# Unit 02 - Reasoning & Proofs

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 1**
Length: **4-5 weeks**
Status: **Published**

## Brief Summary of Unit

In this chapter, students will achieve and exhibit with excellence with how to recognize the hypothesis and conclusion of an if-then statement (as well as its converse), use properties of algebra and congruence in proofs, apply definitions and theorems in proofs, and plan proofs and write them in a two-column format as well as paragraph form.

**Revision Date**: July 2024

## Standards

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| 9.2.12.CAP.3 | Investigate how continuing education contributes to one's career and personal growth. |
| 9.2.12.CAP.6 | Identify transferable skills in career choices and design alternative career plans based on those skills. |
| L.KL.9–10.2.A | Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level. |
| 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. |
| 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. |
| G.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. |
| G.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. |
| SL.PE.11–12.1.A | Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. |

## Essential Questions

- How are inductive reasoning and deductive reasoning similar? How are they different?
- How are properties of equality different than properties of congruence?
- Is there always strictly one way to write a proof?
- What are the four forms a statement can be written?
- What are the various algebraic properties used in proof writing?
- What information does a proof always start with? What information does a proof always end with?
- When is possible for an answer to be always, sometimes, or never regarding postulates of diagrams?

## Enduring  Understandings

- Interpret and sketch diagrams using real world context.
- Prove geometric relationships using properties, theorems, postulates, and corollaries.
- Prove statements about segments and angles using various applications such as triangles, circles, etc.
- Understand and write conditional statements to analyze geometric problems and proofs.
- Use inductive and deductive reasoning to analyze geometric problems and proofs.
- Use properties of equality to solve geometric and algebraic problems.

## Students Will Know

- How to explain postulates using diagrams.
- How to justify steps using algebraic reasoning.
- How to prove geometric relationships.
- Inductive and deductive reasoning.

## Students Will Be Skilled At

- Determining if conditional statements are true by using truth tables.
- Distinguishing between inductive and deductive reasoning.
- Explaining the structure of a two-column proof.
- Identifying algebraic properties of equality.
- Identifying postulates represented by diagrams.
- Identifying the properties of congruence.
- Interpreting a diagram.
- Proving geometric relationships by writing flowchart proofs.
- Proving geometric relationships by writing paragraph proofs.
- Sketching a diagram given a verbal description.
- Using algebraic properties of equality to solve equations.
- Using deductive reasoning to verify conjectures.
- Using inductive reasoning to make conjectures.

- Using properties of equality to solve for geometric measures.
- Writing a two-column proof.
- Writing biconditional statements.
- Writing conditional statements.

## Evidence/Performance Tasks

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: DeltaMath or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, and DeltaMath

- Answer essential questions
- Class discussion of daily topic
- Classwork and homework that assess the essential questions
- Provide alternative means of assessments for certain students
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Written assignments that assess the essential questions that involves providing explanations

## Learning Plan

The following list is meant to create a day-to-day plan. Teachers are encouraged to slow down or condense days as appropriate to the student population in the class. Assessment(s) should be given when appropriate.

- Begin by introducing a conditional statement and its parts. Emphasize the different ways conditional statements can be written, as well as negation. Then connect to how to write a conditional statement's converse, inverse, and contrapositive. Once these are established, give examples that will lead students to conclude biconditional statements exist. (For advanced students, introduce truth tables for conditional, converse, inverse, and contrapositive statements.)
- Students typically need a lot of help when making conjectures and what that exactly means. First, allow students to discuss inductive reasoning, so that they can adjust to searching for a pattern. To help with this, introduce counterexamples.
- On a separate day, layer in deductive reasoning. Students should be able to notice the conceptual meaning of the previous lesson compared to the "hard facts" of this lesson. Use the Laws of Detachment and Syllogism to help with this concept.
- Students will likely need additional time to practice both types of reasoning and listing out

biconditional, conditional, converse, inverse, and contrapositive statements.

- Introduce postulates referring to points, lines, and planes. Encourage students to draw diagrams of each, in multiple colors when possible. This is also a good time to introduce the logical conclusions "always, sometimes, never" to determine how true some statements are when using these postulates.
- Remind students of their algebraic properties, including distributive and substitution properties. Extend into reflexive, symmetric, and transitive properties. Introduce proofs by structuring a solved equation using these properties. When possible, show students that you can solve these equations multiple ways, and therefore the proofs would be slightly changed.
- Formalize the concept of a proof by beginning to weave in the postulates about segments, angles, etc. Introduce the theorems that refer to reflexive, symmetric, and transitive congruence.
- Students will likely need additional time to practice the beginning concept of a proof. Encourage students to brainstorm together to see if there are various ways to prove what is needed.
- Introduce theorems referring to complementary and supplementary angles of congruence. Continue to use other angle relationships within proofs. (For advanced students, introduce the format of a flow chart and how it can help organize thoughts better than a two-column proof.)

## Materials

Core instructional materials: Core Book List including Big Ideas Math Common Core Geometry

Supplemental materials: Khan Academy, Edia, DeltaMath

- District approved textbook
- Khan Academy
- SMART Board
- Teacher created activiites
- Teacher created notes
- Whiteboard tables

## Suggested Strategies for Modifications

Possible accommodations/modification for Geometry