Unit 3, Trigonometry & Similar Triangles

Content Area: **Math**
Course(s): **Geometry H**
Time Period: **JanFeb**
Length: **45 Days, Grades 9,10**
Status: **Published**

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Geometry H, Grade 9,10

Trigonometry and Similarity

Belleville Board of Education

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Board Approved:September 23, 2019

Unit Overview

In this unit students will expand their knowledge of right triangles and understand their importance in analytic geometry and trigonometry. Angle measures and side lengths of right triangles will be found using trigonometric ratios. Real world applications of right triangles will be explored and applied in construction, landscaping, architecture, aviation and surveying.

Enduring Understanding

Identify similar polygons and use ratios and proportions to solve problems.

Recognize and use proportional parts, corresponding perimeters, altitudes, angle bisectors, and medians of similar triangles to solve problems.

Solve problems using the geometric mean, the Pythagorean Theorem, and its converse.

Use trigonometric ratios to solve right triangle problems.

Name, draw, and recognize figures that have been reflected, translated, rotated, or dilated.

Identify and create different types of tessellations.

Find the magnitude and direction of vectors and perform operations on vectors.

Essential Questions

What are the extremes and means of a proportion?

Are two polygons that are congruent also similar? Why?

How is indirect measurement useful in real world applications?

How would you explain the Triangle Proportionality Theorem to a fellow student who was absent today?

What does the angle bisector in a triangle do?

Why can you discard the negative root when finding the altitude or geometric mean?

What can the converse of the Pythagorean Theorem help you determine?

What are the side relationships in 45-45-90 and 30-60-90 triangles?

Under what circumstance would you use the sine ratio? The cosine ratio? The tangent ratio?

What is the difference between the angle of depression and the angle of elevation?

How do you identify the point of symmetry?

How do you translate an image on a coordinate plane?

What is the relationship between the angle of rotation and the angle formed by the intersecting lines when rotating an image by reflection in intersecting lines?

In order to tessellate, what can you say must be true about the angle of the regular polygon?

What would the result of a negative scale factor?

What is a real-world example of when you would find the magnitude of a resultant vector using the Pythagorean Theorem?

Exit Skills

By the end of this Unit students will know:

How to write ratios.

How to use properties of proportions.

How to identify similar figures.

How to solve problems involving scale factors.

How to identify similar triangles.

How to use similar triangles to solve problems.

How to use proportional parts of triangles.

How to divide a segment into parts.

How to recognize and use proportional relationships of corresponding perimeters of similar triangles.

Recognize and use proportional relationships of corresponding angle bisectors, altitudes, and medians of similar triangles.

How to find the geometric mean between two numbers.

How to solve problems involving relationships between parts of a right triangle and the altitude to its hypotenuse.

How to use the Pythagorean Theorem

How to use the converse of the Pythagorean Theorem.

How to use properties of 45-45-90 triangles.

How to use properties of 30-60-90 triangles.

How to find trigonometric ratios using right triangles.

How to solve problems using trigonometric ratios.

How to solve problems involving angles of elevation.

How to solve problems involving angles of depression.

New Jersey Student Learning Standards (NJSLS)

MA.K-12.1	Make sense of problems and persevere in solving them.
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.K-12.2	Reason abstractly and quantitatively.
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.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.G-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.
MA.G-SRT.A.3	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
MA.G-SRT.B	Prove theorems involving similarity
MA.G-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.
MA.G-SRT.C.7	Explain and use the relationship between the sine and cosine of complementary angles.
MA.G-SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
MA.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).
MA.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).
MA.G-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).

Interdisciplinary Connections

LA.RL.9-10.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
9.3.ST-ET.1	Use STEM concepts and processes to solve problems involving design and/or production.
9.3.ST-SM.2	Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

9-12.HS-PS1-4.2	Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
9-12.HS-PS1-3.3	Planning and Carrying Out Investigations
9-12.HS-PS2-4.5	Mathematical and computational thinking at the 9–12 level builds on K–8 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.

