MATHEMATICS

Geometry: Unit 1
Course Philosophy/Description

Geometry stresses the ability to reason logically and to think critically, using spatial sense. A major part of the course will be devoted to teaching the student how to present a formal proof. Geometric properties of both two and three dimensions are emphasized as they apply to points, lines, planes, and solids. In this course, students learn to recognize and work with geometric concepts in various contexts. They build on ideas of inductive and deductive reasoning, logic, concepts, and techniques of Euclidean plane and solid geometry and develop an understanding of mathematical structure, method, and applications of Euclidean plane and solid geometry. Students use visualizations, spatial reasoning, and geometric modeling to solve problems. Topics of study include points, lines, and angles; triangles; quadrilaterals and other polygons; circles; coordinate geometry; three-dimensional solids; geometric constructions; symmetry; similarity; and the use of transformations.

Upon successful completion of this course, students will be able to: Use and prove basic theorems involving congruence and similarity of figures; determine how changes in dimensions affect perimeter and area of common geometric figures; apply and use the properties of proportion; perform basic constructions with straight edge and compass; prove the Pythagorean Theorem; use the Pythagorean Theorem to determine distance and find missing dimensions of right triangles; know and use formulas for perimeter, circumference, area, volume, lateral and surface area of common figures; find and use measures of sides, interior and exterior angles of polygons to solve problems; use relationships between angles in polygons, complementary, supplementary, vertical and exterior angle properties; use special angle and side relationships in special right triangles; understand, apply, and solve problems using basic trigonometric functions; prove and use relationships in circles to solve problems; prove and use theorems involving properties of parallel lines cut by a transversal, quadrilaterals and circles; write geometric proofs, including indirect proofs; construct and judge validity of logical arguments; prove theorems using coordinate geometry including the midpoint of a segment and distance formula; understand transformations in the coordinate plane; construct logical verifications to test conjectures and counterexamples; and write basic mathematical arguments in paragraph and statement-reason form.
ESL Framework

This ESL framework was designed to be used by bilingual, dual language, ESL and general education teachers. Bilingual and dual language programs use the home language and a second language for instruction. ESL teachers and general education or bilingual teachers may use this document to collaborate on unit and lesson planning to decide who will address certain components of the SLO and language objective. ESL teachers may use the appropriate leveled language objective to build lessons for ELLs which reflects what is covered in the general education program. In this way, whether it is a pull-out or push-in model, all teachers are working on the same Student Learning Objective connected to the New Jersey Student Learning Standard. The design of language objectives are based on the alignment of the World-Class Instructional Design Assessment (WIDA) Consortium’s English Language Development (ELD) standards with the New Jersey Student Learning Standards (NJSLS). WIDA’s ELD standards advance academic language development across content areas ultimately leading to academic achievement for English learners. As English learners are progressing through the six developmental linguistic stages, this framework will assist all teachers who work with English learners to appropriately identify the language needed to meet the requirements of the content standard. At the same time, the language objectives recognize the cognitive demand required to complete educational tasks. Even though listening and reading (receptive) skills differ from speaking and writing (expressive) skills across proficiency levels the cognitive function should not be diminished. For example, an Entering Level One student only has the linguistic ability to respond in single words in English with significant support from their home language. However, they could complete a Venn diagram with single words which demonstrates that they understand how the elements compare and contrast with each other or they could respond with the support of their native language with assistance from a teacher, para-professional, peer or a technology program.

http://www.state.nj.us/education/modelcurriculum/ela/ELLOverview.pdf
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<td>Points, Lines, and Planes.</td>
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<td>2</td>
<td>Measuring and Constructing Segments.</td>
<td>G-CO.A.1, G-CO.D.12</td>
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<td>3</td>
<td>Using Midpoint and Distance Formulas.</td>
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<td>Describing Pairs of Angles.</td>
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<td>G-CO.C.9, G-CO.C.10, G-CO.C.11, G-SRT.B.4</td>
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Instruction: 8 weeks
Assessment: 1 week
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<th></th>
<th>Topic</th>
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<tr>
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<td>G-CO.C.9, G-CO.D.12</td>
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Research about Teaching and Learning Mathematics

Structure teaching of mathematical concepts and skills around problems to be solved (Checkly, 1997; Wood & Sellars, 1996; Wood & Sellars, 1997)
Encourage students to work cooperatively with others (Johnson & Johnson, 1975; Davidson, 1990)
Use group problem-solving to stimulate students to apply their mathematical thinking skills (Artzt & Armour-Thomas, 1992)
Students interact in ways that support and challenge one another’s strategic thinking (Artzt, Armour-Thomas, & Curcio, 2008)
Activities structured in ways allowing students to explore, explain, extend, and evaluate their progress (National Research Council, 1999)
There are three critical components to effective mathematics instruction (Shellard & Moyer, 2002):

- Teaching for conceptual understanding
- Developing children’s procedural literacy
- Promoting strategic competence through meaningful problem-solving investigations

Teachers should be:

- Demonstrating acceptance and recognition of students’ divergent ideas.
- Challenging students to think deeply about the problems they are solving, extending thinking beyond the solutions and algorithms required to solve the problem
- Influencing learning by asking challenging and interesting questions to accelerate students’ innate inquisitiveness and foster them to examine concepts further.
- Projecting a positive attitude about mathematics and about students’ ability to “do” mathematics

Students should be:

- Actively engaging in “doing” mathematics
- Solving challenging problems
- Investigating meaningful real-world problems
- Making interdisciplinary connections
- Developing an understanding of mathematical knowledge required to “do” mathematics and connect the language of mathematical ideas with numerical representations
- Sharing mathematical ideas, discussing mathematics with one another, refining and critiquing each other’s ideas and understandings
- Communicating in pairs, small group, or whole group presentations
- Using multiple representations to communicate mathematical ideas
- Using connections between pictures, oral language, written symbols, manipulative models, and real-world situations
- Using technological resources and other 21st century skills to support and enhance mathematical understanding
Mathematics is not a stagnate field of textbook problems; rather, it is a dynamic way of constructing meaning about the world around us, generating knowledge and understanding about the real world every day. Students should be metaphorically rolling up their sleeves and “doing mathematics” themselves, not watching others do mathematics for them or in front of them. (Protheroe, 2007)

**Balanced Mathematics Instructional Model**

Balanced math consists of three different learning opportunities; guided math, shared math, and independent math. Ensuring a balance of all three approaches will build conceptual understanding, problem solving, computational fluency, and procedural fluency. Building conceptual understanding is the focal point of developing mathematical proficiency. Students should frequently work on rigorous tasks, talk about the math, explain their thinking, justify their answer or process, build models with graphs or charts or manipulatives, and use technology.

When balanced math is used in the classroom it provides students opportunities to:

- solve problems
- make connections between math concepts and real-life situations
- communicate mathematical ideas (orally, visually and in writing)
- choose appropriate materials to solve problems
- reflect and monitor their own understanding of the math concepts
- practice strategies to build procedural and conceptual confidence

Teacher builds conceptual understanding by modeling through demonstration, explicit instruction, and think alouds, as well as guiding students as they practice math strategies and apply problem solving strategies. (whole group or small group instruction)

Students practice math strategies independently to build procedural and computational fluency. Teacher assesses learning and reteaches as necessary. (whole group instruction, small group instruction, or centers)

Teacher and students practice mathematics processes together through interactive activities, problem solving, and discussion. (whole group or small group instruction)
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<td>Asking Assessing and Advancing Questions</td>
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<td>Pressing for Accuracy and Reasoning</td>
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<td>Maintain the Cognitive Demand</td>
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Educational Technology

Standards

8.1.12.B.2, 8.1.12.C.1, 8.2.12.B.4

➢ Creativity and Innovation
  ● Apply previous content knowledge by creating a piloting a digital learning game or tutorial.

  Example: Using Prezzi or Power point, students will use their knowledge to create a tutorial on how to identify lines of symmetry when performing rotations and/or reflections on rectangles, parallelograms, trapezoids and regular polygons.

➢ Communication and Collaboration
  ● Develop an innovative solution to a real-world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.

  Example: Students will be able to explain and recognize why particular combinations of corresponding parts establish congruence and why others do not through Google classroom. Students can present their solutions and communicate through this platform.

➢ Technology and Society
  ● Investigate a technology used in a given time period of history, e.g. stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.

  Example: Students can use graph paper and tracing paper to identify a sequence of transformations required in order to map one figure onto another and then compare it to how they can use dynamic geometric software. Students can discuss how the technology has changed over time and how each was beneficial for specific time periods.
Career Ready Practices

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

- **CRP2. Apply appropriate academic and technical skills.**
  Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.

  **Example:** Students will apply prior knowledge when solving real-world problems. Students will make sound judgments about the use of specific tools, such as compass and straightedge, string, reflective devices, folding paper, and dynamic geometric software, to explore and deepen understanding of making formal constructions to show congruence, creating geometric figures, etc.

- **CRP4. Communicate clearly and effectively and with reason.**
  Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others’ time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

  **Example:** Students will on a daily basis communicate their reasoning behind their solution paths by making connections to the context and the quantities, using proper vocabulary, along with decontextualizing and/or contextualizing the problem. Students will use rigid transformations to determine and explain congruence of geometric figures. They will also explain the meaning behind the quantities and units involved. Students will also ask probing questions to clarify and improve arguments.
Career Ready Practices

- **CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.**
  Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

  **Example:** Throughout their daily lessons, students will understand the meaning of a problem and look for entry points into solving their problems by analyzing the relationships of the quantities, constraints and goals of the task. Plans for solution paths will be made and have meaning. Students will self-monitor, evaluate and critique their process and progress as they are working and make changes as necessary.

