Geometry Teacher's Edition - Enrichment

CK-12 Foundation

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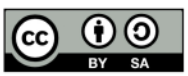

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Chapter 1

Geometry TE - Enrichment

Geometry- Teacher's Edition- Enrichment Jen Kershaw

The goal of an enrichment section is just what is implied in the title, "to enrich." By enrichment, we mean something that breathes a new or different life into something else- to make it better to enliven it. This is the goal of this branch of the teacher's edition. This is an opportunity for you and your students to locate and explore the wonderful world of geometry in other subjects such as architecture or music or art. It is a chance for students to see how the world of mathematics can connect to other subjects that they are passionate about.

Our goal is that using this Enrichment Flexbook will help you to expand your own personal creativity as well as the creativity of your students. The projects/topics in this flexbook can be used in several different ways. They can be used as a discussion point, an example to highlight during a lesson, a project to expand on whether students complete the project in class or at home or as a way to broaden student thinking by using a web search once per week as an example. It is not the intention that every single lesson be used in this flexbook. Take what inspires you and use it to inspire your students. Isn't that what the world of mathematics is all about!

1.1 Basics of Geometry

Points, Lines and Planes

I. Section Objectives

- Understand the undefined terms *point, line and plane.*
- Understand defined terms, including *space, segment and ray.*
- Identify and apply basic postulates of points, lines and planes.
- Draw and label terms in a diagram

II. Cross- curricular Study-Art

- Use the painting on this website.

- www.nationalgalleries.org/media_collection/6/GMA 1279.jpg
- You can print it out or have students look at it on the computer.
- One way to use this painting is to have students work in small groups to identify the points, lines, planes, segments and rays in the painting.
- You could also use it as a spring board for the students to create their own black, white and gray piece of art that contains points, lines, planes, segments and rays.
- You could even pair this up with the art teacher to really incorporate other disciplines into the mathematics classroom.

III. Technology Integration

- One way to integrate technology is to use a drawing/painting program and have the students work to design their own artwork on the computer.
- This could take several days, so be sure that you have access to the computers.
- In the end, the students could present their material to the other students in the class and explain the geometric properties of their work.

IV. Notes on Assessment

- When looking at student work, you want to include creativity in your assessment, but also look at the mathematics incorporated.
- Did the student include all of the geometric elements?
- Is the student able to describe the different elements to his/her peers?
- Has the work been completed with care?
- Offer feedback/correction as needed.

Segments and Distance

I. Section Objectives

- Measure distances using different tools
- Understand and apply the ruler postulate to measurement
- Understand and apply the segment addition postulate to measurement
- Use endpoints to identify distances on a coordinate grid

II. Cross- curricular Study- Surveying

- Land surveyors measure distance all of the time.
- They determine land boundaries, and property lines, as well as determine roads etc.

- One possible activity is to have a land surveyor visit the class.
- Have the surveyor bring in his/her tools also have them demonstrate the actual measuring to the students.
- Maybe work on measuring a part of the school grounds.
- Ask the presenter to be prepared to discuss the ways that geometry and measurement are featured in his/her job.
- Have the students prepare questions and write a short report demonstrating what they have learned following the visit.

III. Technology Integration

- Have the students research land surveying.
- This can be done in class or as an at home assignment.
- Completing this assignment will help the students to be prepared when the land surveyor comes to visit the class.
- Ask students to keep track of the sites that they search and to jot down at least ten facts about land surveying as a career.
- An extension into future careers could have the students research schooling and salary options for land surveyors.
- Ask students to report on their findings.

IV. Notes on Assessment

- One of the biggest points to assess in this activity is the student questions.
- Ask the students to write down their questions and the answers to them.
- This will help you to confirm that the students gave thought to their questions and were alert to the answers.

Rays and Angles

I. Section Objectives

- Understand and identify rays.
- Understand and classify angles.
- Understand and apply the protractor postulate.
- Understand and apply the angle addition postulate.

II. Cross- curricular- Astronomy

- Begin this lesson by asking students to observe the night sky.

- Tell them to make note of the different constellations that they observe.
- Also ask the students to find these constellations on line or in a book and to bring the hard

copy of a picture of the constellation to class.

- When students do this, you can begin a whole discussion about the angles in the constellations and the distance between stars.
- This can lead right into the technology integration.

III. Technology Integration

- www.geocities.com/angolano/Astronomy/PIinSky.html
- Use the website for an in depth student of measurement in the sky.
- This website looks at many different facets of geometry, measurement and astronomy.
- Although some topics have not been discussed yet, have the student read it all anyway.
- Then focus on the last section where students can see how to measure angles in the sky using their hands.
- Then send them back out at night to rediscover the initial constellations using their hands to measure distances.

IV. Notes on Assessment

- Assess student work in three sections.
- First, discuss the initial constellations with the students.
- What did the students discover?
- Were they able to make connections between angles and the constellations?
- Then move on to the astronomy site.
- Finally, assess student observations once they had an understanding of how to measure using their hands.
- What did this do to their initial observations?
- Were the students able to expand on the initial sightings?

Segments and Angles

I. Section Objectives

- Understand and identify congruent line segments
- Identify the midpoint of line segments

- Identify the bisector of a line segment
- Understand and identify congruent angles
- Understand and apply the Angle Bisector Postulate

II. Cross- curricular-Architecture

- Use the image from Wikipedia on A Frame Homes in this lesson. This is Figure01.04.01
- www.en.wikipedia.org/wiki/File:Aframe2.jpg
- You want the students to use the design of the A frame home to prove the theorems in this lesson.
- Students are going to use the image to demonstrate the following:
- 1. Congruent line segments
- 2. Bisecting line segments
- 3. Midpoints of line segments
- 4. Congruent angles
- 5. Bisecting angles
- 6. Angle bisector postulate
- Have students work in small groups, and then present their findings.
- Another option is to have the students design their own A frame home.
- When designing, the students will have to use the concepts in the chapter and apply them to the design of the home.

III. Technology Integration- Websearch

- A great way to study the concept of bisection is through a websearch.
- Have the students google "bisecting"
- When they do this, many pages of images will pop up. For example, one image is of a fence bisecting two mountains. Another is an aerial view of a highway.
- Ask students to select three different real- world images to work with.
- You want the students to draw connections between the concepts in the text and the images that they have selected.
- Ask the students to investigate how the terms bisect, congruent and midpoint applies to each image.
- For example, the student might see that in the highway picture the roads are bisecting by other roads. In the mountain picture, the fence crosses the midpoint between the two mountains bisecting the distance between the two.
- This activity will cause students to use higher level thinking skills. The connections may not be obvious.

IV. Notes on Assessment

- Look at student work.
- Are the students able to apply how each concept applies to the A frame home design?
- Look at student designs- is the A frame home congruent?
- Are the angles congruent?
- You could choose to do some or all of the suggestions in this lesson, you are looking to see that the students understand the concepts and can apply them in real life situations. They could be doing this in a diagram, a presentation or a written explanation.
- Assess student work accordingly.

Angle Pairs

I. Section Objectives

- Understand and identify complementary angles
- Understand and identify supplementary angles
- Understand and utilize the Linear Pair Postulate
- Understand and identify vertical angles

Cross- curricular- Map of NYC

- Use the image of a street map of Manhattan. This is Figure01.05.01.
- www.aaccessmaps.com/show/map/us/ny/manhattan
- Print a copy of this image for students to work with during the activity.
- This map has many different examples of complementary and supplementary angles. As well as vertical angles.
- Have the students work in pairs with a highlighter, colored pencils or markers.
- The students are going to identify examples of each of the types of angles in the map.
- Remind students to look at Broadway and at the way Broadway intersects the other streets.
- Ask the students to make a list of the intersections on paper and how each angle fits the description.
- You could also have the students enlarge the map (or do this ahead of time), and then use a protractor to measure the angles.
- Ask students to share their work in small groups.

III. Technology Integration

- Search maps from different cities.
- You could use the map of the city that you live in.

- You could ask the students to identify a city of their choosing.
- Then complete the same exploration with a protractor on this map.

IV. Notes on Assessment

- Check student maps.
- Collect the student maps and their notes.
- Have the students identified the angle pairs correctly.
- If measurement was completed, is it accurate?
- Provide students with feedback/comments on their work.

Classifying Triangles

I. Section Objectives

- Define triangles
- Classify triangles as acute, right, obtuse, equiangular
- Classify triangles as scalene, isosceles, or equilateral

II. Cross- curricular-Triangle Creations

- This is a fun way to explore triangles.
- To prepare, you will need an assortment of one or more of the following items: gumdrops, marshmallows, toothpicks, tinkertoys, kynex
- Be sure that the students understand the different types of triangles and have an example of each type.
- Then have them create an example of each of the following triangles using the materials provided.
- The students will have a GREAT time with this. It is very hands- on and since so much work has been done on the different triangle types, this will make the lesson fun.
- Students need to label each type and example and be able to explain how and why it is that type of triangle.
- Allow time for the students to present their creations.