Learning Objectives

Identify and classify triangles by angles.

Identify and classify triangles by sides.

Apply the Angle Sum Theorem.

Apply the Exterior Angle Theorem.

Determine, identify, and label corresponding parts of congruent triangles.

Identify congruence transformations.

Use the SSS, SAS, ASA, AAS to test for triangle congruence.

Use the HL Theorem to test for triangle congruence.

Use and apply properties of isosceles triangles .

Use and apply properties of equilateral triangles.

Identify and use perpendicular bisectors and angle bisectors in triangles.

Identify and use medians and altitudes in triangles.

Recognize and apply properties of inequalities to the measures of angles of a triangle.

Use indirect proof with geometry.

Use and apply the Triangle Inequality Theorem.

Determine the shortest distance between a point and a line.

Apply the SAS Inequality.

Apply the SSS Inequality.

Determine the sum of the measures of the interior angles of a polygon.

Determine the sum of the measures of the exterior angles of a polygon.

Recognize and apply properties of the sides and angles of parallelograms.

Recognize and apply properties of diagonals of parallelograms.

Recognize the conditions that ensure a quadrilateral is a parallelogram.

Prove that a set of points forms a parallelogram in the coordinate plane.

Recognize and apply properties of rectangles.

Determine whether parallelograms are rectangles.

Recognize and apply properties of rhombi and squares.

Recognize and apply properties of trapezoids.

Solve problems involving medians of trapezoids.

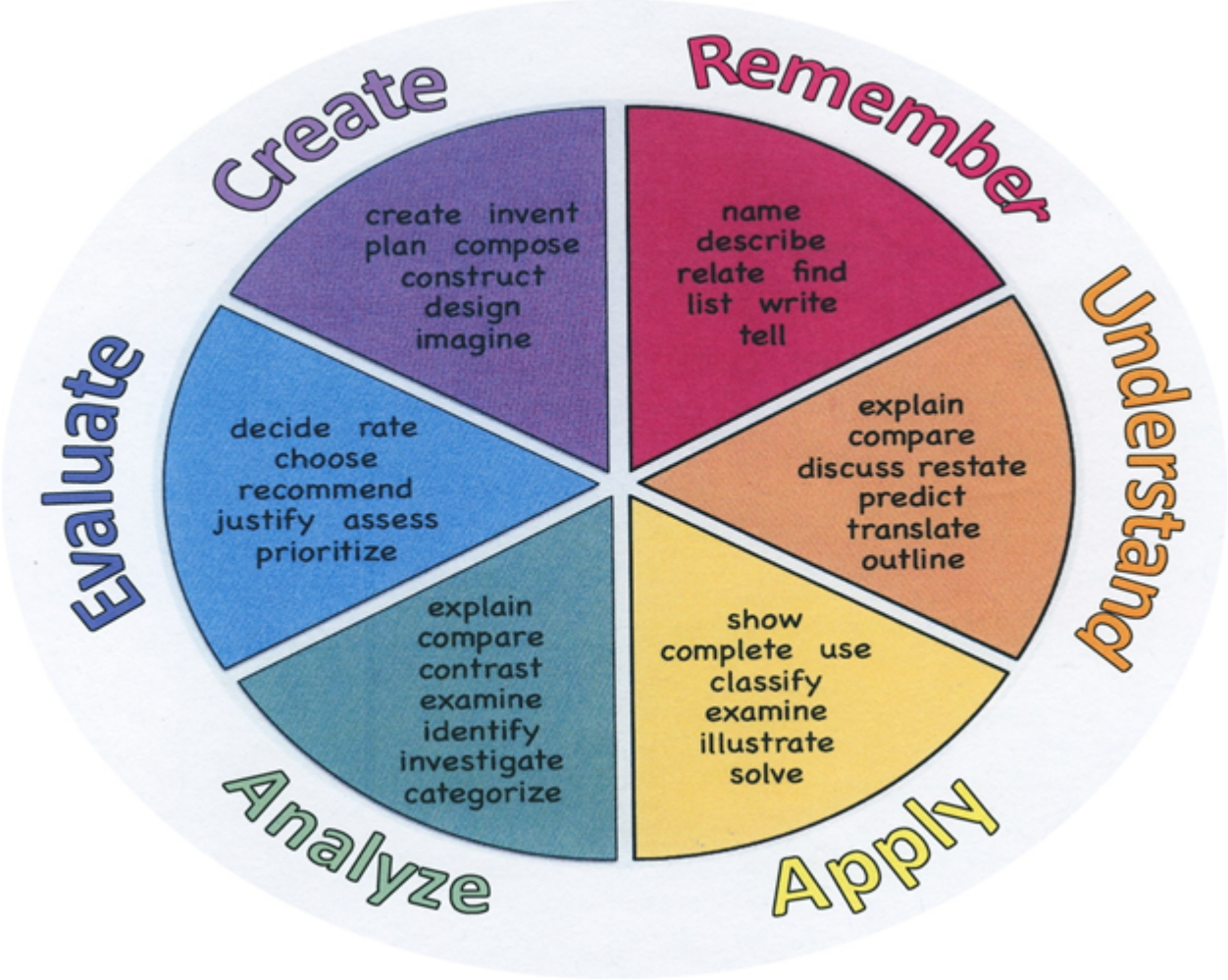
Position and label quadrilaterals for the use in coordinate planes.

