into Math resources
- DeltaMath
- Desmos

**Reflections and Suggested Modifications**

## Write Proofs about Angles (2.4)

**Student Learning Intentions or We are learning to … (WALT)**

- Apply proof concepts to situations and theorems involving angles so that we can prove theorems.

**Student Success Criteria … "I can statements"**

- I can recognize definitions and relations between lines and angles to solve problems involving missing measurements.
- I can use definitions and relations between lines and angles to prove theorems involving lines and angles.

**Instructional Strategies and Activities**

- Into Geometry Spark Your Learning- TE p. 63D
- Guided Notes
    - Analyze congruence and equal measure in a proof
    - Prove Congruent Supplements Theorem
    - Prove theorems about angles
- DeltaMath practice assignment
- Into Geometry Practice- p. 67

**Formative Assessments**

- Into Geometry Check Your Understanding Interactive Lesson

**Instructional Materials and Resources**

- Into Math resources
- DeltaMath
- Desmos

**Reflections and Suggested Modifications**

## Modifications and/or Accommodations

**Suggested Modifications (ELL, Sp. Ed, GIfted, At-risk of Failure)**

### English Language Learners

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing the students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

## Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

## Students with 504 Plans

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## Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

Modify/Change Activities:  Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

## Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next

day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.

## Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media Literacy

**Diversity, Equity, and Inclusion**

**NCTM: Access and Equity in Mathematics Education**

**A Pathway to Equitable Math Instruction**

Provide students with opportunities to give feedback to teachers about the classroom and instruction.

• Verbal Example: Fist to five, How well do you understand what we talked about today? Fist to five, How well did I teach this today?

• Classroom Activity: Exit tickets or surveys that ask students to identify how well teachers taught, what helped them learn, what got in the way of their learning, etc.

Treat mathematics as a language that everyone is learning while authentically centering students home languages.

• Classroom Strategies: Color-coding ideas, learning vocabulary in student languages, visual and kinesthetic learning, representations of learning without words.

• Classroom Activity: Multilingual Frayer Models for
definitions or concepts

Incorporate true culturally relevant pedagogy, practice, and curriculum.

• Verbal Example: What are some of your family traditions that you are proud of? Would you be okay if we brought some of those into the classroom?

• Classroom Activity: Use Ankara fabric to teach mathematical concepts such as tessellations, fractions, area, percentages, etc.

Incorporate the history of mathematics into lessons.
• Verbal Example: Why do you think we call it Pythagorean's theorem, when it was used before he was even born? What should we call it instead?
• Classroom Activity: Learn about different bases and numerical ideas: Base 2, binary and connections to

computer programming, how the Yoruba of Nigeria used base 20, and how the Mayans conceptualized the number 0 before the first recording of it

Solicit student ways of thinking and processing.
• Verbal Example: How might you all go about this? What do you notice?
• Classroom Activity: Incorporate explorations, where students interact with mathematics in a way that allows them to "discover" or experience mathematics.

Reorganize your classroom teaching around concepts, and teach them more like a web rather than discrete sets of knowledge.
• Verbal Example: How does this connect to what you've learned in the past? How can you use that knowledge today?
• Classroom Activity: Learning webs that connect content

Start with more complex math problems and scaffold as necessary.
• Verbal Example: If we wanted to build a rocket, what are all the things we might need to know before we get started? Along the way, we decided that we want the rocket to reach the moon. What do we need to consider now?
• Classroom Activity: When solving equations, start with the most complex problem, generate ideas for how to solve it, and use the simpler equations as examples to support those ideas.

Offer a variety of ways to demonstrate thinking and knowledge.
• Verbal Example: Show your thinking with words, pictures, symbols.

Ask other questions that will demonstrate learning when it is not clear to you how students know the answer.
• Verbal Example: If you were working with a fellow mathematician who was absent this day, what might you tell them to help them learn it?

Learn about, engage with, and incorporate ethnomathematics.
• Verbal Example: Reflect on your day so far. What math have you already used today?
• Classroom Activity: Community walks to engage with slope.

Co-construct knowledge in the classroom.
• Verbal Example: Let's get into partners and do a think pair-share. We will incorporate everyone's ideas and try to synthesize them.
• Classroom Activity: Have students create mathematical definitions in their own words in groups, and bring the groups together to co-construct mathematical definitions as a class

Choose problems that have complex, competing, or multiple answers.
• Verbal Example: Come up with at least two answers that might solve this problem.
• Classroom Activity: Challenge standardized test questions by getting the "right" answer, but justify other answers by unpacking the assumptions that are made in the problem.
• Classroom Activity: Deconstructed Multiple Choice
- given a set of multiple choice answers, students discuss why these answers may have been included (can also be used to highlight common mistakes).

Identify what is right about the thinking, and highlight the mistake in what is factually or procedurally accepted.
• Verbal Example: You recognized that you had to combine the constants 27 and 9, could you explain your thinking?
• Classroom Activity: Error Analysis worksheets that highlight what is the right idea behind the mistake.

Using thoughtful questioning to solicit mathematical thoughts rather than telling.

• Verbal Example: What would a mathematician who is confused ask about this question?

• Classroom Activity: After students demonstrate knowledge of a topic, have them play a game where they have to explain their topic to a fellow mathematician and a skeptic. Develop their own reflective questioning/explaining in all three roles.

Create multiple ways of participating that honor myriad ways of thinking and being.
• Verbal Example: For this section, feel free to work alone, in pairs, trios, or quads (let them choose).
• Classroom Activity: Community circles or storytelling circles, incorporating dance, music, song, call and response, and other cultural ways of communicating.

**Climate Change**

Math Climate Change Companion Guide

• G.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).
Climate Change Example: Students may apply the concept of population density of different urban areas, including calculations of population density, and discuss different environmental factors (e.g., air and water quality, waste disposal, energy consumption) that might be exacerbated by increased population density.

## New Jersey Student Learning Standards: Content Area

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|---|---|
| MATH.9-12.G.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. |
| MATH.9-12.G.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. |
| MATH.9-12.G.CO.D.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. |
| MATH.9-12.G.GPE.B.7 | Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. |
| MATH.9-12.G.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). |
| MATH.9-12.G.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). |

## Integration of Career Readiness, Life Literacies and Key Skills

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|---|---|
| TECH.9.4.12.CI.1 | Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a). |
| TECH.9.4.12.CI.2 | Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8). |
| TECH.9.4.12.CI.3 | Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1). |
| TECH.9.4.12.CT.1 | Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3). |
| TECH.9.4.12.CT.2 | Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a). |
| TECH.9.4.12.TL.2 | Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. |
| TECH.9.4.12.TL.3 | Analyze the effectiveness of the process and quality of collaborative environments. |

## Integration of Computer Science and Design Thinking

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|---|---|
| CS.9-12.8.1.12.AP.1 | Design algorithms to solve computational problems using a combination of original and existing algorithms. |
| CS.9-12.8.1.12.AP.5 | Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects. |

## Interdisciplinary Connections: NJSLS for ELA, Social Studies, Science and/or Math

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|---|---|
| ELA.RI.MF.9–10.6 | Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as |

| | |
|---|---|
| | well as in words in order to address a question or solve a problem. |
| ELA.W.AW.9–10.1.E | Provide a concluding paragraph or section that supports the argument presented. |
| | Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. |

## 21st Century Life and Career

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|---|---|
| TECH.8.1.12.A.3 | Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue. |
| TECH.8.1.12.A.CS2 | Select and use applications effectively and productively. |