III. Technology Integration- Geometric paintings

- Use the following website for an investigation in geometric paintings using triangles. This is Figure 01.06.01
- www.4.bp.blogspot.com/_wLt09kFTsi4/RdsN0RvBmgI/AAAAAAAAAAk/Oo6kiVl78AE/s400/BlackBeetle.jpg
- Ask the students to work in small groups and identify the different types of triangles in this painting.

- Then have the students create their own painting using the different types of triangles.
- They should create a key and color code to show each type of triangle.
- An alternative to this would be to have the students search and find triangles in other geometric paintings.
- They can then use this one as a springboard for their own design.

IV. Notes on Assessment

- Create a specific set of directions for the student art piece.
- How many triangles do the students need to have in their design?
- How many of each type?
- Consider creativity.
- Provide students with comments/feedback on their work.

Classifying Polygons

I. Section Objectives

- Define polygons
- Understand the difference between convex and concave polygons
- Classify polygons by the number of sides
- Use the distance formula to find side lengths on a coordinate grid

II. Cross- curricular-Architecture

- You will need a computer or a way to show this video during class.
- You can go to www.futureschannel.com and have the students watch the short video on polygons in architecture.
- Use this video as a discussion prompt.
- Ask the students to identify how architecture is shaped by the use of polygons and how it depends on polygons.
- Ask the students to brainstorm the many different types of polygons in the classroom.
- Extension- ask the students to go home- take one room and write down all of the different types of polygons that they can find in that room.
- Allow time for students to share their work.

III. Technology Integration

- Have the students complete a websearch on different types of lens.
- They can use Wikipedia for this.
- Students are going to explore the concepts of concave and convex as it applies to lenses.
- Ask the students to make a list of the different characteristics of concave polygons.
- Then ask students to make a list of the characteristics of convex polygons.
- Then have the student select five different lenses.
- They need to create a description/explanation of how each lens is either concave, convex or neither.
- Allow time for the students to share their work when finished.

IV. Notes on Assessment

- Student work is assessed through discussion.
- Be sure that all students have an opportunity to share.
- You want to encourage this class lesson to include a lively engaging discussion.

Problem Solving in Geometry

I. Section Objectives

- Read and understand given problem situations
- Use multiple representations to restate problem situations
- Identify problem- solving plans
- Solve real- world problems using planning strategies

II. Cross-curricular- Putting It Together

- In this chapter, students have been working with all of the basics of geometry.
- Now they are going to be combining these ideas to create their own word problem.
- Students can use magazine pictures, clip art or other pictures in their problem.
- Have the students work in pairs or small groups to design a word problem that uses some or all of the following concepts: lines, angles, triangles, polygons.
- Students should demonstrate an answer key where students use the problem solving techniques from the chapter to solve the problem.
- This may seem to be too broad an activity.
- If so, you can give the students a topic to write their problems about such as sports.
- Then all of the problems that the students write will have to do with the topic of sports.

- Collect all student problems and answers when finished.

III. Technology Integration

- Use the following website and have the students watch the video and geometry and dance.
- www.thefutureschannel.com/dockets/realworld/dancing/
- Use this as a discussion starting point.
- Then you could show students a short clip from The Nutcracker (you will need to prep this ahead of time).
- Ask the students to use the concepts from the first movie clip and apply it to the dancing in the Nutcracker.
- This can be a fun way of showing how math is in places where you least expect it.

IV. Notes on Assessment

- Collect student problems and answers.
- Check all work for accuracy.
- Provide students with feedback/correction.
- You can use these problems as quiz questions or extra credit work.

1.2 Reasoning and Proof

Inductive Reasoning

I. Section Objectives

- Recognize visual patterns and number patterns
- Extend and generalize patterns
- Write a counterexample to a pattern rule

II. Cross- curricular- Music

- Prepare several different examples of repetitive music.
- For example, rap, classical, folk song, childrens song.
- You want a few with a refrain or a clear consistent pattern.
- You will need to prepare this ahead of time.
- You want the students to develop a rule for each selection.
- Brainstorm a list of possible pattern rules and decide on one.

- Then write this one on the board.
- Ask the students to come up with a counterexample to the pattern rule.
- You can do this first one as a whole class so that the students understand the idea.
- Then break students off into groups.
- Have them listen to each of the other selections and write a rule and a counter example for each.
- When finished, allow time for students to share their work.

III. Technology Integration

- Have the students complete a google search on patterns in nature.
- Students are going to select one or more examples of patterns in nature.
- Ask them to write a rule for each pattern.
- Then write a counter example for each pattern.
- Finally allow time for students to share their work.

IV. Notes on Assessment

- Assessment is done through class sharing.
- Do the students understand how to write a pattern rule?
- Are the rules accurate?
- Do the students understand how to write a counterexample?
- Provide feedback as needed.

Conditional Statements

I. Section Objectives

- Recognize if- then statements
- Identify the hypothesis and conclusion of an if-then statement
- Write the converse, inverse and contrapositive of an if-then statement
- Understand a biconditional statement

II. Cross- curricular-Literature

- Provide students with a copy of the poem "The Road Not Taken" by Robert Frost.
- Read the poem with the class.
- Discuss the meaning of the poem and the thoughts behind it.

- Then tell the students that they are going to change the poem to be written in all conditional statements.
- They can reword it if they wish.
- Allow time for the students to work on this in small groups.
- When they have finished, ask them if the meaning of the poem has changed with their conditional statements.
- Ask them how conditional statements can impact different statements.
- Allow time for the students to read their poems.

III. Technology Integration

- Have the students use the following website to investigate conditional statements further.
- www2.edc.org/makingmath/mathtools/conditional/conditional.asp
- Ask the students to use the diagrams to write three different conditional statements.
- Allow time for the students to share their work in small groups.

IV. Notes on Assessment

- You will hear how well the students understand conditional statements by listening to their poems.
- Provide feedback/correction as needed.

Deductive Reasoning

I. Section Objectives

- Recognize and apply some basic rules of logic
- Understand the different parts that inductive reasoning and deductive reasoning play in logical reasoning
- Use truth tables to analyze patterns of reasoning

II. Cross- curricular-Mount Everest

- Begin this activity with a discussion about deductive and inductive reasoning.
- Review these concepts so that the students are not confused when working on this activity.
- Have students research through books or technology facts about people who have climbed Mt. Everest.
- Ask the students to make a list of at least ten facts about people who have climbed Everest.
- Then write this on the board, "If you have climbed Mt. Everest, then you…."
- Tell the students that they are to write at least five different statements using deductive reasoning to complete this statement.

- When finished, have students share their work in small groups.
- Ask each group to assess whether or not the students have successfully written statements using deductive reasoning.

III. Technology Integration

- Complete a websearch on Aristotle.
- Ask students to do some research about Aristotle and how he developed the concept of logic.
- Students can write a short essay about this or apply it to a real life example.
- Collect student work.

IV. Notes on Assessment

- Collect student statements.
- Assess them for accuracy.
- Provide students with feedback/correction as needed.
- When working on the technology integration, ask the students to share what they have discovered about Aristotle and logic.
- This can become a lively discussion about how the actions of someone in the past impacts the way we work today- draw a connection to the judicial system.

Algebraic Properties

I. Section Objectives

- Identify and apply properties of equality
- Recognize properties of congruence "inherited" from the properties of equality
- Solve equations and cite properties that justify the steps in the solution
- Solve problems using properties of equality and congruence

II. Cross- curricular- Scale Design

- This activity involves students exploring the concept of equality.
- Bring in several different scales for students to work with.
- Then prepare an assortment of items for students to work with. For example, apples, bananas, bags of flour, bags of rice, oranges, etc. You can use non food items too.
- Students need to come up with collections of items that demonstrate equality.
- For example, apples and oranges- can you put so many apples to equal so many oranges?

- Have students make a list of the items that equal other items.
- Then ask students to use the properties from the chapter and write a reflexive statement, a symmetric statement and a transitive statement about two of their equal statements.
- Finally, allow time for the students to share their work.

III. Technology Integration

- Have students explore how properties apply to circuits.
- Use the following website for this exploration.
- www.allaboutcircuits.com/vol_4/chpt_7/4.html
- Begin a discussion about the information. Create a list of important facts on the board.
- You can also have the students do this in small groups.
- Students can then create their own diagrams to demonstrate how the circuit works and how algebraic properties impact circuits.
- Allow time for the students to share their diagrams.

IV. Notes on Assessment

- Observe students as they work.
- Then collect all student statements and diagrams.
- Check student work for accuracy.
- Provide feedback/correction as needed.

Diagrams

I. Section Objectives

- Provide the diagram that goes with a problem or proof.
- Interpret a given diagram.
- Recognize what can be assumed from a diagram and what can not be
- Use standard marks for segments and angles in diagrams.