Prove theorems using coordinate proofs.

Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize
Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive

Outline Point Quote Recall Recognize Repeat Reproduce	Represent Restate Rewrite Select Show Summarize Tell Translate Associate Compute Convert Discuss Estimate Extrapolate Generalize Predict	Calculate Change Classify Complete Compute Discover Divide Examine Graph Interpolate Manipulate Modify Operate Subtract	Diagram Discriminate Illustrate Outline Point out Separate	Support Test	Devise Generate Integrate Prescribe Propose Reconstruct Revise Rewrite Transform



Suggested Activities & Best Practices

Textbook, eAssessment, supplemental materials:

https://my.mheducation.com/login

AI Assessment and Learning System:

https://www.aleks.com/

Mindset:

https://www.youtube.com/watch?v=3icoSeGqQtY

http://www.youcubed.org/wp-content/uploads/Positive-Classroom-Norms2.pdf

Coaching Corner:

https://sites.google.com/belleville.k12.nj.us/thecoachingcorner/home

Videos:

https://www.mathantics.com/

https://mashupmath.com/high-school-math-lessons

Constructions:

http://www.mathopenref.com/tocs/constructionstoc.html

Geometry Activities:

https://math.rice.edu/~lanius/Geom/

Geogebra:

https://www.geogebra.org/a/7?lang=en

Desmos:

https://teacher.desmos.com/activitybuilder/custom/5664e067eb08d9501576caa0

Kahoot:

https://create.kahoot.it/

Assessment Evidence - Checking for Understanding (CFU)

Glencoe McGraw Hill : Chapter Asssessments, Midchapter Assessments (Summative) - https://connected.mcgraw-hill.com/c2j/assetBuckets.assess.do?bookId=DFRTR2RBH9YT25W7OSMM6J3XM1&selectedCategoryId=3KTMO6D7VZ6SJ4YD3XNOQB3O44

EAssessment test generator (Summative): https://assess.k12.mhedu.com/Instructor/TestGenerator.aspx

Edulastic Formative Assessment (Formative)s: https://app.edulastic.com/#renderResource/close/Mjk0MjE2ODUwOA%3D%3D

Common benchmarks on OnCourse (Benchmark)

"Do Now/Exit Ticket" Activity (Formative)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's

- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

Primary Resources & Materials

Glencoe McGraw-Hill Geometry 2014

Practice Glencoe Geometry

Study Guide Glencoe Geometry

Ancillary Resources

ALEKS

The Glencoe Personal Tutor Plus

The Glencoe Personal Tutor Plus(Spanish)

Kutasoftware Geometry

Technology Infusion

Create and have students complete exit tickets using Edulastic
{ https://app.edulastic.com/#renderResource/close/Mjk0MjE2ODUwOA%3D%3D } or Google forms

Create classes on Google classroom and post assignments, monitor student progress, and offer feedback.