- **CRP12. Work productively in teams while using cultural global competence.**
  Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

  **Example:** Students will work in collaborative and whole group settings to develop various solutions to math tasks that are presented to them. They will work together to understand the terms of the problem, ask clarifying and challenging questions among each other, and develop agreed upon solutions using a variety of strategies and models. Students will listen to, read and discuss arguments with each other with respect and courtesy at all times and will be willing to assist those that may need assistance. Students will demonstrate and explain to a peer or small group how they developed formal definitions of rotations, reflections and translations.
WIDA Proficiency Levels

At the given level of English language proficiency, English language learners will process, understand, produce or use

<table>
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<tr>
<th>Level</th>
<th>Proficiency Description</th>
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| 6- Reaching | - Specialized or technical language reflective of the content areas at grade level  
- A variety of sentence lengths of varying linguistic complexity in extended oral or written discourse as required by the specified grade level  
- Oral or written communication in English comparable to proficient English peers |
| 5- Bridging | - Specialized or technical language of the content areas  
- A variety of sentence lengths of varying linguistic complexity in extended oral or written discourse, including stories, essays or reports  
- Oral or written language approaching comparability to that of proficient English peers when presented with grade level material. |
| 4- Expanding | - Specific and some technical language of the content areas  
- A variety of sentence lengths of varying linguistic complexity in oral discourse or multiple, related sentences or paragraphs  
- Oral or written language with minimal phonological, syntactic or semantic errors that may impede the communication, but retain much of its meaning, when presented with oral or written connected discourse, with sensory, graphic or interactive support |
| 3- Developing | - General and some specific language of the content areas  
- Expanded sentences in oral interaction or written paragraphs  
- Oral or written language with phonological, syntactic or semantic errors that may impede the communication, but retain much of its meaning, when presented with oral or written, narrative or expository descriptions with sensory, graphic or interactive support |
| 2- Beginning | - General language related to the content area  
- Phrases or short sentences  
- Oral or written language with phonological, syntactic, or semantic errors that often impede the communication when presented with one to multiple-step commands, directions, or a series of statements with sensory, graphic or interactive support |
| 1- Entering | - Pictorial or graphic representation of the language of the content areas  
- Words, phrases or chunks of language when presented with one-step commands directions, WH-, choice or yes/no questions, or statements with sensory, graphic or interactive support |
# Language Development Supports For English Language Learners

To Increase Comprehension and Communication Skills

## Environment

- Welcoming and stress-free
- Respectful of linguistic and cultural diversity
- Honors students' background knowledge
- Sets clear and high expectations
- Includes routines and norms
- Is thinking-focused vs. answer-seeking
- Offers multiple modalities to engage in content learning and to demonstrate understanding
- Includes explicit instruction of specific language targets
- Provides participation techniques to include all learners

- Integrates learning centers and games in a meaningful way
- Provides opportunities to practice and refine receptive and productive skills in English as a new language
- Integrates meaning and purposeful tasks/activities that:
  - Are accessible by all students through multiple entry points
  - Are relevant to students' lives and cultural experiences
  - Build on prior mathematical learning
  - Demonstrate high cognitive demand
  - Offer multiple strategies for solutions
  - Allow for a language learning experience in addition to content

## Sensory Supports*

- Real-life objects (realia) or concrete objects
- Physical models
- Manipulatives
- Pictures & photographs
- Visual representations or models such as diagrams or drawings
- Videos & films
- Newspapers or magazines
- Gestures
- Physical movements
- Music & songs

## Graphic Supports*

- Graphs
- Charts
- Timelines
- Number lines
- Graphic organizers
- Graphing paper

## Interactive Supports*

- In a whole group
- In a small group
- With a partner such as *Turn-and-Talk*
- In pairs as a group (first, two pairs work independently, then they form a group of four)
- In triads
- Cooperative learning structures such as *Think-Pair-Share*
- Interactive websites or software
- With a mentor or coach

## Verbal and Textual Supports

- Labeling
- Students' native language
- Modeling
- Repetitions
- Paraphrasing
- Summarizing
- Guiding questions
- Clarifying questions
- Probing questions
- Leveled questions such as *What? When? Where? How? Why?*
- Questioning prompts & cues
- Word Banks
- Sentence starters
- Sentence frames
- Discussion frames
- Talk moves, including *Wait Time*

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# BUILDING EQUITY IN YOUR TEACHING PRACTICE

How do the essential questions highlight the connection between the big ideas of the unit and equity in your teaching practice?

## CONTENT INTEGRATION
Teachers use examples and content from a variety of cultures & groups.

- This unit / lesson is connected to other topics explored with students.
- There are multiple viewpoints reflected in the content of this unit / lesson.
- The materials and resources are reflective of the diverse identities and experiences of students.
- The content affirms students, as well as exposes them to experiences other than their own.

## KNOWLEDGE CONSTRUCTION
Teachers help students understand how knowledge is created and influenced by cultural assumptions, perspectives & biases.

- This unit / lesson provides context to the history of privilege and oppression.
- This unit / lesson addresses power relationships.
- This unit / lesson help students to develop research and critical thinking skills.
- This curriculum creates windows and mirrors* for students.

## PREJUDICE REDUCTION
Teachers implement lessons and activities to assert positive images of ethnic groups & improve intergroup relations.

- This unit / lesson help students question and unpack biases & stereotypes.
- This unit / lesson help students examine, research and question information and sources.
- The curriculum encourage discussion and understanding about the groups of people being represented.
- This unit / lesson challenges dominant perspectives.

## EQUITABLE PEDAGOGY
Teachers modify techniques and methods to facilitate the academic achievement of students from diverse backgrounds.

- The instruction has been modified to meet the needs of each student.
- Students feel respected and their cultural identities are valued.
- Additional supports have been provided for students to become successful and independent learners.
- Opportunities are provided for student to reflect on their learning and provide feedback.

## EMPOWERING SCHOOL CULTURE
Using the other four dimensions to create a safe and healthy educational environment for all.

- There are opportunities for students to connect with the community.
- My classroom is welcoming and supportive for all students?
- I am aware of and sensitive to the needs of my students and their families.
- There are effective parent communication systems established. Parents can talk to me about issues as they arise in my classroom.

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Culturally Relevant Pedagogy Examples

- **Integrate Relevant Word Problems:** Contextualize equations using word problems that reference student interests and cultures.
  
  **Example:** When learning about the definitions of angle, circle, perpendicular line, parallel line, and line segment, incorporate problems that relate to student interests such as music, sports and art enable the students to understand and relate to the concept in a more meaningful way.

- **Everyone has a Voice:** Create a classroom environment where students know that their contributions are expected and valued.
  
  **Example:** Norms for sharing are established that communicate a growth mindset for mathematics. All students are capable of expressing mathematical thinking and contributing to the classroom community. Students learn new ways of looking at problem solving by working with and listening to each other.

- **Run Problem Based Learning Scenarios:** Encourage mathematical discourse among students by presenting problems that are relevant to them, the school and/or the community.
  
  **Example:** Using a Place Based Education (PBE) model, students explore math concepts while determining ways to address problems that are pertinent to their neighborhood, school or culture.

- **Encourage Student Leadership:** Create an avenue for students to propose problem solving strategies and potential projects.
  
  **Example:** Students can deepen their understanding of rotations, reflections, and translations by creating problems together and deciding if the problems fit the necessary criteria. This experience will allow students to discuss and explore their current level of understanding.

- **Present New Concepts Using Student Vocabulary:** Use student diction to capture attention and build understanding before using academic terms.
  
  **Example:** Teach math vocabulary in various modalities for students to remember. Use multi-modal activities, analogies, realia, visual cues, graphic representations, gestures, pictures and cognates. Directly explain and model the idea of vocabulary words having multiple meanings. Students can create the Word Wall with their definitions and examples to foster ownership.
SOCIAL AND EMOTIONAL LEARNING (SEL) COMPETENCIES

SELF-AWARENESS
The ability to accurately recognize one’s own emotions, thoughts, and values and how they influence behavior. The ability to accurately assess one’s strengths and limitations, with a well-grounded sense of confidence, optimism, and a “growth mindset.”
- Identifying Emotions
- Accurate Self-Perception
- Recognizing Strengths
- Self-confidence
- Self-efficacy

SOCIAL AWARENESS
The ability to take the perspective of and empathize with others, including those from diverse backgrounds and cultures. The ability to understand social and ethical norms for behavior and to recognize family, school, and community resources and supports.
- Perspective-taking
- Empathy
- Appreciating Diversity
- Respect for Others

RESPONSIBLE DECISION-MAKING
The ability to make constructive choices about personal behavior and social interactions based on ethical standards, safety concerns, and social norms. The realistic evaluation of consequences of various actions, and a consideration of the well-being of oneself and others.
- Identifying Problems
- Analyzing Situations
- Solving Problems
- Evaluating
- Reflecting
- Ethical Responsibility

SELF-MANAGEMENT
The ability to successfully regulate one’s emotions, thoughts, and behaviors in different situations — effectively managing stress, controlling impulses, and motivating oneself. The ability to set and work toward personal and academic goals.
- Impulse Control
- Stress Management
- Self-Discipline
- Self-Motivation
- Goal Setting
- Organizational Skills

RELATIONSHIP SKILLS
The ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups. The ability to communicate clearly, listen well, cooperate with others, resist inappropriate social pressure, negotiate conflict constructively, and seek and offer help when needed.
- Communication
- Social Engagement
- Relationship Building
- Teamwork