II. Cross- curricular-Airports

- Begin this activity by reviewing each of the eleven postulates in the chapter.
- Make a list of them and their characteristics on the board.
- Then move on to the activity.

- Use a copy of the map of the runway at O'Hare International Airport. This is Figure02.05.01.
- www.en.wikipedia.org/wiki/O'Hare_International_Airport
- Ask the students to use colored pencils to find an example of each of the eleven postulates.
- They need to use a color to highlight each example.
- Then they can use this color as an indicator and write a description of HOW the example illustrates the postulate.
- Do this for all of the eleven postulates.
- When students are finished, allow time for them to share their work.

III. Technology Integration

- Have the students do a search for different housing floor plans.
- They can use the following website for the search or another of their own choosing.
- www.thehousedesigners.com/
- Then ask the students to make a list of how the different postulates apply to housing floor plans.
- Would it be possible for houses to be designed without these postulates?
- Conduct a class discussion on this topic.

IV. Notes on Assessment

- Collect the airport maps and student notes.
- Check them for accuracy.
- Did the students follow the directions?
- Is each of the eleven postulates represented?
- Were the students able to write a written explanation of how the postulate is shown in the map?
- Provide feedback/correction as needed.

Two- Column Proof

I. Section Objectives

- Draw a diagram to help set up a two- column proof.
- Identify the given information and statement to be proved in a two- column proof.
- Write a two- column proof.

II. Cross-curricular- Cooking

- In this activity, the students are going to need to prove the following statement.
- "You must have eggs to make a chocolate cake."
- Assign half of the class the job of proving that this is a true statement.
- Assign the other half of the class the job of disproving the statement.
- This can branch off into technology as well.
- If students have access to computers, they can search recipes and cake information on line.
- Some students will break right off and talk about dairy- free or vegan cakes.
- This is great because students can talk about that, but they will need to prove it.
- Tell students that they need at least four different statements.
- Tell students that they will need to use resources to back up their statements.
- Allow students time to work.
- When finished, allow them time to share their arguments.
- The class can assess whether they successfully proved it or not.
- You may want to do this first in small groups.
- Have each group select the best proof.
- Then have a whole class debate using the best proofs.
- Ask the students to share what worked or was challenging about this assignment.
- Students may figure out that they can be very specific in their proof.

III. Technology Integration

- Incorporate technology into the above activity by allowing students computer access to do their recipe/cooking searches.

IV. Notes on Assessment

- Assess student work through the debates and discussions.
- Collect students work and read through their proofs.
- This is a GREAT class for demonstrating how challenging it can be to prove or disprove something.
- For fun, you could serve chocolate cake when finished.

Segment and Angle Congruence Theorems

I. Section Objectives

- Understand basic congruence properties.
- Prove theorems about congruence.

II. Cross- curricular-Roller Coasters

- Use the following image from Wikipedia for the first part of this lesson.
- This is Figure02.07.01
- www.en.wikipedia.org/wiki/File:Wooden_roller_coaster_txgi.jpg
- Review the segment and angle congruence theorems from the lesson in the text.
- Make a list of them on the board.
- Then distribute this image to the students.
- Students are going to work in pairs or small groups.
- They need to use the image to explain why segment and angle congruence theorems are important to roller coaster design.
- Allow time for the students to work on this.
- This is a written explanation and should include the definitions from the text applied in a real life context.
- Allow time for the students to share their work when finished.

III. Technology Integration

- Have students complete a websearch of roller coasters.
- Ask each student to select one that best uses the segment and angle congruence theorems.
- Then conduct a large class discussion on this.
- Be sure that the students see how the theorems apply in real life.
- If segments and angles weren't congruent, how would this impact the operations of the roller coaster?

IV. Notes on Assessment

- Assessment is completed through class discussion.
- Observe students as they work and listen to their ideas in the discussion.
- Are the students connecting the theorems to the design?
- Help them to make the connections.

Proofs about Angle Pairs

I. Section Objectives

- State theorems about special pairs of angles.
- Understand proofs of the theorems about special pairs of angles.
- Apply the theorems in problem solving.

II. Cross- curricular-Theorems in Art

- Students are going to use art to prove the different theorems.
- Use the following image from this website for this activity. This is Figure 02.08.01.
- www.prestonsteed.com/Sale_pages/Right_Angles/Right.Angles.html
- Then ask the students to come up with an example of each of the following theorems in this painting.
- 1. Right Angle Theorem
- 2. Supplements of the Same Angle Theorem
- 3. Complements of the Same Angle Theorem
- 4. Vertical Angles Theorem
- Have students discuss their findings in small groups.
- Allow time for sharing in the large group as well.

III. Technology Integration

- Students can use the power point presentation in this website to explore different angles and their relationships.
- www.learninginhand.com/lessonplans/angles.html
- The activities themselves are an excellent integration of technology.

IV. Notes on Assessment

- Assess student work through observation.
- Walk around and listen to students as they discuss the painting.
- Sit in and interject thoughts are ideas.
- Are the students connecting the theorems to the painting?
- Are they discovering the angle relationships?
- Offer feedback/suggestions as needed.

1.3 Parallel and Perpendicular Lines

Lines and Angles

I. Section Objectives

- Identify parallel lines, skew lines, and perpendicular lines
- Know the statement of and use the Parallel Line Postulate.
- Know the statement of and use the Perpendicular Line Postulate.
- Identify angles made by transversals.

II. Cross- curricular-Architecture

- Use this image from Wikipedia for a discussion on lines and angles.
- This is Figure 03.01.02
- www.en.wikipedia.org/wiki/English_Gothic_architecture
- Discuss the lines and angles in the picture.
- Show students how perpendicular angles are a major feature in the structure.
- This can be a fun lively discussion on how architecture and geometry come together.
- Write student points on the board.

III. Technology Integration-Artist Todd Hoover

- Use the following painting by Todd Hoover titled "Coming Together."
- It can be found at this website. This is Figure 03.01.01.
- www.fineartamerica.com/featured/coming-together-todd-hoover.html
- Have the students discuss the different lines and angles in this painting.
- Then use this image as a springboard to have the students create their own painting.
- Simplicity is key.
- Allow time for the students to create their work.
- Display art in the classroom.

IV. Notes on Assessment

- Create a rubric for grading student art.
- Establish how many types of lines need to be in the painting.
- Be sure to include creativity when grading.
- How well did the students take Todd Hoover's simplicity and make it their own?
- Provide feedback to students on their work.

Parallel Lines and Transversals

I. Section Objectives

- Identify angles formed by two parallel lines and a non- perpendicular transversal.
- Identify and use the Corresponding Angles Postulate.
- Identify and use the Alternate Interior Angles Theorem.
- Identify and use the Alternate Exterior Angles Theorem.
- Identify and use the Consecutive Interior Angles Theorem.

II. Cross- curricular-Tube Map in London

- Use the following image from Wikipedia. This is Figure 03.02.01.
- www.en.wikipedia.org/wiki/File:Tube_map_thumbnail.png
- Be sure that each student has a copy of the map.
- Students are going to use this map to find an example of each of the postulates/theorems in this lesson.
- 1. Corresponding Angles Postulate
- 2. Alternate Interior Angles Theorem
- 3. Alternative Exterior Angles Theorem
- 4. Consecutive Interior Angles Theorem
- Students will need to prove that each example in the map is accurate.
- Have them use a protractor to measure and provide a list of statements and proof for each postulate/theorem.
- Then allow time for students to share their work.

III. Technology Integration- Transportation Search

- Have students use this map of the Tube and compare it with the map of the subway in NYC and the map of the "L" in Chicago.
- Compare and contrast each map and the use of angles, parallel lines and transversals.
- Have students write a few concluding statements to describe each in mathematical terms.
- Then allow time for students to share their work.

IV. Notes on Assessment

- Collect student tube maps and statements.
- Did the students justify each theorem/postulate correctly and accurately?
- Did they use angle measures in their justifications?
- Provide students with feedback/correction when needed.

Proving Lines Parallel

I. Section Objectives

- Identify and use the Converse of the Corresponding Angles Postulate.
- Identify and use the Converse of Alternate Interior Angles Theorem.
- Identify and use the Converse of Alternate Exterior Angles Theorem.
- Identify and use the Converse of Consecutive Interior Angles Theorem.
- Identify and use the Parallel Lines Property.

II. Cross- curricular-Washington DC

- Use the following map of the mall in Washington DC.
- This is Figure 03.03.01
- www.visitingdc.com/images/national-mall-map.jpg
- There are several different examples of parallel lines and transversals in this map.
- Students are going to write a series of directions to take someone on a tour of the mall.
- Ask them to start their directions at the American History Museum and write a list of directions in a mathematical way.
- Students can work in small groups on this assignment.
- When finished, have the students swap directions with a neighboring group and check to be sure that the directions work.
- Have the groups provide each other with feedback on their directions.
- Make corrections as needed.