Use geogebra to model problems.

Technology that may be infused into this unit to enhance learning may include

- Youtube
- Khan academy
- Google Classroom
- GSuite
- Kutasoftware
- PodCasts
- Skype
- Twitter
- Ted Talks
- ALEKS
- QR Barcode Generator
- Calculator/Graphing calculator
- Flipgrid
- Peardeck
- Edulastic
- McGraw-Hill Education
- Desmos.com
- Geogebra.org

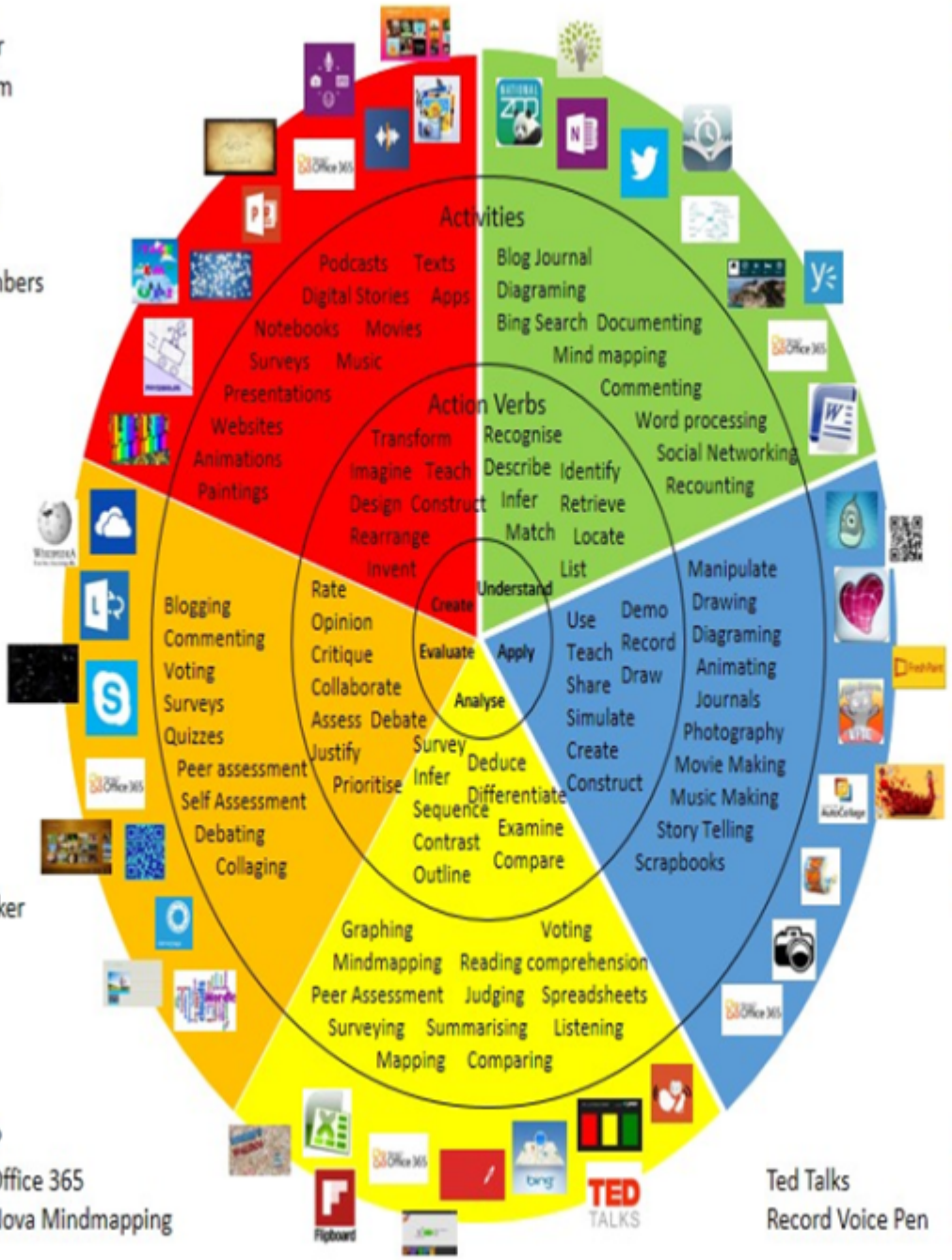
Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker

Where's Waldo?
MS Excel
Flipboard
Office 365
Nova Mindmapping

Ted Talks
Record Voice Pen



Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

Alignment to 21st Century Skills & Technology

Develop mathematical thinking using real world problems in the Glencoe Interactive Student Guide Workbook

Mastery and infusion of **21st Century Skills & Technology** and their Alignment to the core content areas is essential to student learning. The core content areas include:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- Technology;
- Visual and Performing Arts.

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.
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.F.CS1	Identify and define authentic problems and significant questions for investigation.

21st Century Skills/Interdisciplinary Themes

Glencoe -McGrawHill Resources:

Chapter Projects - Map Your Town, Scientific Method,Function of Lines in Construction, Classifying Triangles, Architecture:Triangular Design, Game Time, Picture This Photography &Tesselations, Graduation Planning, Time or Rebound

- Communication and Collaboration

- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

Differentiation

Glencoe-McGrawHill Resources:

Chapter Openers Animation

Student Anticipation Guide

Student Anticipation Guide(Spanish)

Teaching with Foldables

Math Triumphs: Foundations for Geometry

Interactive Student Guide

Personal Tutor

Personal Tutuor (Spanish)

Kutasoftware Geometry

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments

- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping

- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

Glencoe-McGrawHill Resources:

Chapter Openers Animation

Student Anticipation Guide

Teaching with Foldables

Math Triumphs: Foundations for Geometry

Personal Tutor

Kutasoftware Geometry

Interactive Student Notebooks

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Glencoe-McGrawHill Resources:

Chapter Openers Animation

Student Anticipation Guide(English & Spanish)

Teaching with Foldables

Math Triumphs: Foundations for Geometry

Interactive Student Guide

Personal Tutuor (English and Spanish)

Kutasoftware Geometry

Khan Academy - Geometria Spanish Website

https://es.khanacademy.org/math/geometry-home

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

Glencoe-McGrawHill Resources:

Chapter Projects

Chapter Openers Animation

Student Anticipation Guide

Student Anticipation Guide(Spanish)

Teaching with Foldables

Math Triumphs: Foundations for Geometry

Interactive Student Guide

Personal Tutor

Personal Tutuor (Spanish)

Kutasoftware Geometry

Khan Academy Geometry Lessons

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

Glencoe-McGrawHill Resources:

Chapter Openers Animation

Student Anticipation Guide

Student Anticipation Guide(Spanish)

Teaching with Foldables

Interactive Student Guide

Personal Tutor

Personal Tutuor (Spanish)

Math Forum

Kutasoftware Geometry

Khan Academy Lessons

SAT/ACT practice problems

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

Using the template below, please develop a **Sample Lesson** for the first unit only.

Unit Name:

NJSLS:

Interdisciplinary Connection:

Statement of Objective:

Anticipatory Set/Do Now:

Learning Activity:

Student Assessment/CFU's:

Materials:

21st Century Themes and Skills:

Differentiation/Modifications:

Integration of Technology: