

01 Constructions & Transformations

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **4 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

Math Lab is designed to support students and cultivate favorable attitudes towards mathematics. This course fosters conceptual understanding and procedural fluency of important content through relevant meaningful mathematical experiences while accommodating for the speed at which students learn. Math Lab encourages and develops problem-solving ability and critical thinking skills. Students will have access to resources that reinforce the curriculum and help to increase mastery of knowledge and skills. Small group instruction will encourage the discovery of mathematical content and support students' efforts to learn and achieve in their study of mathematics.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives:

In this unit, students first informally explore geometric properties using straightedge and compass constructions. This allows them to build conjectures and observations before formally defining rotations, reflections, and translations. In middle school, students studied transformations of figures in the coordinate plane. In this unit, they transition to more formal definitions that don't rely on the coordinate plane, and the focus shifts from transforming whole figures towards a more point-by-point analysis. Students then begin to use the rigorous definitions they developed to prove statements involving angles and distances, preparing them for congruence proofs in the next unit. (IM)

Essential Questions:

- Why are point and line considered undefined terms?
- How are the concepts of rigid motions and congruence related?
- How can you determine if two figures are congruent to one another?
- What constitutes a "geometric construction"?

Enduring Understandings:

- The structure of Geometry is based on a set of undefined terms and well defined manipulations of points, lines, and planes
- The notion of congruence can be based on concept of rigid motions/transformations
- Formal constructions can be used to study and analyze properties of figures and relationships among figures.

CONTENT AREA STANDARDS

MA.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.
MA.G-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).
MA.G-CO.A.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
MA.G-CO.A.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
MA.G-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.
MA.G-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.
MA.G-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.
MA.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.).

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

CS.K-12.1.a	Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.
CS.K-12.2.b	Create team norms, expectations, and equitable workloads to increase efficiency and effectiveness.
CS.K-12.2.c	Solicit and incorporate feedback from, and provide constructive feedback to, team members and other stakeholders.
CS.K-12.2.d	Evaluate and select technological tools that can be used to collaborate on a project.
CS.K-12.3.a	Identify complex, interdisciplinary, real-world problems that can be solved computationally.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.
CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
LA.RH.9-10.4	Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history and the social sciences; analyze the cumulative impact of specific word choices on meaning and tone.

LA.RH.9-10.5	Analyze how a text uses structure to emphasize key points or advance an explanation or analysis.
LA.RH.9-10.7	Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text, to analyze information presented via different mediums.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.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.
LA.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.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.6	Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

STUDENT LEARNING TARGETS

Plot coordinates located in each quadrant and on the x and y axis.

Determine which quadrant a coordinate lies in.

Graph horizontal and vertical lines

Graph a linear equation in the form $y = mx + b$

Graph a line parallel to another line through a specific point

Graph a line perpendicular to another line through a specific point

State the slope of a line that is parallel to and perpendicular to a given linear equation.

Identify when an image has been reflected over a line, rotated about a point, or translated.

Perform multiple rigid motions to transform an image to a desired location.

Identify multiple rigid motions that were applied, to describe the change in location of an image.

Identify congruent segments and angles from the original location of an image to a new position.

Apply and identify rules used to translate images in both horizontal and vertical positions.

Apply and identify rules used to reflect images over the x, y axis, over the line $y = x$, $y = -x$

Apply and identify rules used to rotate images about the origin 90° , 180° and 270°

Declarative Knowledge

Students will understand that:

- Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment

Procedural Knowledge

Students will be able to:

- Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure.
- Represent transformations in a plane.
- Develop definitions of rotations, reflections, and translations.
- Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotation and reflections that carry it onto itself.
- Specify a sequence of transformations that will carry a given figure onto another.
- Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- 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.
- Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure.

EVIDENCE OF LEARNING

Formative Assessments

- Student feedback/questioning/observation
- Error analysis
- Specific skill assessment/questions
- Survey/polling

- Task completion and review of quizzes and material presented in the Geometry class

Summative Assessments

There will be no formal assessments in this course.

RESOURCES (Instructional, Supplemental, Intervention Materials)

NJ DOE Model Curriculum unit: [Congruence, Proof & Constructions](#)

Illustrative Mathematics unit: [Constructions and Rigid Transformations](#)

Khan Academy Unit: [Performing Transformations](#)

NJCTL Unit: [Transformations](#) ; [Points, Lines, and Planes](#) ;

Patty Paper demonstrations and practice [Multiple Transformations Tutorial](#)

Tesselations Tutorials [Translations](#) [Rotations](#) [Reflections](#)

Desmos Activities: [Coordinate Practice](#) [Parallel and Perpendicular Lines Practice](#) [Translations Practice](#)
[Reflections Practice](#) [Rotational Practice](#)

Constructions tutorials: <https://mathopenref.com/tocs/constructionstoc.html>

Kuta Software worksheets

Approved course textbook

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations taken from business, physics, engineering, biology, statistics, geography, and numerous other fields. Examples can be found in topic specific textbook problems and digital resources.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.