Diagram:
- Self-Awareness
- Social Awareness
- Relationship Skills
- Responsible Decision-Making
- Self-Management
- Social and Emotional Learning
- Homes and Communities
- Schools
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<th>SEL Competency</th>
<th>Examples</th>
<th>Content Specific Activity &amp; Approach to SEL</th>
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<tr>
<td>✓ Self-Awareness</td>
<td><strong>Example practices that address Self-Awareness:</strong>&lt;br&gt;• Clearly state classroom rules&lt;br&gt;• Provide students with specific feedback regarding academics and behavior&lt;br&gt;• Offer different ways to demonstrate understanding&lt;br&gt;• Create opportunities for students to self-advocate&lt;br&gt;• Check for student understanding / feelings about performance&lt;br&gt;• Check for emotional wellbeing&lt;br&gt;• Facilitate understanding of student strengths and challenges</td>
<td>Encourage students to articulate their thoughts by restating the problem in their own words or by describing to you what they know about the scenario and the question(s) being asked. Acknowledge any student frustrations with the task and remind them that frustration is normal when working with a challenging task. Ask students to identify their own personal interest, strengths, and weaknesses in math. Encourage them to use mathematical representations to elaborate (for example, “I am good at graphing transformations but struggle with showing and explaining that two triangles are congruent using corresponding pairs of sides and corresponding pairs of angles, and by using rigid motions.”)</td>
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<td>Self-Management Social-Awareness Relationship Skills Responsible Decision-Making</td>
<td><strong>Example practices that address Self-Management:</strong>&lt;br&gt;• Encourage students to take pride/ownership in work and behavior&lt;br&gt;• Encourage students to reflect and adapt to classroom situations&lt;br&gt;• Assist students with being ready in the classroom&lt;br&gt;• Assist students with managing their own emotional states</td>
<td>Have students brainstorm ways to motivate themselves and self-monitor. Use fraction bars and other linear diagrams to represent their learning targets (e.g., mood thermometers or progress lines). Discuss your own self-motivation techniques that keep you going when you want to give up. Practicing how to make tough decisions can help your students learn how their actions affect others. Give your students real-life application problems in which they would have to make an important choice. Have them write down their answer to each situation by themselves, then discuss their answers as a</td>
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<td>Self-Awareness</td>
<td>Example practices that address Social-Awareness:</td>
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| Self-Management | • Encourage students to reflect on the perspective of others  
| ✓ Social-Awareness | • Assign appropriate groups  
| Relationship Skills | • Help students to think about social strengths  
| Responsible Decision-Making | • Provide specific feedback on social skills  
| | • Model positive social awareness through metacognition activities | During the first week of school, work collaboratively with students to establish shared classroom rules, expectations and consequences so that students can see the impact of their own actions and behaviors on outcomes. |

Tell stories about famous mathematicians who showed respect for each other within the discipline (e.g., Blaise Pascal and Pierre de Fermat) to demonstrate to students how to listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve their arguments.

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<th>Self-Awareness</th>
<th>Example practices that address Relationship Skills:</th>
<th>Use cooperative learning and project-based learning to provide students with frequent opportunities to develop and routinely practice communication, social, and assertive skills. Ask students to explain their partner’s reasoning to you. Frequent check-ins with students establish “perspective taking” as the classroom norm.</th>
</tr>
</thead>
</table>
| Self-Management | • Engage families and community members  
| ✓ Relationship Skills | • Model effective questioning and responding to students  
| Social-Awareness | • Plan for project-based learning  
| Responsible Decision-Making | • Assist students with discovering individual strengths  
| | • Model and promote respecting differences  
| | • Model and promote active listening  
| | • Help students develop communication skills  
<p>| | • Demonstrate value for a diversity of opinions | Implement the use of a group rubric for students to complete for group activities or projects. Students should reflect after working together on how well the group works together, follows the lead of others, supports each person in the group, provides structure, and supports ideas. |</p>
<table>
<thead>
<tr>
<th>Self-Awareness</th>
<th>Example practices that address Responsible Decision-Making:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Management</td>
<td>• Support collaborative decision making for academics and behavior</td>
</tr>
<tr>
<td>Social-Awareness</td>
<td>• Foster student-centered discipline</td>
</tr>
<tr>
<td>Relationship Skills</td>
<td>• Assist students in step-by-step conflict resolution process</td>
</tr>
<tr>
<td><strong>✓ Responsible Decision-Making</strong></td>
<td>• Foster student independence</td>
</tr>
<tr>
<td></td>
<td>• Model fair and appropriate decision making</td>
</tr>
<tr>
<td></td>
<td>• Teach good citizenship</td>
</tr>
</tbody>
</table>

Have students use their understanding of point, line and distance around a circular arc to create definitions for angles, circles, parallel lines, perpendicular lines and line segments.

Teach and model for students how to make a decision about which tool to use (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.) to make formal constructions.
## Differentiated Instruction

Accommodate Based on Students Individual Needs: Strategies

<table>
<thead>
<tr>
<th>Time/General</th>
<th>Processing</th>
<th>Comprehension</th>
<th>Recall</th>
</tr>
</thead>
</table>
| - Extra time for assigned tasks  
- Adjust length of assignment  
- Timeline with due dates for reports and projects  
- Communication system between home and school  
- Provide lecture notes/outline | - Extra Response time  
- Have students verbalize steps  
- Repeat, clarify or reword directions  
- Mini-breaks between tasks  
- Provide a warning for transitions  
- Partnering | - Precise processes for balanced math instructional model  
- Short manageable tasks  
- Brief and concrete directions  
- Provide immediate feedback  
- Small group instruction  
- Emphasize multi-sensory learning | - Teacher-made checklist  
- Use visual graphic organizers  
- Reference resources to promote independence  
- Visual and verbal reminders  
- Graphic organizers |

<table>
<thead>
<tr>
<th>Assistive Technology</th>
<th>Tests/Quizzes/Grading</th>
<th>Behavior/Attention</th>
<th>Organization</th>
</tr>
</thead>
</table>
| - Computer/whiteboard  
- Tape recorder  
- Video Tape | - Extended time  
- Study guides  
- Shortened tests  
- Read directions aloud | - Consistent daily structured routine  
- Simple and clear classroom rules  
- Frequent feedback | - Individual daily planner  
- Display a written agenda  
- Note-taking assistance  
- Color code materials |
Differentiated Instruction

Accommodate Based on Content Specific Needs

- Teacher modeling of thinking processes necessary to determine a series of transformations
- Pre-teach vocabulary using visual models that are connected to real-life situations
- Word wall with visual representations of geometric terms
- Calculator to assist with computations
- Reference sheets that list step-by-step procedures for transformations
- Graph paper, tracing paper, cut out shapes, reflection mirrors or geometry software to represent images or pre-images as a result of dilations, rotations, reflections and translations
- Highlight and label the solution steps for multi-step problems in different colors
- Utilize technology through interactive sites to explore Plane Geometry, Constructions, and Coordinate Geometry
  
  www.mathopenref.com  https://www.geogebra.org/

- Use compass and straightedge, string, reflective devises, or paper folding to perform formal constructions and identify the congruencies underlying each construction
Interdisciplinary Connections

Model interdisciplinary thinking to expose students to other disciplines.

Art Connection:
Name of Task: Paper Cutting (1.3.12.D.2)
- This task uses lines of symmetry to demonstrate how they can be used in the art of paper cutting.

ELA Connection:
Name of Tasks: Defining Parallel lines (RL.10.4)
- This task asks students to analyze definitions: Are they mathematically sound, complete, accurate, confusing? This challenges students to look at the concepts more closely and understand how important definitions are.

Architecture and Construction Career Connection:
Name of Task: Horizontal Stretch of the Plane (9.3.ST-ET.5 and 9.3.ST-SM-2)
- This task asks students to look at the effect of horizontal stretch on an image.
Enrichment

What is the Purpose of Enrichment?

- The purpose of enrichment is to provide extended learning opportunities and challenges to students who have already mastered, or can quickly master, the basic curriculum. Enrichment gives the student more time to study concepts with greater depth, breadth, and complexity.
- Enrichment also provides opportunities for students to pursue learning in their own areas of interest and strengths.
- Enrichment keeps advanced students engaged and supports their accelerated academic needs.
- Enrichment provides the most appropriate answer to the question, “What do you do when the student already knows it?”

Enrichment is…

- Planned and purposeful
- Different, or differentiated, work – not just more work
- Responsive to students’ needs and situations
- A promotion of high-level thinking skills and making connections within content
- The ability to apply different or multiple strategies to the content
- The ability to synthesize concepts and make real world and cross-curricular connections
- Elevated contextual complexity
- Sometimes independent activities, sometimes direct instruction
- Inquiry based or open-ended assignments and projects
- Using supplementary materials in addition to the normal range of resources
- Choices for students
- Tiered/Multi-level activities with flexible groups (may change daily or weekly)

Enrichment is not…

- Just for gifted students (some gifted students may need intervention in some areas just as some other students may need frequent enrichment)
- Worksheets that are more of the same (busywork)
- Random assignments, games, or puzzles not connected to the content areas or areas of student interest
- Extra homework
- A package that is the same for everyone
- Thinking skills taught in isolation
- Unstructured free time
Assessments

**Required District/State Assessments**
- Unit Assessment
- NJSLA
- SGO Assessments

**Suggested Formative/Summative Classroom Assessments**
- Describe Learning Vertically
- Identify Key Building Blocks
- Make Connections (between and among key building blocks)
- Short/Extended Constructed Response Items
- Multiple-Choice Items (where multiple answer choices may be correct)
- Drag and Drop Items
- Use of Equation Editor
- Quizzes
- Journal Entries/Reflections/Quick-Writes
- Accountable talk
- Projects
- Portfolio
- Observation
- Graphic Organizers/Concept Mapping
- Presentations
- Role Playing
- Teacher-Student and Student-Student Conferencing
- Homework
**New Jersey State Learning Standards**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.CO.A.1</td>
<td>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.</td>
</tr>
<tr>
<td>G.CO.C.9</td>
<td>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.</td>
</tr>
<tr>
<td>G.CO.C.10</td>
<td>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.</td>
</tr>
<tr>
<td>G.CO.C.11</td>
<td>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.</td>
</tr>
<tr>
<td>G.CO.D.12</td>
<td>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.</td>
</tr>
<tr>
<td>G.GPE.B.5</td>
<td>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.</td>
</tr>
<tr>
<td>G.GPE.B.6</td>
<td>Find the point on a directed line segment between two given points that partitions the segment in a given ratio.</td>
</tr>
<tr>
<td>G.GPE.B.7</td>
<td>Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.</td>
</tr>
<tr>
<td>G.MG.A.1</td>
<td>Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).</td>
</tr>
<tr>
<td>G.SRT.B.4</td>
<td>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.</td>
</tr>
</tbody>
</table>
Mathematical Practices

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.
|----------|--------------|--------------------------------------------------------------------------------|

**NJSLS:**

**Unit Focus:**

- Points, Lines, and Planes
- Measuring and Constructing Segments
- Using Midpoint and Distance Formulas
- Perimeter and Area in the coordinate Plane
- Measuring and Constructing Angles
- Describing Pairs of Angles
- Conditional Statements
- Inductive and Deductive Reasoning
- Postulates and Diagrams
- Algebraic Reasoning
- Proving Statements about Segments and Angles
- Proving Geometric Relationships
- Pairs of Lines and Angles
- Parallel Lines and Transversals
- Proofs with Parallel and Perpendicular Lines
- Equations of Parallel and Perpendicular Lines
New Jersey Student Learning Standard(s):

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.

Student Learning Objective 1: Points, Lines, and Planes.

Modified Student Learning Objectives/Standards:

M.EE.G-CO.1. Know the attributes of perpendicular lines, parallel lines, and line segments; angles; and circles.

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 4</td>
<td>G-CO.1</td>
<td>Name points, lines, and planes. Name segments and rays. Sketch intersections of lines and planes. Solve real-life problems involving lines and planes. Use point, line, distance along a line and/or distance around a circular arc to give a precise definition of the following: • Angle • circle (the set of points that are the same distance from a single point - the center) • perpendicular line (two lines are perpendicular if an angle formed by the two lines at the point of intersection is a right angle) • parallel lines (distinct lines that have no point in common) • and line segment Identify, name and represent points, lines,</td>
<td>How can you use dynamic geometry software to visualize geometric concepts? What are the undefined terms in geometry and why are they undefined? Can you use these undefined terms to define angles, circles, parallel lines and line segments? What are the building blocks of geometry and how are they used?</td>
<td>Type I: Defining Parallel Lines Type II, III: Defining Perpendicular Lines Ferris Wheel Dilations and Distances Fixed Points of Rigid Motions Horizontal Stretch of the Plane.</td>
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</tr>
</tbody>
</table>
segments, rays and planes.

Apply basic facts, postulates and theorems about points, lines and planes.

Engage students to investigate more closely the definition that shapes are congruent when they have the same size and shape.

In earlier grades, students experimented with transformations in the plane. They will now build more precise definitions for the rigid motions (rotation, reflection and translation) based on their previously understood terms, such as point, line, between angle, circle, perpendicular, etc.

**PED Strategies:**
Pre-teach vocabulary using visual and verbal models that are connected to real life situations.

Encourage students to maintain a reference notebook for Geometry by providing them with notes or guiding them in notetaking.

**ELL Strategies:**
Build knowledge from real world examples.

Find the distance from one corner of the classroom to the opposite corner.
New Jersey Student Learning Standard(s):

**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.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.

**Student Learning Objective 2:** Measuring and Constructing Segments.

**Modified Student Learning Objectives/Standards:**

**M.EE.G-CO.1.** Know the attributes of perpendicular lines, parallel lines, and line segments; angles; and circles.

<table>
<thead>
<tr>
<th>MPs</th>
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<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 3</td>
<td>G-CO.D Make and understand geometric constructions as detailed in G-CO.D</td>
<td>Use the Ruler Postulate. Copy segments and compare segments for congruence. Use the Segment Addition Postulate.</td>
<td>How can you measure and construct a line segment?</td>
<td>Type I:</td>
</tr>
<tr>
<td>MP 5</td>
<td></td>
<td>Copy and discuss the Core Concept. Students should be familiar with congruent segments (and angles) from middle school.</td>
<td>What special marks are used to show that segments are congruent?</td>
<td>Ferris Wheel</td>
</tr>
</tbody>
</table>
| MP 6  | i) About 75% of tasks align to G.CO.12.                                                              | Copy and discuss the Segment Addition Postulate. Example 4 suggests that the three cities lie approximately in a straight line. This does not mean that vehicular travel would be a straight line, but weather fronts could be.  
   - Use actual maps or electronic maps to demonstrate the Segment Addition Postulate. | How do you know if two segments are congruent?                                                   | Type II, III:                             |
|       | ii) Tasks may include requiring students to justify steps and results of a given construction.       |                                                                                                  | What does it mean when two segments are congruent?                                                 | Dilations and Distances                |
|       |                                                                                                      |                                                                                                  | What does the verb postulate mean?                                                                  | Fixed Points of Rigid Motions          |
|       |                                                                                                      |                                                                                                  |                                                                                                     | Horizontal Stretch of the Plane.       |
**SPED Strategies:**

Pre-teach vocabulary using visual and verbal models that are connected to real life situations.

Provide students with hands on opportunities to explore and extend their understanding of measuring and constructing segments by using transparencies, graph paper, dry erase markers, cut out shapes.

Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics.

Encourage students to add this concept to their reference notebook by providing notes or guiding notetaking.

**ELL Strategies:**

Provide visual cues, graphic representations, gestures, and pictures. Use the smart board software to visualize the rotations and translations.

Build knowledge from real world examples. Measuring and constructing the segments. The scale distance in a local map.
New Jersey Student Learning Standard(s):

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.

G.GPE.B.7: Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

Student Learning Objective 3: Using Midpoint and Distance Formulas.

Modified Student Learning Objectives/Standards:

M.EE.G-GPE.7: Find perimeters and areas of squares and rectangles to solve real-world problems.

<table>
<thead>
<tr>
<th>MPs</th>
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<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
</table>
| MP 2 MP 5 | G-CO.D Make and understand geometric constructions as detailed in G-CO.D  
   i) About 75% of tasks align to G.CO.12.  
   ii) Tasks may include requiring students to justify steps and results of a given construction. | Find segment lengths using midpoints and segment bisectors. Use the Midpoint Formula. Use the Distance Formula.  
If students have paper-folded to find the midpoint in Exploration 1, change the context.  
You want to find the midpoint of something that cannot be folded, like the diagonal of a picture frame. You have a straightedge (not a ruler) and paper. Explain how to find the midpoint.  
Pose the problem and have students work with their partners to solve. Solving an equation with variables on both sides should be a secure skill for students. | How can you find the midpoint and length of a line segment in a coordinate plane?  
What is the easiest way to find the midpoint?  
How is the midpoint formula derived?  
How do you find the midpoint when given the other point? | Type II, III:  
Squares on a coordinate grid  
Triangle Perimeters  
Bisecting an angle |
SPED Strategies:

Review the meaning of midpoint and use visual and verbal models to demonstrate how to find midpoint in different situations.

Model the thinking and processes necessary to find the midpoint by using the distance formulas. Encourage students to add this concept to their reference notebook by providing notes or guiding notetaking.

ELL Strategies:

Provide visual cues, graphic representations, gestures, and pictures. Use the smart board software to visualize the find the midpoint, using distance formulas.

Use graph paper and ruler to determine and explain congruence of geometric figures.

New Jersey Student Learning Standard(s):
**G.GPE.B.7:** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.

**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).

**Student Learning Objective 4:** Perimeter and Area in the Coordinate Plane.

**Modified Student Learning Objectives/Standards:**

**M.EE.G-GPE.7:** Find perimeters and areas of squares and rectangles to solve real-world problems.

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 1 MP 3 MP 6</td>
<td>G-Int.1 Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in G-MG and G-GPE.7.</td>
<td>Classify polygons. Find perimeters and areas of polygons in the coordinate plane. To find the perimeter of a polygon in the coordinate plane, you need to find the length of each side. To find the area of a polygon, it is necessary to deconstruct the polygon into polygons of which you know how to find the area. The (mostly Greek) numerical prefixes for polygons are likely familiar to students. They may have heard the 7-sided polygon called a <em>septagon</em>, from the Latin prefix “septua-,” “Hepta-” is the Greek prefix for seven. The suffix “-gon” is from the Greek meaning <em>angles</em>. Interestingly, <em>trilateral</em> and <em>quadrilateral</em> are Latin. • Note concave polygons are defined as <em>not</em> being convex. This may be students’ first experience with a definition that, instead of defining what it is, defines what it is not.</td>
<td>How can you find the perimeter and area of a Polygon in a coordinate plane? How can you use a coordinate plane to solve perimeter and area problems? What does perimeter and area have in common? Can the perimeter be the same as the area?</td>
<td>Type II, III: Squares on a coordinate grid Triangle Perimeters Hexagonal Pattern of Beehives How many cells are in the human body How many leaves on a tree How thick is a soda can Variation Solar Eclipse</td>
</tr>
</tbody>
</table>
Students should be familiar with concave lenses and spoons.

• To quickly check for understanding, ask students to sketch a convex hexagon, concave octagon, and concave triangle (not possible). Use *Popsicle Sticks* to select students to share their work at the board.

**SPED Strategies:**
Pre-teach vocabulary using visual and verbal models that are connected to real life situations and ensure that students include these definitions their reference notebook.

Provide students with clues to remember the definitions and know the differences between the terms/concepts. Encourage students to verbalize their thinking while working in small groups by asking assessing and advancing questions. Use this information to tailor instruction to student needs.

**ELL Strategies:**
Provide visual cues, graphic representations, gestures, and pictures to generate definitions by induction.

Draw polygon figures using graph paper, ruler, and/or geometry software and identify the coordinate the polygon. Find perimeter and area of the polygon.

**New Jersey Student Learning Standard(s):**

<table>
<thead>
<tr>
<th>The Lighthouse Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet Roll</td>
</tr>
</tbody>
</table>
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.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.

**Student Learning Objective 5:** Measuring and Constructing Angles.

**Modified Student Learning Objectives/Standards:**

M.EE.G-CO.1. Know the attributes of perpendicular lines, parallel lines, and line segments; angles; and circles.

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 3 MP 6</td>
<td>G-CO.D Make and understand geometric constructions as detailed in G-CO.D i) About 75% of tasks align to G.CO.12. ii) Tasks may include requiring students to justify steps and results of a given construction.</td>
<td>Name angles. Measure and classify angles. Identify congruent angles. Use the Angle Addition Postulate to find angle measures. Bisect angles. Sketch a figure similar to Example 1. Have partner A share what he/she knows about naming angles. Use Popsicle Sticks and ask a partner B to share with the class how to name angles. Have student’s paper-fold the angle bisector of an angle. Show an aerial view of the runways at an airport. Number the angles formed by different Run ways to facilitate students being able to reference them more easily. Ask students to make a list of pairs of angles and then state the relationships between each pair of angles. Do</td>
<td>How can you measure and classify an angle? How do you measure angles in construction? What are the 7 types of angles? What is the symbol for angle?</td>
<td>Type II, III: Similar circles Angle bisection and midpoints of line segments Bisecting an angle Construction of perpendicular bisector Origami regular octagon</td>
</tr>
</tbody>
</table>
not specify the measures of the angles.

**SPED Strategies:**

Model the thinking and processes necessary to understand measuring and constructing the angles.

Provide students with hands on opportunities to explore and extend their understanding by using available tools such as calculators, graph paper, dry erase markers.

**ELL Strategies:**

Embed links to websites for additional knowledge.

Provide Math word bank and math reference sheet /translated/copied for students.

Have students conduct activities in small groups, pairs/triads and share discuss solutions.

| Reflected Triangles |  |  |
New Jersey Student Learning Standard(s):

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.

Student Learning Objective 6: Describing Pairs of Angles.

Modified Student Learning Objectives/Standards:

M.EE.G-CO.1. Know the attributes of perpendicular lines, parallel lines, and line segments; angles; and circles.

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 3</td>
<td>G-CO.1</td>
<td>Identify complementary and supplementary angles. Identify linear pairs and vertical angles. Write the Core Concept and draw sketches to support the definitions. Note that complementary and supplementary angles do not need to be adjacent. Their relationship is a matter of measurement, not position. Understand angles are very important. A common question from students will be why vertical angles are called vertical instead of opposite. Also confusing to students is the use of vertical to describe the orientation of being upright, and yet the position of vertical angles can be horizontal! Searching online or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>How can you describe angle pair relationships and use these descriptions to find angle measures? How do pairs of angles help me understand real world problems? How can I effectively prove theorems involving lines, angles, triangles and parallelograms?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type II, III: Defining Parallel Lines Defining Perpendicular Lines Similar circles</td>
<td></td>
</tr>
</tbody>
</table>
In math history books, there are different explanations for the origin of the term *vertical angles*.

**SPED Strategies:**

Model the thinking and processes necessary to understand pairs of angles.

Provide students with hands on opportunities to explore and extend their understanding by using available tools such as calculators, graph paper, dry erase markers.

**ELL Strategies:**

Embed links to websites for additional knowledge.

Provide Math word bank and math reference sheet/translated/copied for students.

Have students conduct activities in small groups, pairs/triads and share discuss solutions.
**New Jersey Student Learning Standard(s):**

**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.CO.C.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.

**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.

**Student Learning Objective 7:** Conditional Statements.

**Modified Student Learning Objectives/Standards: N/A**

<table>
<thead>
<tr>
<th>MPs</th>
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<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 5</td>
<td><strong>HS.C.14.2</strong></td>
<td>Write conditional statements. Use definitions written as conditional statements. Write biconditional statements. Make truth tables. Write the <em>Core Concept</em>, paying attention to the words and the symbols.</td>
<td>When is a conditional statement true or false? What is an example of a conditional statement? What is the most common</td>
<td>Type II, III: Congruent angles made by parallel lines and a transverse Points equidistant</td>
</tr>
<tr>
<td>MP 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>geometric propositions or conjectures. Content scope: G-CO.A, G-CO.B</td>
<td>Ask students what a double negative is and to give examples. They should also state what the double negative means when simplified. <em>Example:</em> “I am not going to not eat” means “I am going to eat.”</td>
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<tr>
<td><strong>HS.C.14.5</strong></td>
<td><strong>HS.D. 3-4a</strong></td>
<td></td>
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</tr>
<tr>
<td>● Construct, autonomously, chains of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-SRT.A</td>
<td>Reasoned estimates: Use reasonable estimates of known quantities in a chain of reasoning that yields an estimate of an unknown quantity. Content Scope: Knowledge and skills articulated in the Geometry Type I, Sub-Claim A Evidence Statements.</td>
<td></td>
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</tr>
<tr>
<td><strong>SPED Strategies:</strong> Pre-teach vocabulary using visual and verbal models that are connected to real life situations.</td>
<td><strong>ELL Strategies:</strong> Provide visual cues, graphic representations, gestures, and pictures. Use the smart board and software when is needed.</td>
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</tr>
<tr>
<td>Provide students with hands on opportunities to explore and extend their understanding of conditional statements by using truth table.</td>
<td>Build knowledge from real world examples and find the practical examples and discuss them in class. Ask students to come up a real world example and make truth table.</td>
<td></td>
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</tr>
<tr>
<td>Link concepts to everyday examples so that students can visualize the truth table and understand the concept of conditional statements.</td>
<td>conditional statement? What is IF AND THEN statement?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.</td>
<td>from two points in the plane</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Classifying Triangles</strong></td>
<td><strong>Congruent angles in isosceles triangles</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Sum of angles in a triangle</strong></td>
<td><strong>Congruence of parallelograms</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>Is this a parallelogram</strong></td>
<td><strong>Midpoints of the Sides of a Parallelogram</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Parallelograms and Translations</strong></td>
<td><strong>Joining two midpoints of sides of a triangle</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pythagorean Theorem</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
New Jersey Student Learning Standard(s):

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.CO.C.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.

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.

Student Learning Objective 8: Inductive and Deductive Reasoning.

Modified Student Learning Objectives/Standards: N/A

<table>
<thead>
<tr>
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<th>Essential Understandings/ Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 3</td>
<td>G-CO.C</td>
<td>Use inductive reasoning. Use deductive reasoning. Discuss the Core Concept. Showing that a conjecture is true means you must show that it is true for all cases. Showing that a conjecture</td>
<td>How can you use reasoning to solve problems? What does it mean to deduce something? What does it mean to induce</td>
<td></td>
</tr>
<tr>
<td>MP 6</td>
<td>About 75% of tasks align to G.CO.9 or G.CO.10. Theorems include but</td>
<td></td>
<td></td>
<td>Type II, III: Congruent angles made by parallel lines and a transverse Points equidistant</td>
</tr>
</tbody>
</table>
are not limited to the examples listed in standards G-CO.9, 10,11.

HS.C.14.1

- Construct, autonomously, chains of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-CO.9, G-CO.10

- Theorems include, but are not limited to, the examples listed in standards G-CO.9 & G-CO.10.

is false means you only need one counterexample.

The first law, Law of Detachment, is easier to state than to understand for most students.

Symbolically, it says if $p \rightarrow q$ is true and $p$ is true, then you conclude that $q$ is true. The Law of Syllogism says if $p \rightarrow q$ is true and $q \rightarrow r$ is true, then you conclude that $p \rightarrow r$ is true

**SPED Strategies:**

Pre-teach vocabulary using visual and verbal models that are connected to real life situations.

Provide students with hands on opportunities to explore and extend their understanding of transformations by using transparencies, graph paper, dry erase markers, cut out shapes.

Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics.

Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.

**ELL Strategies:**

something?

Why is inductive and deductive reasoning important?

What are the similarities between inductive and deductive reasoning?

Which is the best example of deductive reasoning?

What is deductive reasoning in English?

from two points in the plane

Classifying Triangles

Congruent angles in isosceles triangles

Sum of angles in a triangle

Congruence of parallelograms

Is this a parallelogram

Midpoints of the Sides of a Parallelogram

Parallelograms and Translations

Joining two midpoints of sides of a triangle

Pythagorean Theorem
Provide visual cues, graphic representations, gestures, and pictures. Use the smart board software when is needed.

Build knowledge from real world examples

Find the reflexion of a triangle on a mirror.
The scale distance in a local map.

Find the reflexion of a photo inside a camera.
New Jersey Student Learning Standard(s):

**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.CO.C.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.

**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.

**Student Learning Objective 9:** Postulates and Diagrams.

**Modified Student Learning Objectives/Standards:** N/A

<table>
<thead>
<tr>
<th>MPs</th>
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<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 4</td>
<td>G-CO.C</td>
<td>Identify postulates using diagrams. Sketch and interpret diagrams. Construct and explain proofs of theorems about triangles including: o a line parallel to one side of a triangle</td>
<td>In a diagram, what can be assumed and what needed to be labeled? Is it true If two lines intersect, then their intersection is</td>
<td>Type II, III: Congruence of parallelograms Is this a parallelogram</td>
</tr>
</tbody>
</table>
are not limited to the examples listed in standards G-CO.9, 10,11.

HS.C.14.1
- Construct, autonomously, chains of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-CO.9, G-CO.10

Theorems include, but are not limited to, the examples listed in standards G-CO.9 & G-CO.10.

- The Pythagorean Theorem (using triangle similarity).

Use the similarity criteria to establish a new and important relationship found in similar triangles, such as the side splitting theorem and the angle bisector theorem.

Side Splitting Theorem: A line parallel to one side of a triangle divides the other two proportionally. Students are able to handle the easy relationships of comparing pieces to pieces, but when the ratio of the full length side is used in a ratio they often compare the wrong things. Many examples should be done to work out this confusion.

Angle Bisector Theorem: An angle bisector of an angle of a triangle divides the opposite side in two segments that are proportional to the other two sides of the triangle.

Is it true If two planes intersect, then their intersection is a line?

Midpoints of the Sides of a Parallelogram

Parallelograms and Translations

Joining two midpoints of sides of a triangle

Pythagorean Theorem
Use student prior connection to similarity with connections to ratios, scale factors, and proportion all connect to the concept of similarity and the non-isometric transformation, dilation.

Prove the Pythagorean Theorem using similarity and the geometric means.

A common error is comparing the proportional pieces cut by the parallel line to the third side that has not been cut into pieces. Students too often relate pieces of sides to whole sides and that causes an error.
SPED Strategies:
Model the thinking and processes involved in constructing a two columns or paragraph proof involving triangles. Provide students with notes and examples to illustrate the concept and skills necessary to demonstrate proficiency.

Encourage students to verbalize their thinking while working in small groups by asking assessing and advancing questions. Use this information to tailor instruction to student needs.

ELL Strategies: Sequence and explain the steps to prove theorems about triangles in student’s native language and/or use gestures, examples and selected technical words.

Provide students with graphic organizers.
New Jersey Student Learning Standard(s):

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.CO.C.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.

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.

Student Learning Objective 10: Algebraic Reasoning.

Modified Student Learning Objectives/Standards: N/A

<table>
<thead>
<tr>
<th>MPs</th>
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<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 2</td>
<td>G-CO.C</td>
<td>Use Algebraic Properties of Equality to justify the steps in solving an equation. Use the Distributive Property to justify the steps in solving an equation. Use properties of equality involving segment lengths and angle</td>
<td>How can algebraic properties help you solve an equation? What is algebraic reasoning? How do you know that your work and/or answer are</td>
<td>Type II, III: Congruent angles made by parallel lines and a transverse Points equidistant</td>
</tr>
<tr>
<td>MP 7</td>
<td>● About 75% of tasks align to G.CO.9 or G.CO.10. ● Theorems include but</td>
<td></td>
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</tbody>
</table>

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<table>
<thead>
<tr>
<th>are not limited to the examples listed in standards G-CO.9, 10,11.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS.C.14.1</td>
</tr>
<tr>
<td>● Construct, autonomously, chains of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-CO.9, G-CO.10</td>
</tr>
<tr>
<td>Theorems include, but are not limited to, the examples listed in standards G-CO.9 &amp; G-CO.10.</td>
</tr>
<tr>
<td>G-SRT.2</td>
</tr>
<tr>
<td>● The “explain” part of the standard G-SRT.2 is not assessed here.</td>
</tr>
<tr>
<td>measures.</td>
</tr>
<tr>
<td>Discuss the properties in the <em>Core Concept</em>. The one property that may be unfamiliar is the Substitution Property of Equality. This property was used when solving systems of equations in algebra.</td>
</tr>
<tr>
<td><strong>SPED Strategies:</strong></td>
</tr>
<tr>
<td>Pre-teach vocabulary using visual and verbal models that are connected to real life situations. Provide students with hands on opportunities to explore and extend their understanding of algebraic reasoning by using real world problem applications.</td>
</tr>
<tr>
<td>Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics.</td>
</tr>
<tr>
<td>Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.</td>
</tr>
<tr>
<td><strong>ELL Strategies:</strong></td>
</tr>
<tr>
<td>Build knowledge from real world examples</td>
</tr>
<tr>
<td>Let students to work as a group and create a problem and find solution(s) among themselves.</td>
</tr>
<tr>
<td>accurate?</td>
</tr>
<tr>
<td>Is there another way you could approach this problem?</td>
</tr>
<tr>
<td>What are enduring understandings and essential questions is geometry?</td>
</tr>
<tr>
<td>from two points in the plane</td>
</tr>
<tr>
<td>Classifying Triangles</td>
</tr>
<tr>
<td>Congruent angles in isosceles triangles</td>
</tr>
<tr>
<td>Sum of angles in a triangle</td>
</tr>
<tr>
<td>Congruence of parallelograms</td>
</tr>
<tr>
<td>Is this a parallelogram</td>
</tr>
<tr>
<td>Midpoints of the Sides of a Parallelogram</td>
</tr>
<tr>
<td>Parallelograms andTranslations</td>
</tr>
<tr>
<td>Joining two midpoints of sides of a triangle</td>
</tr>
<tr>
<td>Pythagorean Theorem</td>
</tr>
</tbody>
</table>
New Jersey Student Learning Standard(s):

**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.

**Student Learning Objective 11:** Proving Statements about Segments and Angles.

**Modified Student Learning Objectives/Standards:** N/A

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<tr>
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<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 8</td>
<td>G-CO.C</td>
<td>Write two-column proofs. Name and prove properties of congruence.</td>
<td>How can you prove a mathematical statement?</td>
<td>Type II, III: Congruent angles made by parallel lines and a transverse</td>
</tr>
<tr>
<td></td>
<td>● About 75% of tasks align to G.CO.9 or G.CO.10.</td>
<td>Begin with a discussion of proof and a reminder of what deductive reasoning is. Explain that statements are either given information or they result from applying a known property or fact to statements already made. Reasons are the explanations for the corresponding statements.</td>
<td>How do you prove math questions?</td>
<td>Points equidistant from two points in the plane</td>
</tr>
<tr>
<td></td>
<td>● Theorems include but are not limited to the examples listed in standards G-CO.9, 10,11. HS.C.14.1</td>
<td>Give partners time to write the statements or reasons in the Monitoring Progress.</td>
<td>How do you prove something is true?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>● Construct, autonomously, chains of reasoning that will justify or refute</td>
<td>Do not rush in to answer questions.</td>
<td>Is evidence the same as proof?</td>
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<tr>
<td></td>
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<td></td>
<td>How do you prove a negative?</td>
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</tr>
</tbody>
</table>
| geometric propositions or conjectures. Content scope: G-CO.9, G-CO.10 Theorems include, but are not limited to, the examples listed in standards G-CO.9 & G-CO.10. | **SPED Strategies:**
Pre-teach vocabulary using visual and verbal models that are connected to real life situations.
Provide students with hands on opportunities to explore and extend their understanding of Proving of an Statements by using actual problem from sport or real world problem.
Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics.
Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.

**ELL Strategies:**
Provide visual cues, graphic representations, gestures, and pictures to generate definitions by induction.
Build knowledge from real world examples
Ask students to work in groups and find their own examples. |
New Jersey Student Learning Standard(s):

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.

Student Learning Objective 12: Proving Geometric Relationships.

Modified Student Learning Objectives/Standards: N/A

<table>
<thead>
<tr>
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<th>Essential Understandings/ Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 3</td>
<td>G-CO.C</td>
<td>Write flowchart proofs to prove geometric relationships. Write paragraph proofs to prove geometric relationships. A flowchart proof, or simply flow proof, is another format for writing a proof. A flowchart proof is a graphical representation of a two-column proof. Sets of statements and reasons are recorded in boxes, and arrows are drawn from one step to the next. A flowchart proof is used to show the logical flow of information and how different ideas are brought together to formulate the proof. You may find that some students are able to follow the reasoning in a proof more easily.</td>
<td>How can you use a flowchart to prove a mathematical statement? What is the purpose and structure of a proof in geometry? What are the two methods for writing geometric proofs?</td>
<td>Type II, III: Congruent angles made by parallel lines and a transverse Points equidistant from two points in the plane</td>
</tr>
<tr>
<td>MP8</td>
<td>● About 75% of tasks align to G.CO.9 or G.CO.10. ● Theorems include but are not limited to the examples listed in standards G-CO.9, 10,11. HS.C.14.1 ● Construct, autonomously, chains</td>
<td></td>
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</tr>
</tbody>
</table>
of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-CO.9, G-CO.10

Theorems include, but are not limited to, the examples listed in standards G-CO.9 & G-CO.10.

when it is presented in a flowchart proof format than when written linearly in a two-column format.

How particular steps fit together, or how one statement is a result of previous statement(s), seems more evident in a flowchart proof to some students. There are other alternatives as well.

**SPED Strategies:**

Pre-teach vocabulary using visual and verbal models that are connected to real life situations.

Provide students with hands on opportunities to explore and extend their understanding of proving statements about segments and angles by using actual practical examples. Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics.

Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.

**ELL Strategies:**

Provide visual cues, graphic representations, gestures, and pictures to generate definitions by induction. Build knowledge from real world
examples
Find the real world problem in sport or other
current topics. Let students work in groups and
find their own examples.

New Jersey Student Learning Standard(s):

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.

Student Learning Objective 13: Pairs of Lines and Angles.

Modified Student Learning Objectives/Standards:

M.EE.G-CO.1. Know the attributes of perpendicular lines, parallel lines, and line segments; angles; and circles.

<table>
<thead>
<tr>
<th>MPs</th>
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<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 4</td>
<td>G-CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along</td>
<td>Identify lines and planes. Identify parallel and perpendicular lines. Identify pairs of angles formed by transversals. You may want to take time for students to practice sketching parallel planes. Explain that three letters are used to identify a plane.</td>
<td>What does it mean when two lines are parallel, intersecting, coincident, or skew? Why are vertical lines a special case for parallel lines? Why is there a special case</td>
<td>Type II, III: Symmetries of a Quadrilateral I Symmetries of a Quadrilateral II</td>
</tr>
</tbody>
</table>
a line, and distance around a circular arc.

- Definitions are limited to those in the evidence statement
- Plane is also considered and defined notion.

Please don’t forget to review the slope-intercept form of the equation of a line, \( y = mx + b \), where \( m \) is the slope of the line and \( b \) is the \( y \)-intercept.

Remind students that the slope of the line is represented by \( m \) and describes the steepness of the line. The \( y \)-intercept is represented by \( b \), and it is the \( y \)-coordinate of the point where the line intersects the \( y \)-axis.

Students will be working with parallel and perpendicular lines in this chapter, extending what they already know about these concepts in the Cartesian plane.

**SPED Strategies:**

Pre-teach vocabulary using visual and verbal models that are connected to real life situations.

Provide students with hands on opportunities to explore and extend their understanding of pairs of lines and angles by using available tools such as graphing calculators, graph paper, dry erase markers, cut out shapes and etc. Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.

**ELL Strategies:**

for a vertical line and a horizontal line being perpendicular?

Have students discuss Example 1 with their partners.

**Symmetries of Rectangles**
Provide visual cues, graphic representations, gestures, and pictures to generate definitions by induction.

Build knowledge from real world examples
Let students work in groups and find real world examples.

### New Jersey Student Learning Standard(s):

**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.

### Student Learning Objective 14: Parallel Lines and Transversals.

### Modified Student Learning Objectives/Standards: N/A

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
</table>
| MP 3 | **G-CO.C**  
- About 75% of tasks align to G.CO.9 or G.CO.10.  
- Theorems include but are not limited to the examples listed in standards G-CO.9, | Use properties of parallel lines. Prove theorems about parallel lines. Solve real-life problems.  
Students will recognize that when parallel lines are given, angle pairs are going to be supplementary or congruent. Still, expect | When two parallel lines are cut by a transversal,  
Which of the resulting pairs of angles are congruent?  
Will there always be four acute and four obtuse angles | **Type II, III:**  
Congruent angles made by parallel lines and a transverse  
Points equidistant from two points in the |
<table>
<thead>
<tr>
<th>10,11. HS.C.14.1</th>
<th>justification for how the problem is set up. In Example 2, the angles are supplementary because a vertical angle is substituted for a consecutive interior angle.</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Construct, autonomously, chains of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-CO.9, G-CO.10</td>
<td>In proving the Alternate Interior Angles Theorem (Thm. 3.2), any previously stated postulate, theorem, or definition may be used.</td>
</tr>
<tr>
<td>Theorems include, but are not limited to, the examples listed in standards G-CO.9 &amp; G-CO.10.</td>
<td>• White boarding: Have partners work on the proof together. Ask for volunteers to share their work. Continue to ask, “How do you know?”</td>
</tr>
</tbody>
</table>

**SPED Strategies:**

Pre-teach vocabulary using visual and verbal models that are connected to real life situations.

Provide students with hands on opportunities to explore and extend their understanding of parallel lines and transversals by using available tools such as graphing calculators, graph paper, dry erase markers, cut out shapes and etc. Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.

Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics.

when the Transversal intersects the two parallel lines? Explain.”

plane
**ELL Strategies:**

Provide visual cues, graphic representations, gestures, and pictures to generate definitions by induction.

Build knowledge from real world examples
Let students work in groups and find real world examples.

### New Jersey Student Learning Standard(s):

**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.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.

### Student Learning Objective 15: Proofs with Parallel Lines.

### Modified Student Learning Objectives/Standards: N/A

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<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 3</td>
<td>G-CO.C ● About 75% of tasks</td>
<td>Use the Corresponding Angles Converse.</td>
<td>For which of the theorems</td>
<td>Type II, III:</td>
</tr>
<tr>
<td>Task</td>
<td>Description</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Construct parallel lines. Prove theorems about parallel lines.</td>
<td>Use the Transitive Property of Parallel Lines.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>The converse of the Corresponding Angles Theorem (Thm. 3.1) from the</td>
<td>is also a theorem, the Corresponding Angles Converse (Thm. 3.5). The</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>previous lesson is also a theorem, the Corresponding Angles</td>
<td>converses of the other angle theorems are also theorems and are proven to</td>
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<tr>
<td>Converse (Thm. 3.5). The converses of the other angle theorems are</td>
<td>be true using the Corresponding Angles Converse.</td>
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<tr>
<td>also theorems and are proven to be true using the Corresponding</td>
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<tr>
<td>Angles Converse.</td>
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<tr>
<td><strong>Transitive Property of Parallel lines:</strong> If two lines are parallel</td>
<td>If two lines are parallel to the same line, then they are parallel to</td>
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<tr>
<td>to the same line, then they are parallel to each other.</td>
<td>each other.</td>
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</tr>
<tr>
<td><strong>Lines Perpendicular to a Transversal Theorem:</strong></td>
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<tr>
<td>Is lines and transversals is the converse true?</td>
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<tr>
<td>What are five ways to prove two lines are parallel?</td>
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<tr>
<td>How do you prove that a triangle has parallel lines?</td>
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<tr>
<td>How do you construct parallel lines?</td>
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</tr>
<tr>
<td><strong>SPED Strategies:</strong></td>
<td></td>
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</tr>
<tr>
<td>Pre-teach vocabulary using visual and verbal</td>
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<tr>
<td><strong>Congruent angles made by parallel lines and a transverse:</strong></td>
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<tr>
<td>Points equidistant from two points in the plane</td>
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</tbody>
</table>
models that are connected to real life situations.

Provide students with hands on opportunities to explore and extend their understanding of parallel lines by using available tools such as graphing calculators, graph paper, dry erase markers, cut out shapes and etc.

Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.

**ELL Strategies:**

Provide visual cues, graphic representations, gestures, and pictures to generate definitions by induction.

Build knowledge from real world examples

Let students work in groups and find real world examples.
**New Jersey Student Learning Standard(s):**

**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.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.

**Student Learning Objective 16:** Proofs with Perpendicular Lines.

**Modified Student Learning Objectives/Standards:**

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<thead>
<tr>
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<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 3</td>
<td>G-CO.C ● About 75% of tasks align to G.CO.9 or G.CO.10. ● Theorems include but are not limited to the examples listed in standards G-CO.9, 10,11. HS.C.14.1 ● Construct, autonomously, chains</td>
<td>Find the distance from a point to a line. Construct perpendicular lines. Prove theorems about perpendicular lines. Solve real-life problems involving perpendicular lines. Discuss the altitude of an airplane or the altitude of a triangle. The distance from a point to a line will be perpendicular.</td>
<td>What conjectures can you make about perpendicular lines? How do you find the distance between a line and point not on the line? Why do you think cities are often designed in a grid fashion with streets running parallel and perpendicular?</td>
<td>Type II, III: Congruent angles made by parallel lines and a transverse Points equidistant from two points in the plane Construction of perpendicular bisector</td>
</tr>
</tbody>
</table>
of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-CO.9, G-CO.10

Theorems include, but are not limited to, the examples listed in standards G-CO.9 & G-CO.10.

G-CO.D

Make and understand geometric constructions as detailed in G-CO.D.

i) About 75% of tasks align to G.CO.12.

ii) Tasks may include requiring students to justify steps and results of a given construction.

The three theorems need to be read carefully.

To introduce the first one ask, “When two lines intersect to form congruent adjacent angles, what do you know?” The lines are perpendicular.

Probing Question: “In the Perpendicular Transversal Theorem (Thm. 3.11), why is it necessary for the lines to be coplanar?” If the perpendicular line were not in the same plane as the parallel lines, then it would be perpendicular to only one of the parallel lines.

• The third theorem demonstrates why there is no transitive property for perpendicular lines!

Ask students to identify, aloud or on a paper to be collected, the most significant point (or part) in the lesson that aided their learning.

Linear Pair of Perpendicular Theorem:

If two lines intersect to form a linear pair of congruent angles, then the lines are perpendicular.

![](image)

Lines Perpendicular to a Transversal

What objects have perpendicular lines?

Which symbol is used for perpendicular lines?

Can 3 lines be perpendicular?

 Origami equilateral triangle
 Origami regular octagon
 Reflected Triangles

Objects have perpendicular lines?

Which symbol is used for perpendicular lines?

Can 3 lines be perpendicular?
Theorem:
In a plane, if two lines are perpendicular to the same line, then they are parallel to each other.

SPED Strategies:
Pre-teach vocabulary using visual and verbal models that are connected to real life situations.
Provide students with hands on opportunities to explore and extend their understanding of perpendicular lines by using available tools such as graphing calculators, graph paper, dry erase markers, cut out shapes and etc.
Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.
Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics.

ELL Strategies:
Provide visual cues, graphic representations, gestures, and pictures to generate definitions by induction.
Build knowledge from real world examples
Let students work in groups and find real world examples.

New Jersey Student Learning Standard(s):

G.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).

G-GPE.B.6: Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

Student Learning Objective 17: Equations of Parallel and Perpendicular Lines.

Modified Student Learning Objectives/Standards: N/A

<table>
<thead>
<tr>
<th>MPs</th>
<th>Evidence Statement Key/Clarifications</th>
<th>Skills, Strategies &amp; Concepts</th>
<th>Essential Understandings/Questions (Accountable Talk)</th>
<th>Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP 5</td>
<td>G-GPE.6</td>
<td>Use slope to partition directed line segments. Identify parallel and perpendicular lines. Write equations of parallel and perpendicular lines. Use slope to find the distance from a point to a line. The lesson begins with partitioning a directed line segment into two segments of a specified</td>
<td>How can you write an equation of a line that is parallel or perpendicular to a given line and passes through a given point? Why do you think it is necessary to state that horizontal lines are perpendicular to vertical</td>
<td></td>
</tr>
<tr>
<td>MP 6</td>
<td>G-Int.1</td>
<td></td>
<td></td>
<td>Type II, III: Equal Area Triangles on the Same Base I Equal Area Triangles on the Same Base II</td>
</tr>
<tr>
<td>MP 7</td>
<td>Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills</td>
<td></td>
<td></td>
<td>Equal Area Triangles on the Same Base II</td>
</tr>
</tbody>
</table>
articulated in G-MG and G-GPE.7.

**HS.C.13.3**

Apply geometric reasoning in a coordinate setting, and/or use coordinates to draw geometric conclusions. Content scope: G-GPE.5

<table>
<thead>
<tr>
<th>Ratio. The outcome is an ordered pair on the line segment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve problems using the slope criteria for parallel and perpendicular lines and determine whether two slopes represent parallel or perpendicular relationships.</td>
</tr>
<tr>
<td>Find the equation of a line parallel and line perpendicular to a given line that passes through a given point.</td>
</tr>
<tr>
<td>Students should also be able to graph and write linear equations and the slope of a line.</td>
</tr>
<tr>
<td>Slopes tell us a lot of information about geometric shapes. Parallel and perpendicular relationships occur in many geometric shapes such as the parallelogram family. Determining slope helps us classify shapes more specifically.</td>
</tr>
<tr>
<td>Knowing that parallel lines that have equal slopes?</td>
</tr>
<tr>
<td>The set of points that are equidistant from two points A and B lie on the perpendicular bisector of line segment AB, because every point on the perpendicular bisector can be used to construct two triangles that are congruent by definition of triangle congruence, reflection and/or Side-Angle-Side; corresponding parts of congruent triangles are congruent.</td>
</tr>
<tr>
<td>For any point C that lies on the perpendicular bisector of points A and B, C is equidistant from points A and B because the perpendicular bisector divides triangle ABC into two congruent right triangles.</td>
</tr>
<tr>
<td>A midsegment connects the midpoints of two sides of a triangle and divided the side lengths into a 1:2 ratio. The</td>
</tr>
</tbody>
</table>
Slopes and perpendicular lines have negative reciprocal slopes allows us to further analyze geometric shapes to determine what they are and what properties they have.

Classify geometric shapes using slopes and/or distances.

The ability to understand and recognize negative reciprocal is difficult to students. So many students use negative slopes or reciprocal slopes as perpendicular slopes instead or negative reciprocal slopes.

The new part of this skill is using two slope relationships to establish or classify various geometric shapes using slope and distance. Students feel comfortable on the grid counting things out but when we use variables for coordinates instead of values they start to struggle.

**SPED Strategies:**

- Pre-teach vocabulary using visual and verbal models that are connected to real life situations.
- Provide students with hands on opportunities to explore and extend their understanding of equations of parallel and perpendicular Lines.
- by using available tools such as graphing calculators, graph paper, dry erase markers, cut

Use of coordinate geometry techniques for finding length and slope verify that a midsegment’s length is half of the third side and it is also parallel to the third side.

How do you determine if two lines are parallel, perpendicular or neither?

Given an equation of a line and a point not on the line, how do you write the equation of a line that is parallel to the given line and through the given point? Perpendicular?

How are geometry and algebra related to each other?

How can you use coordinate geometry to prove relationships?

What is the relationship between slopes of perpendicular and parallel lines?
out shapes and etc.

Encourage students to add this concept to their reference notebook by providing notes or guiding note taking.

Link concepts to everyday examples so that students can visualize the transformations and internalize their distinguishing characteristics

**ELL Strategies:**

Provide visual cues, graphic representations, gestures, and pictures to generate definitions by induction.

Build knowledge from real world examples

Let students work in groups and find real world examples.
Integrated Evidence Statements

G-CO.C: Prove geometric theorems as detailed in G-CO.C.
- About 75% of tasks align to G.CO.9 or G.CO.10.
- Theorems include but are not limited to the examples listed in standards G-CO.9, 10, 11.
- Multiple types of proofs are allowed (e.g., two-column proof, indirect proof, paragraph proof, and flow diagram).

G-CO.D: Make and understand geometric constructions as detailed in G-CO.D.
- About 75% of tasks align to G.CO.12.
- Tasks may include requiring students to justify steps and results of a given construction.

HS.C.14.2: Construct, autonomously, chains of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-CO.A, G-CO.B.

HS.C.14.3 Construct, autonomously, chains of reasoning that will justify or refute geometric propositions or conjectures. Content scope: G-CO.D.

HS.D.1-2: Solve multi-step contextual problems with degree of difficulty appropriate to the course, requiring application of knowledge and skills articulated in 6.G, 7.G, and/or 8.G.
<table>
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<th>Unit 1 Vocabulary</th>
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<td>• acute angle</td>
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<tr>
<td>• adjacent angles</td>
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<tr>
<td>• angle</td>
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<tr>
<td>• Angle-Side-Angle Congruence Theorem</td>
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<tr>
<td>• center of a circle</td>
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<tr>
<td>• circle</td>
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<tr>
<td>• circular arc</td>
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<tr>
<td>• compass</td>
</tr>
<tr>
<td>• Composition Theorem</td>
</tr>
<tr>
<td>• construction</td>
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<tr>
<td>• corresponding angles</td>
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<tr>
<td>• corresponding sides</td>
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<tr>
<td>• corresponding parts</td>
</tr>
<tr>
<td>• dilation</td>
</tr>
<tr>
<td>• distance</td>
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<tr>
<td>• distance from a point to a line</td>
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<tr>
<td>• equilateral polygon</td>
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<tr>
<td>• equilateral triangle</td>
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<tr>
<td>• figure</td>
</tr>
<tr>
<td>• function</td>
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<tr>
<td>• horizontal stretch</td>
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<td>• line of reflection</td>
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<tr>
<td>• line of symmetry</td>
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<tr>
<td>• line segment</td>
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<tr>
<td>• Hypotenuse-Leg Congruence Theorem</td>
</tr>
<tr>
<td>• image</td>
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<tr>
<td>• input</td>
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<td>• inscribed</td>
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<td>• isometry</td>
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<tr>
<td>• line</td>
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<tr>
<td>• Linear Pair of Perpendicular Theorem</td>
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<tr>
<td>• Lines Perpendicular to a Transversal Theorem</td>
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<tr>
<td>• parallel lines</td>
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<td>• parallel planes</td>
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<tr>
<td>• parallelogram</td>
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<tr>
<td>• perpendicular</td>
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<tr>
<td>• perpendicular lines</td>
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<tr>
<td>• Perpendicular Transversal Theorem</td>
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<td>• plane</td>
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<td>• point</td>
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<td>• postulate</td>
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<td>• pre-image</td>
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<td>• ray</td>
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<tr>
<td>• Reflections in Intersecting Lines Theorem</td>
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<td>• Reflections in Parallel Lines Theorem</td>
</tr>
<tr>
<td>• rectangle</td>
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<tr>
<td>• regular polygons</td>
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<td>• rigid motion</td>
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<tr>
<td>• rotation</td>
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<td>• Side- Angle-Side Congruence Theorem</td>
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<tr>
<td>• Side-Side-Side Congruence Theorem</td>
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<tr>
<td>• straightedge</td>
</tr>
<tr>
<td>• symmetry</td>
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<tr>
<td>• theorem</td>
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<tr>
<td>• Third Angles Theorem</td>
</tr>
<tr>
<td>• Transformation</td>
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<tr>
<td>• Transitive Property of Parallel lines</td>
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<tr>
<td>• translation</td>
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<td>• transversal</td>
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<tr>
<td>• trapezoids</td>
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<tr>
<td>• Side- Angle-Side Congruence Theorem</td>
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<tr>
<td>• Side-Side-Side Congruence Theorem</td>
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<tr>
<td>• Segment addition postulate</td>
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# References & Suggested Instructional Websites

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<th>URL</th>
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<td><a href="https://www.youcubed.org/week-of-inspirational-math/">https://www.youcubed.org/week-of-inspirational-math/</a></td>
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<tr>
<td>NCTM Illuminations</td>
<td><a href="http://illuminations.nctm.org/Lessons-Activities.aspx">http://illuminations.nctm.org/Lessons-Activities.aspx</a> (choose grade level and connect to search lessons)</td>
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<tr>
<td>CK-12</td>
<td><a href="http://www.ck12.org">www.ck12.org</a></td>
</tr>
<tr>
<td>Mathematics Common Core Toolbox</td>
<td><a href="http://www.ccsstoolbox.org/">http://www.ccsstoolbox.org/</a></td>
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</table>
**Field Trip Ideas**

**SIX FLAGS GREAT ADVENTURE**- This educational event includes workbooks and special science and math related shows throughout the day. Your students will leave with a better understanding of real world applications of the material they have learned in the classroom. Each student will have the opportunity to experience different rides and attractions linking mathematical and scientific concepts to what they are experiencing.

[www.sixflags.com](http://www.sixflags.com)

**MUSEUM of MATHEMATICS**- Mathematics illuminates the patterns that abound in our world. The National Museum of Mathematics strives to enhance public understanding and perception of mathematics. Its dynamic exhibits and programs stimulate inquiry, spark curiosity, and reveal the wonders of mathematics. The Museum’s activities lead a broad and diverse audience to understand the evolving, creative, human, and aesthetic nature of mathematics.

[www.momath.org](http://www.momath.org)

**LIBERTY SCIENCE CENTER** - An interactive science museum and learning center located in Liberty State Park. The center, which first opened in 1993 as New Jersey's first major state science museum, has science exhibits, the largest IMAX Dome theater in the United States, numerous educational resources, and the original *Hoberman sphere*.

[http://lsc.org/plan-your-visit/](http://lsc.org/plan-your-visit/)