III. Technology Integration

- Have the students explore proving lines parallel by watching the video.
- Use the following website.
- www.yourteacher.com/geometry/provinglinesparallel.php
- When finished, use this as a discussion starter.

IV. Notes on Assessment

- Collect student maps and directions.
- Check work for accuracy.
- Provide students with feedback/correction as needed.

Slopes of Lines

I. Section Objectives

- Identify and compute slope in the coordinate plane.
- Use the relationship between slopes of parallel lines.
- Use the relationship between slopes of perpendicular lines.
- Plot a line on a coordinate plane using different methods.

II. Cross- curricular-Construction/Architecture

- Ask a roof designer, architect or contractor to visit the class and present information on designing a roof.
- Prepare the presenter that he/she needs to be able to talk about slope or pitch and how mathematics plays an important role in construction.
- Ask the students to write questions for the presenter to answer.
- Conduct a follow- up discussion with the students on career connections between architecture and slope.

III. Technology Integration- Roof Design

- Have the students use the following website to explore slopes and roof design.
- Given that the pitch of the roof is connected to the slope of the roof, students can see and explore the real life application of how slope is used in construction.
- www.roofgenius.com/roofpitch.htm
- There are several different websites that do a great job at this.
- Ask the students to begin with this one, and then explore further with other websites.
- A possible extension is for students to design their own roof plan.

IV. Notes on Assessment

- Observe students during the presentation.
- Listen to student questions and answers.
- Be sure that the students understand how roofing and slopes are connected.

Equations of Lines

I. Section Objectives

- Identify and write equations in slope- intercept form.
- Identify equations of parallel lines.
- Identify equations of perpendicular lines.
- Identify and write equations in standard form.

II. Cross- curricular-Ramp Design

- Have a presenter from the local skate shop come in to explain ramps and how they are constructed.
- Be sure that the person that you are having as a speaker is knowledgeable about skateboard ramps and how the ramps are designed.
- You could also have someone come in who is an expert in snowboarding and ramps too.
- Ask the person to bring in some designs or ramps and compare the slope to the equation of the line.
- You can expand this after the presentation by asking the students to draw a diagram representing a skateboard ramp and demonstrate the slope and equation of the line in the diagram.

III. Technology Integration

- Have students complete a websearch on parallel and perpendicular lines.
- Students will find several different websites to explore about parallel lines and the equations of a line.
- Also, they can search for perpendicular lines and equations of a line.
- Use these websites to expand student understanding and prompt discussion.

IV. Notes on Assessment

- Assessment is done through observation in this lesson.
- You want to be sure that the students are engaging in exploring the concepts of the lesson.
- There is not a specific measureable content piece for this lesson.

Perpendicular Lines

I. Section Objectives

- Identify congruent linear pairs of angles.
- Identify the angles formed by perpendicular intersecting lines.
- Identify complementary adjacent angles.

II. Cross- curricular-Gymnastics

- Use the following image from Wikipedia.
- This is Figure 03.06.01
- www.en.wikipedia.org/wiki/Parallel_bars
- Use this image as a discussion point about perpendicular lines of the gymnast and the high bar.
- One of the ways that gymnasts are scored is on their ability to reach a perfectly perpendicular point.
- This is the basis for the discussion.
- Ask the students to identify a linear pair of angles.
- Also ask the students to find the angles formed by the perpendicular lines.
- Begin this conversation as a springboard to extend into the technology integration.

III. Technology Integration

- Have students continue to search gymnastics through Wikipedia.
- There are several different examples of angles and geometric components of gymnastics.
- Ask the students to make a list of the ways that geometry is integrated into gymnastics.
- Allow time for a class discussion.

IV. Notes on Assessment

- Assess student understanding through discussion.
- Ask the students to point out different examples of geometric terms as they are illustrated in gymnastics.
- Then participate with the students during discussion.

Perpendicular Transversals

I. Section Objectives

- Identify the implications of perpendicular transversals on parallel lines.
- Identify the converse theorems involving perpendicular transversals and parallel lines.
- Understand and use the distance between parallel lines.

II. Cross- curricular-Airport Map

- For this activity, download the map of the main terminal from the following website for the Atlanta International Airport.

- Use this website, and consider this Figure 03.07.01
- www.atlanta-airport.com/forms/passenger/frmPassengerInformation_terminallayout.aspx
- Then use this map to show the main terminal and each of the concourses A- E at the bottom of the map to show a perpendicular transversal and the angles formed by the perpendicular transversal.
- Have the students explore the rest of the map and discover ways that the perpendicular transversals are represented in the other places on the map.
- Allow students to discuss this in small groups first.
- Then bring the students back together and have them share in a large group.

III. Technology Integration

- Have the students google perpendicular transversals.
- Then after doing this, allow students the time to work through some of the websites and explore the information.
- You can ask them to search through particular sites or allow this to be a general investigation time.
- Ask students to make a list of the sites that they explore and at least three things that are presented on the site.

IV. Notes on Assessment

- Look at the student maps and at the notes that the students make about the map.
- Is their work accurate?
- Are there patterns that they can find in the map having to do with perpendicular transversals?
- How can they be sure that the lines are perpendicular?
- What does this do to the angles formed?

Non- Euclidean Geometry

I. Section Objectives

- Understand non- Euclidean geometry concepts.
- Find taxicab distances.
- Identify and understand taxicab circles.
- Identify and understand taxicab midpoints.

II. Cross- curricular-Game Time

- Review the basics of taxicab geometry, distances, circles and midpoints with the students.

- Have them work in small groups.
- Their task is to create a board game that uses the concepts of taxicab geometry.
- You can provide students with a piece of cardboard for a game board, index cards, dice or number cubes, and small colored circle pieces.
- Then set them to work.
- The students will need to create a grid for the "taxis" to move on.
- When finished, let the students play each other's games.
- This can be very in depth and take several days for the students to work on.

III. Technology Integration

- This is a very fun website that has the students go on a treasure hunt while using taxicab geometry.
- www.learner.org/teacherslab/math/geometry/shape/taxicab/
- Allow time for students to explore this website and hunt for the treasure.
- Then allow them time to play and then discuss what they have learned about taxicab geometry while hunting for treasure.

IV. Notes on Assessment

- Create a rubric that gives the students guidelines on how their game will be graded.
- Then walk around and observe students as they work.
- When assessing the game, be sure to play it yourself or observe students playing it so that you can assess whether the game works or not.
- Provide feedback/correction as needed.

1.4 Congruent Triangles

Triangle Sums

I. Section Objectives

- Identify interior and exterior angles in a triangle.
- Understand and apply the Triangle Sum Theorem.
- Utilize the complementary relationship of acute angles in a right triangle.
- Identify the relationship of the exterior angles in a triangle.

II. Cross- curricular-Hang Gliders

- Have students examine the triangles in the image from Wikipedia.
- This is Figure 04.01.01.
- www.en.wikipedia.org/wiki/Hang_gliding
- Ask students what they notice about the number of triangles that are in the hang glider.
- Then have the students identify all of the different angles of the triangles, also include the interior and exterior angles.
- There are angles created by the strings too.
- Complete this as a whole class discussion.

III. Technology Integration

- Have students complete a google search on triangles in nature.
- There they will find hundreds of different images of how triangles are found in nature.
- Ask the students to look for triangles and assign them the task of finding a real example of triangles in nature.
- Have students bring in these examples the next day and show them to the class.

IV. Notes on Assessment

- This class is a discussion class.
- You want the students to see the connection between the different angles of the triangles both interior and exterior.
- Although it is not directly mentioned, you can draw students back to the Triangle Sum Theorem and explain how the measurement of the angles still equal 180°.
- Also make note of any congruent triangles and why they are important to the hang glider being able to fly.
- If the top sails weren't congruent, what would happen then?

Congruent Figures

I. Section Objectives

- Define congruence in triangles.
- Create accurate congruence statements.
- Understand that if two angles of a triangle are congruent to two angles of another triangle, the remaining angles will also be congruent.
- Explore properties of triangle congruence.

II. Cross- curricular-Bridge Construction

- Begin by showing students some truss bridge designs.
- For this activity, the students are going to use popsicle sticks or toothpicks to build a truss bridge.
- In younger grades, there are several workbooks on how to do this.
- Given that this is a high school course, have the students design and then build the bridge themselves.
- They need to draw a design first and get it approved.
- Then they can move on to the construction piece of the project.
- When finished, have students explain the importance of congruent triangles in building a solid bridge.

III. Technology Integration

- Students are going to work on a bridge exploration in this activity.
- Have the students google "triangles in bridges"
- Then the students need to look at the different types of bridges.
- Have the students explore two different types bridge designs.
- Ask the students to write congruence statements explaining the congruence of the triangles in the different bridge designs.
- When finished, allow students time to share their work.

IV. Notes on Assessment

- Grade student work in two parts.
- First, grade the design. Is it accurate? Is it neat? Is it labeled? Are the triangles congruent?
- Then grade the construction. Is it complete? Did the students demonstrate with congruent triangles? Is it accurate with the design?
- Provide students with feedback on their work.

Triangle Congruence Using SSS

I. Section Objectives

- Use the distance formula to analyze triangles on a coordinate grid.
- Understand and apply the SSS postulate of triangle congruence.

II. Cross- curricular-Quiltmaking

- Students are going to be creating their own quilt squares.
- This will extend into the next two lessons.

- In this first lesson, the students are going to design a square that uses triangles that can be proven congruent using the SSS postulate.
- Students should use certain colors in this square and design a key card to explain the color code and that the triangles can be proven congruent using the SSS postulate.
- For example, this red and blue quilt square is made up of triangles that can be proven congruent using the SSS Postulate.
- Then the student would include measurements.
- Students can create this as a poster on poster board or using cloth and sewing by hand.
- If sewing, students could have a small quilt by the time they have finished this chapter.
- If working on poster board, they will have a poster when finished.

III. Technology Integration

- Have students search on quilt making.
- There they can find directions on making quilt squares as well as different stitches to use.
- Students can also see examples of different quilts and quilt squares on different websites.

IV. Notes on Assessment

- Assess the student's quilt square.
- Does it represent the SSS postulate?
- Is it clearly explained on the note card?
- Provide students with feedback as needed.

Triangle Congruence Using ASA and AAS

I. Section Objectives

- Understand and apply the ASA Congruence Postulate.
- Understand and apply the AAS Congruence Postulate.
- Understand and practice two- column proofs.
- Understand and practice flow proofs.

II. Cross- curricular-Quilt making

- In this lesson, students are going to add on to their quilts.
- They need to design two different squares.
- One is going to use triangles that can be proven congruent using the ASA Congruence Postulate.

- One is going to use triangles that can be proven congruent using the AAS Congruence Postulate.
- Students need to create a color card with these two squares as well.
- They need to include measurements and explain how the triangles are proven congruent using the different postulates.
- This can be done as an addition to the poster that was started in the last lesson.
- It can also be done as an addition to a sewn quilt.

III. Technology Integration

- Have students complete some research on the history of quilt making.
- Request that each student write a short report on its history and relevance in American society.
- Students can research their material at home or school and write the report as part of a final grade on the quilt.

IV. Notes on Assessment

- Check each quilt square.
- Is the postulate represented?
- Is the note card clearly written?
- Is the report on quilt making clearly written?
- Provide feedback as needed.

Proof Using SAS and HL

I. Section Objectives

- Understand and apply the SAS Congruence Postulate.
- Identify the distinct characteristics and properties of right triangles.
- Understand and apply the HL Congruence Theorem.
- Understand that SSA does not necessarily prove triangles are congruent.

II. Cross- curricular- Quilt making

- Students are working on adding on to their quilts.
- In this lesson, they are going to be creating quilt squares using right triangles.
- After the student has created his/her square, ask them to create a color card to demonstrate congruence using the SAS Congruence Postulate.
- These quilt squares should contain right triangles.

- Add these quilt squares to the poster.
- Students can also sew these to the quilt.

III. Technology Integration

- Ask students to look at patterns using right triangles.
- Then have them find quilt patterns using right triangles.
- This investigation can impact their design work on the quilt squares.
- Have students look at some examples of Amish Quilts.
- How do they differ from other quilt designs?
- Ask the students to identify some of their favorite patterns and explain why they were selected.

IV. Notes on Assessment

- Examine student work.
- Is the student caught up on the work on the quilt?
- Is each square in today's lesson using right triangles?
- Does the student understand the SAS Congruence Postulate?
- Is this clearly demonstrated on the color card?
- Provide students with feedback/coaching as needed.

Using Congruent Triangles

I. Section Objectives

- Apply various triangles congruence postulates and theorems.
- Know the ways in which you can prove parts of a triangle congruent.
- Find distances using congruent triangles.
- Use construction techniques to create congruent triangles.

II. Cross- curricular-Quilt making

- Today have the students use what they have already been working on with regard to their quilts to explain the different congruence postulates.
- This can be a discussion piece that takes place in small groups.
- As the students discuss each of the triangles and how to prove congruence, the students will expand their understanding of the information.

- Next, allow time for students to "catch up" on unfinished work with regard to the quilts.
- If students are sewing, they will probably need an extra day to sew their quilt squares.

III. Technology Integration

- Have students go to the following website to explore the concepts behind proving triangles are congruent.
- www.onlinemathlearning.com/congruent-triangles.html
- This website not only has information for students to learn with, but also has short videos for students to watch.
- This is created as a support for students to expand what they have already learned.

IV. Notes on Assessment

- Listen to student explanations during the presentations.
- Listen for accuracy in student explanations.
- If the students are missing important information stop them and provide correction/feedback.
- If the students are not clear in their explanations, help them to clarify their explanation on how to determine congruence.
- You can also use this class as a way for students to complete their quilt squares.
- Help the students to make a backing for the quilt if it is made of cloth.
- If it is in poster form, then display the student quilt posters in the class.

Isosceles and Equilateral Triangles

I. Section Objectives

- Prove and use the Base Angles Theorem.
- Prove that an equilateral triangle must also be equiangular.
- Use the converse of the Base Angles Theorem.
- Prove that an equiangular triangle must also be equilateral.

II. Cross- curricular- Geodesic Domes

- For this activity, students are going to examine the equilateral triangles in a geodesic dome.
- Use this website to see this image. This is Figure 04.07.01.
- www.en.wikipedia.org/wiki/File:Epcot07.jpg
- Ask students to use to image to justify the Base Angles Theorem.

- Ask students to use the image to prove that an equilateral triangle is also equiangular.
- Show how an equiangular triangle is also equilateral.
- Allow time for the students to share their work in small groups.
- Have students work on designing their own geodesic dome.
- They can draw it out on graph paper.
- Once they decide on the size of the equilateral triangle, the rest comes together quite easily by repeating the pattern.
- The technology integration can help with this.

III. Technology Integration

- In designing their geodesic domes, the students may want some support from technology.
- Students can research geodesic domes and look at some designs for them.
- Here is another option. Use this website.
- www.fetchaphrase.com/dome/index.html
- This website shows you how to build a geodesic dome out of cardboard.
- Students can use this to construct small geodesic domes.

IV. Notes on Assessment

- Collect student explanations of the different concepts and theorems from the text.
- Be sure that the students have an understanding of how to prove each one of them using the image of the geodesic dome.
- If anything is unclear, provide students with correction and feedback.

Congruence Transformations

I. Section Objectives

- Identify and verify congruence transformations.
- Identify coordinate notation for translations.
- Identify coordinate notation for reflections over the axes.
- Identify coordinate notation for rotations about the origin.

II. Cross- curricular-Art Images

- Have the students select a singular image.

- They can choose any image that they would like to choose as long as it is singular and simple.
- Then have the students make several different copies of the image.
- If it is in book, they can use a copy machine.
- The students are going to create a piece of art using the image and what they have learned about transformations.
- Each of the transformations needs to be represented.
- Students are going to include a reflection, a rotation, a slide and a dilation of their image.
- Students should do this in a creative way.
- Students are welcome to use more copies of the image as long as at least one of the above listed transformations is in the art piece.

III. Technology Integration

- Have students use the following website to explore all of the different types of transformations.
- www.mathsnet.net/transform/index.html
- On this website, students can explore, understand and work with transformations in an interactive way.
- This is a great way to integrate technology into the lesson.
- You can have students work on this individually or in pairs.

IV. Notes on Assessment

- Examine each student's piece of art.
- Does it contain each of the required transformations?
- Is there more that the student could have done creatively?
- Provide students with feedback/criticism.
- Display work in the classroom.

1.5 Relationships Within Triangles

Midsegments of a Triangle

I. Section Objectives

- Identify the midsegment of a triangle.
- Apply the Midsegment Theorem to solve problems involving side lengths and midsegments of triangles.
- Use the Midsegment Theorem to solve problems involving variable side lengths and midsegments of triangles.

II. Cross- curricular-Mapping

- Use the following image of the Bermuda Triangle in this activity.
- This is Figure 05.01.01
- www.en.wikipedia.org/wiki/File:Bermuda_Triangle.png
- Each student will need a copy of the image to work with.
- Use a scale and a ruler to determine the distance between each of the vertices of the triangle.
- Then determine the midsegment of the triangle.
- Draw the midsegment into the image of the triangle.
- After drawing in the midsegment, write a proof that proves that this is the correct midsegment of the triangle.
- Students can work on this in pairs so that they have peer support when writing the proof.
- Students may want to name each of the vertices to help with writing the proof.
- When finished, allow time for the students to share their work.

III. Technology Integration

- Use Wikipedia or another website to research facts about the Bermuda Triangle.
- What are some of the mysteries surrounding this area?
- When was it discovered to be a "triangle" in shape?
- Be prepared to share your findings with the others in the class.

IV. Notes on Assessment

- Assess student understanding by examining the proof.
- Is it clear?
- Is the given information clear?
- Is it clear which information needs to be proven and which does not?
- Provide students with feedback on their work.
- Share strong example with the others in the class so that all can improve their proof writing.

Perpendicular Bisectors in Triangles

I. Section Objectives

- Construct the perpendicular bisector of a line segment.
- Apply the Perpendicular Bisector Theorem to identify the point of concurrency of the perpendicular bisectors of the sides (the circumcenter).
- Use the Perpendicular Bisector Theorem to solve problems involving the circumcenter of triangles.

II. Cross- curricular-Origami

- There are several different origami designs that you can do that require the use of an equilateral triangle.
- First, use this website to help the students move from a circle to an equilateral triangle.
- www.cyffredin.co.uk/The equilateral triangle.htm
- This will help the students to have an equilateral triangle in design.
- Then you can move on to folding in perpendicular bisectors of the triangle.
- This will help you to identify and mark the circumcenter.
- After the exploration is complete, you can ask the students what they have learned about the perpendicular bisectors of a triangle and the circumcenter of the triangle.
- Brainstorm a list of conclusions on the board.

III. Technology Integration

- Complete a websearch on origami.
- There are several different sites and patterns that students can explore.
- Ask them to select patterns that begin with an equilateral triangle.
- Use this pattern and the equilateral triangle to fold a dolphin or another animal of choice.
- Allow students time to share their work.

IV. Notes on Assessment

- Assessment is completed through observation.
- You can walk around and see students working with the equilateral triangles and the perpendicular bisectors as they fold their designs.

Angle Bisectors in Triangles

I. Section Objectives

- Construct the bisector of an angle.
- Apply the Angle Bisector Theorem to identify the point of concurrency of the perpendicular bisectors of the sides (the incenter).
- Use the Angle Bisector Theorem to solve problems involving the incenter of triangles.

II. Cross- curricular-Art

- This activity builds on the origami that the students completed in the last lesson.
- This time, students aren't going to be working with equilateral triangles but with three different sized triangles.
- Ask the students to cut out triangles that are three different sizes.
- Then with each triangle, students are to fold the paper to show the three bisecting lines of each of the angles of the triangle.
- In the end, the students will have the point of concurrency.
- From there, they can inscribe the circle into the triangle.
- Students need to complete this with all three triangles.
- Allow time for the students to share their work in small groups when finished.

III. Technology Integration

- Students can use the following website to explore bisecting angles.
- www.geom.uiuc.edu/~demo5337/Group2/incenter.html
- When finished, ask the students to share what they discovered about angle bisectors and inscribing circles.
- Write the conclusions on the board.

IV. Notes on Assessment

- Walk around and observe the students as they work on the paper folding.
- Assist students who are having difficulty.
- Students should see this as a hands- on way to work through the point of concurrency and inscribing circles.

Medians in Triangles

I. Section Objectives

- Construct the medians of a triangle.
- Apply the Concurrency of Medians Theorem to identify the point of concurrency of the medians of the triangle (the centroid).
- Use the Concurrency of Medians Theorem to solve problems involving the centroid of triangles.

II. Cross- curricular-Art

- Use the concept of Napolean's Theorem to create a new design/stained glass window effect.
- Review Napolean's Theorem and how it works.
- Then have students begin to work on a design.
- Students can explore trying different sizes of triangles.
- They can also see if it makes sense to integrate different shapes.
- Since the goal is a stained glass window of sorts, students are going to create a frame and then place different colored tissue paper inside the frame.
- Students can complete this and hang them in the window and the sunlight will come through the design.

III. Technology Integration

- One of the ways to integrate technology into this lesson is to have the students look at some of the other designs of Napolean's Theorem.
- They can begin by googling Napolean's Theorem.
- There will be several different websites that will come up where students can read about Napoleans Theorem and see different patterns and designs.
- When finished, students will have expanded their thinking on this theorem.

IV. Notes on Assessment

- Walk around and assist students as they work.
- When finished, assess student designs.
- Does it work according to Napolean's Theorem?
- If not, what would make a difference?
- Is the shape incorrect or does there need to be more shapes?
- How detailed did the student get?
- Is the stained glass window colorful and creative?
- Provide students with feedback on their work.

Altitudes in Triangles

I. Section Objectives

- Construct the altitude of a triangle.
- Apply the Concurrency of Altitudes Theorem to identify the point of concurrency of the altitudes of the triangle (the orthocenter).
- Use the Concurrency of Altitudes Theorem to solve problems involving the orthocenter of triangles.

II. Cross- curricular-Sculpture

- Investigate the concept of altitude by using the following image. This is Figure 05.05.01
- This is an image of the Mihashira Torii sculpture.
- www.en.wikipedia.org/wiki/File:Yamato_mihasira006.jpg
- Use this image and ask the students to share how they think the concept of altitude impacts this sculpture.
- Brainstorm ideas and write them on the board.
- Then set students to work on designing and building their own sculpture.
- You will need dowels, small hand saws, sand paper and wood glue or fast drying glue.
- You can use dowels with a small diameter so that they will be easy to cut.
- The students need to work with a triangle as the basic shape of the sculpture and demonstrate the altitude of the triangle in their sculpture.
- Allow time for the students to work and then present their sculptures when finished.

III. Technology Integration

- Investigate the concept of altitude using the computer.
- Ask the students to search all of the different ways that altitude impacts our way of life.
- Have them keep a list of the websites that they visit.
- They also need to make notes on at least ten different ways that altitude impacts how we live.
- Allow time for students to share their research when finished.

IV. Notes on Assessment

- Assessment is completed through observation.
- Walk around and see how the students are doing on their sculptures.
- Help out when needed.

Inequalities in Triangles

I. Section Objectives

- Determine relationships among the angles and sides of a triangle.
- Apply the Triangle Inequality Theorem to solve problems.

II. Cross- curricular-Sculpture

- In this activity, you are going to design a sculpture using triangles.
- You want to show that your triangles represent an inequality.
- To do this, you will need to design your sculpture before building it.
- This design should have measurements and demonstrate an inequality.
- When finished with the design, students can use clay to build their triangles.
- Have tools available to work with.
- When finished, have students write a short explanation of their sculpture, what they designed, how it was created and how it demonstrates the concept of an inequality.

III. Technology Integration

- Have the students research triangular sculptures.
- There are so many different sites to select and sculptures to see.
- Students need to select one triangle sculpture that they appreciate.
- Then there is a writing piece to this assignment.
- Students need to write about why they selected the piece and to use principles already learned to describe it.
- What kind of triangle(s) are in the sculpture?
- Is it in three- dimensions or two?
- Are there congruent triangles involved?
- How can you determine congruence?

IV. Notes on Assessment

- Assess student designs and sculptures.
- Does the design and the sculpture match up?
- Does the sculpture represent an inequality?
- Is student writing clear?
- Does the student have an understanding of the concept of triangle inequalities?
- Provide students with feedback/notes.

Inequalities in Two Triangles

I. Section Objectives

- Determine relationships among the angles and sides of two triangles.
- Apply the SAS and SSS Triangle Inequality Theorems to solve problems.

II. Cross- curricular- Architecture

- Use the concept of gable windows during this lesson.
- Students can use the two Theorems to determine the relationship between triangles in gable windows.
- Use the following image. This is Figure 05.07.01.
- www.loghomebuilders.org/files/images/log-home-bham-gable-windows.preview.jpg
- Have students work in small groups.
- In each group, the students need to come up with a way to prove the relationship between the two triangles in the image of gable windows.
- They are going to be using the SAS and the SSS Triangle Inequality Theorem to do this.
- When finished, have the students present their work to the class.

III. Technology Integration

- Expand this websearch into many different types of triangular windows.
- Some windows will show congruent triangles, but others won't.
- Have the students select a window pair that is congruent and then prove congruency.
- Have the students select a window pair that demonstrates an inequality and then prove this using the theorems.
- Have the students repeat the exercise that they did in small groups with a new window design.

IV. Notes on Assessment

- Assessment is completed through observation.
- Walk around as students work.
- Ask questions and probe into student thinking.

Indirect Proofs

I. Section Objectives

- Reason indirectly to develop proofs of statement.

II. Cross- curricular-Sports

- You have the job of being a sports announcer at a basketball game.
- To do this, you will be reporting on the actions of the game.
- However, you can only report your findings using if-then statements.
- You are going to prepare a short broadcast and then present it with a peer to the class.
- This is meant to be a fun short assignment to help students to see how to use if then statements in real life.
- Students will have fun with this.
- Give them time to work and props are fine to use as well.
- When finished, allow time for each pair to present their skit.

III. Technology Integration

- What is proof?
- Who uses proof?
- What kinds of careers or projects require people to prove something?
- Complete a web investigation on the topic of proof.
- Make a list of the websites that you visit.
- Keep a record of the data you discover.
- Write a one page paper to share/explain your findings.

IV. Notes on Assessment

- Assessment is complete through observation.
- Did the students use if- then statements?
- Were they prepared?
- Were they focused?
- Offer feedback to students as needed.

1.6 Quadrilaterals

Interior Angles

I. Section Objectives

- Identify the interior angles of convex polygons.
- Find the sums of interior angles in convex polygons.
- Identify the special properties of interior angles in convex quadrilaterals.

II. Cross- curricular-Mandalas

- Use the following image to discuss interior angles of quadrilaterals.
- This is Figure 06.01.01
- www.isibrno.cz/~gott/mandala/sriclr2.gif
- This is an image of a mandala that is composed of triangles that can also be interpreted to be quadrilaterals.
- You can use this image to discuss the measure of the interior angles of the quadrilateral with students.
- Show them how two triangles can be combined together to become a quadrilateral.
- Then remind students that the interior angles of a triangle add up to be 180° according to the Triangle Sum Theorem.
- Then ask the students to look at how many degrees are in a quadrilateral based on the fact that it is made up of two triangles.
- The students will conclude that it is equal to 360°.

III. Technology Integration

- Have students complete some research on mandalas.
- Where do they come from?
- When were they first used?
- What is the purpose of a mandala?
- Have students keep a record of the websites that they visit.
- Allow time for students to share their findings.

IV. Notes on Assessment

- Assessment is completed through student discussion.
- Listen to the students as they share their thoughts and ideas.
- Be sure that they understand how the interior angles of a quadrilateral are equal to 360°.

Exterior Angles

I. Section Objectives

- Identify the exterior angles of convex polygons.
- Find the sums of exterior angles in convex polygons.

II. Cross- curricular- Mandalas

- Use the information that you developed in the last lesson to work on this project.
- Use the image of the mandala on this website.
- This is Figure 06.02.01
- www.isibrno.cz/~gott/mandala/sriclr2.gif
- Now tell students that today they are going to be working to design their own mandalas.
- The students need to include triangles and quadrilaterals in their design.
- Then they also need to identify the interior and exterior angles of the quadrilaterals.
- Be sure to tell students to use color and creativity in their designs.
- Then have the students write a paragraph describing the mandala and explaining the connections between the interior angles and the exterior angles and the measurements of 180° and 360°.
- Allow time for students to share their work when finished.
- Display the mandalas in the classroom.

III. Technology Integration

- Students can go to the following website and investigate the interior and exterior angles of quadrilaterals.
- This site is fun, interactive and colorful.
- www.slideshare.net/guest4210b1/quadrilaterals
- Students can participate in this as an independent study activity.

IV. Notes on Assessment

- Assess student mandalas.
- Did the students incorporate the triangles and quadrilaterals?
- Are the interior angles labeled or identified in some way?
- Are the exterior angles labeled or identified in some way?
- Is the writing piece clearly written?
- Does it explain the angle measures?
- Provide students with feedback on their work.

Classifying Quadrilaterals

I. Section Objectives

- Identify and classify a parallelogram.
- Identify and classify a rhombus.
- Identify and classify a rectangle.
- Identify and classify a square.
- Identify and classify a kite.
- Identify and classify a trapezoid.
- Identify and classify an isosceles trapezoid.
- Collect the classifications in a Venn diagram.
- Identify how to classify shapes on a coordinate grid.

II. Cross- curricular-Art

- Use the following website and image of a geometric pattern for the following activity.
- This is Figure06.03.01
- www.tfaoi.com/cm/2cm/2cm511.jpg
- Ask the students to work in teams and identify all of the different quadrilaterals in the drawing.
- Students need to identify the quadrilateral and then write the characteristics of that quadrilateral.
- Next, have the students work to complete their own quadrilateral art piece.
- All of the different types of quadrilaterals should be included in the piece.
- Also, the art design should only consist of quadrilaterals.
- Design and color need to be included in this work.
- Once they have done the design, have the students write a description of their work identifying each quadrilateral in the design and its characteristics.

III. Technology Integration

- Students can go to the following website to see a video on how to identify and classify quadrilaterals.
- www.onlinemathlearning.com/quadrilaterals.html
- Then the students can use this information in the first part of this lesson, or this can be used to help students to solidify the information that they have already learned.

IV. Notes on Assessment

- Assess student designs.
- Have the students created a design composed only of quadrilaterals?
- Is it creative?
- Does the writing piece identify and describe each quadrilateral according to its characteristics?
- Provide students with feedback on their work.

Using Parallelograms

I. Section Objectives

- Describe the relationships between opposite sides in a parallelogram.
- Describe the relationship between opposite angles in a parallelogram.
- Describe the relationship between consecutive angles in a parallelogram.
- Describe the relationship between the two diagonals in a parallelogram.

II. Cross- curricular-Architecture

- Select several of the images on the following website.
- Print these images and distribute them to the students or have the students use computers to look at the images.
- www.trendir.com/house-design/
- All of the homes here are constructed using many different parallelograms.
- There are large parallelograms, small ones, all kinds of different ones.
- Ask the students to select one of the houses and work with it to identify the elements of the parallelograms in the designs.
- Students need to be looking for the relationship between the opposite sides of a parallelogram.
- The consecutive angles and the diagonals- how can the relationship be determined?
- Ask students to take notes on their home and then to share their findings in small groups.

III. Technology Integration

- One possible integration is to have the students explore this website and the house designs further.
- www.trendir.com/house-design/
- Then they can actually work to design their own home using parallelograms.
- Students can draw this out on grid paper or on plain paper.
- The key element or focus of the home must be the parallelogram.

- Have students share their work with their peers.

IV. Notes on Assessment

- Assessment is completed through observation.
- Walk around and participate in student groups as they look at the different elements of the house that they have been given.
- Examine each house design.
- Is the key element a parallelogram?
- Provide students with feedback on their work.

Proving Quadrilaterals are Parallelograms

I. Section Objectives

- Prove a quadrilateral is a parallelogram given congruent opposite sides.
- Prove a quadrilateral is a parallelogram given congruent opposite angles.
- Prove a quadrilateral is a parallelogram given that the diagonals bisect each other.
- Prove a quadrilateral is a parallelogram if one pair of sides is both congruent and parallel.

II. Cross- curricular- Drama

- Assign students the task of creating a skit to prove that a quadrilateral is a parallelogram.
- Begin this lesson by reviewing the different characteristics that make a quadrilateral a parallelogram.
- The synopsis of the skit is "Mr./Ms. Quadrilateral needs to prove that he/she is a parallelogram. He/she has selected Geo Geometry to prove the case."
- Then let the students go to work.
- They can use props, scenery (simple) and costumes.
- Allow time for them to write a skit and rehearse it.
- Then the students need to be given time to perform their skit.

III. Technology Integration

- Students can explore the properties of a parallelograms with the following website.
- www.mathwarehouse.com/geometry/quadrilaterals/parallelograms/interactive-parallelogram.php
- On this website, there is a place where it lists the criteria for proving that a quadrilateral is a parallelogram.
- Then it also has an interactive part where you can click and drag the vertices of the parallelogram to alter the side lengths, angle measures, etc.

- The numbers change instantly on the screen as you move the vertices around.
- A great interactive site to work with.

IV. Notes on Assessment

- Assess each skit.
- Did the students get the job done?
- Did they prove that the quadrilateral is a parallelogram?
- If so, what did they do well?
- If not, what was missing?
- Provide students with feedback on their work.

Rhombi, Rectangles, and Squares

I. Section Objectives

- Identify the relationship between the diagonals in a rectangle.
- Identify the relationship between the diagonals in a rhombus.
- Identify the relationship between the diagonals and opposite angles in a rhombus.
- Identify and explain biconditional statements.

II. Cross- curricular-Design Collage

- In this activity, have the students work in groups of three.
- Each student is going to select one of the three quadrilaterals.
- Then they are going to create a collage about the quadrilateral that they have chosen.
- Included in the collage should be pictures of their shape out in the world.
- Have each group pick a theme for their collage.
- For example, sports or nature or furniture.
- Students can hunt through magazines for these pictures.
- On one of the pictures, they need to draw in the angles and diagonals of the figure.
- This is a way to demonstrate the characteristics of that figure.
- When finished, each group should have a complete description of all three types of quadrilaterals.

III. Technology Integration

- Students can explore the properties of rectangles, squares and rhombi on the following website.

- www.mathsisfun.com/quadrilaterals.html
- This is a basic site, but since these are basic figures, the information should be review.
- There is also a place where they have interactive quadrilaterals and students can manipulate the size and configuration of the quadrilateral.

IV. Notes on Assessment

- Assess the continuity of each design trio.
- Is there a consistent theme?
- Does each design show the characteristics of each quadrilateral?
- Provide students with feedback on their work.

Trapezoids

I. Section Objectives

- Understand and prove that the base angles of isosceles trapezoids are congruent.
- Understand and prove that if base angles in a trapezoid are congruent, it is an isosceles trapezoid.
- Understand and prove that the diagonals in an isosceles trapezoid are congruent.
- Understand and prove that if the diagonals in a trapezoid are congruent, the trapezoid is isosceles.
- Identify the median of a trapezoid and use its properties.

II. Cross- curricular-Buildings/Construction

- Use the following image of the Flatiron Building in NYC from Wikipedia.
- This is Figure 06.07.01
- www.en.wikipedia.org/wiki/File:Flatiron_crop_20040522_114306_1.jpg
- Print the image so that the students can look at the image in their seats.
- Use this as a feature of discussion.
- Show the students how the sides of the building are the trapezoids.
- This building is formed by three trapezoids and then the top is a triangle.
- Are the students able to identify the type of triangle?
- What would the shape of the building change to if the sides were composed of four trapezoids instead of three?
- You can either have this part as a discussion or as an exploration.
- If you want students to explore this, be sure that they have cardboard, scissors, rulers, tape and a copy of the image to work with.

- Have the student begin by building a rough model of the Flatiron Building as it is now.
- Then they can look at altering it by adding another trapezoid.
- This gives students a discussion point about the building.
- Allow time to discuss and share findings and conclusions following the exploration.

III. Technology Integration

- Ask students to complete a websearch.
- Students are going to google "trapezoid images" for this websearch.
- There will be tons of different images that use trapezoids.
- Ask the students to select five different ones to share.
- If possible, have them print these images, if not they should make notes about the images and where the trapezoid is in the image.
- Also be sure that students write down any websites where the images are located.
- Allow time for students to share their work.

IV. Notes on Assessment

- Assess student understanding of trapezoids through class discussions and sharing.
- Provide students with feedback on their work.

Kites

I. Section Objectives

- Identify the relationship between diagonals in kites.
- Identify the relationship between opposite angles in kites.

II. Cross- curricular-Kites

- Have students work to design their own kite.
- They can look at the different kinds of kites that are possible by looking at the Wikipedia website.
- www.en.wikipedia.org/wiki/Kite
- In the kite, the students should show the diagonals and the opposite angles of the kite.
- Students should be very creative with their kite and have it say something about them.
- Use this in connection with the technology integration section.

III. Technology Integration

- Have students do some research on kites.
- They can do a web search on kites and see many different designs.
- Students should be able to report on the origin of kites.
- Three cultural elements of kites
- Three countries known for kites
- How and why kites fly
- How kites are used in science and technology
- Ask students to write a report on this topic.

IV. Notes on Assessment

- Assess student reports and kite designs.
- Is the design creative?
- Does it say something about the student?
- Is the report complete?
- Are all of the components in it?
- Provide students with feedback/correction as needed.

1.7 Similarity

Ratios and Proportions

I. Section Objectives

- Write and simplify ratios.
- Formulate proportions.
- Use ratios and proportions in problem solving.

II. Cross- curricular-Greek Architecture

- Provide students with an image of the Parthenon from Wikipedia.
- This is Figure 08.01.01
- www.en.wikipedia.org/wiki/File:Parthenon-2008.jpg
- Then provide students with an image of the Acropolis from Wikipedia.
- www.en.wikipedia.org/wiki/File:AthensAcropolisDawnAdj06028.jpg

- Now use the images as a discussion about the golden ratio of approx. 1.6 and how this is shown in the dimensions of each building.

III. Technology Integration

- Students can look at this website using The Golden Ratio and talking about how beauty has to do with ratios. Check it out first.
- www.intmath.com/Numbers/mathOfBeauty.php
- Students can also use this website which looks at ratios in nature.
- www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/fibInArt.html
- This website has a ton of different links for students to explore when looking at how ratios play into different topics.

IV. Notes on Assessment

- The content of this lesson is assessed through the discussion.
- You want students to understand that when you compare different facets, the ratios impact the design.
- With the golden ratio, the ratio is the same.
- Then you want the students to begin to make the connections on their own.
- Students can see the real life examples of ratios, especially the golden ratio.

Properties of Proportions

I. Section Objectives

- Prove theorems about proportions.
- Recognize true proportions.
- Use proportions theorem in problem solving.

II. Cross- curricular- Astronomy

- Use the following map of the constellations in this activity.
- This is Figure 08.02.01
- www.nightskyinfo.com/sky_highlights/july_nights/july_sky_map.png
- Use the image of Ursa Major and Ursa Minor to explore the concepts of proportions.
- Are the two images in proportion?
- How can we tell?
- Complete an in class discussion on what makes two images or two ratios a proportion.

- What kinds of measurements would we need to prove that the two constellations were proportional?
- Encourage students to work with the concepts of proportions and apply it to the constellation map.

III. Technology Integration

- Students can use this youtube video to study the planets in proportion.
- www.youtube.com/watch?v=PZNrQGCEXzs
- Students can follow this up by researching and comparing two planets.
- Have them choose two to compare and write ratios and proportions to compare them both.
- Allow time for students to share their work when finished.

IV. Notes on Assessment

- Assess student work through the discussion and through student notes.
- Were the students able to decide how to write proportions and ratios on the planets and constellations?
- Then provide students with feedback on their work.

Similar Polygons

I. Section Objectives

- Recognize similar polygons.
- Identify corresponding angles and sides of similar polygons from a statement of similarity.
- Calculate and apply scale factors.

II. Cross- curricular-Model Design

- This is a great opportunity to include scale and design into the mathematics classroom.
- You can work with this lesson in two different ways.
- The first way is to have the students choose a polygon and to build a model of two polygons that are similar using a scale model.
- This way, the students can actually have a hands- on experience of figuring out the dimensions of a scale model and then put these measurements to work building the model.
- The second way is to choose a mountain or a building for the students to use to create a scale design or model of.
- For example, if you chose the Empire State Building, the students would figure out the actual measurements, and then build a model or draw a design using a scale.
- You could do 1” per foot, etc.

- Allow time for students to share their work when finished.

III. Technology Integration

- Students can go to the following website to explore similar polygons.
- www.saskschools.ca/curr_content/byersjmath/geometry/students/polygon/intmovie.html
- When the students go to this website, they need to go to the section on similar polygons.
- From there, they can watch the animation which explains all how to determine similar polygons and how to create similar polygons.

IV. Notes on Assessment

- Check student work for accuracy.
- Is the scale accurate?
- Does the model or design match the scale?
- Do the students have a good understanding of similar polygons?
- Provide students with correction/feedback on their work.

Similarity by AA

I. Section Objectives

- Determine whether triangles are similar.
- Understand AAA and AA rules for similar triangles.
- Solve problems about similar triangles.

II. Cross- curricular-Pyramids

- This lesson will work best with the technology integration.
- Have students complete the study of Thales first and then move to a hands- on activity.
- Once students have selected a pyramid, they are going to work on this activity.
- Students are going to use the researched dimensions of the pyramid to build a model to scale.
- Students can build this model out of sugar cubes and glue.
- Sugar cubes tend to work well.
- After completing the model, use a darkened room and a high powered flashlight to demonstrate the shadow of the pyramid.
- Is it accurate according to Thales?

- See if the students can develop a way to test out this theory.
- Allow time for students to share their work when finished.

III. Technology Integration

- Have students complete some research on Thales and on indirect measurement.
- Students can read about Thales at the following website.
- www.phoenicia.org/thales.html
- Conduct a discussion on Thales and on how he discovered and figured out the height of the pyramids using indirect measurement.
- Once students have a good understanding of this, move on to the next part of this lesson.
- Then have the students do a search and choose a pyramid.
- Students are going to use the dimensions of this pyramid to build a model.

IV. Notes on Assessment

- Assess student work through discussion and observation.
- Do the students understand who Thales was and the significance of his discovery?
- Is the student model to scale?
- Were the students able to come up with a way to test Thales' findings?
- What are students sharing about this assignment?
- Is higher level thinking involved?
- Provide students with feedback as needed.

Similarity by SSS and SAS

I. Section Objectives

- Use SSS and SAS to determine whether triangles are similar.
- Apply SSS and SAS to solve problems about similar triangles.

II. Cross- curricular-Literature/Poetry

- In this activity, students need to create a poem, song or story that explains the three ways to figure out if two triangles are similar.
- The first is AA- angle angle
- The second is side- side- side.

- The third is side- angle- side.
- You can begin this lesson by reviewing the definitions of each and how to use them to figure out if two triangles are similar.
- Then divide students into groups of three.
- Have the groups work on their expression of figuring out if two triangles are similar.
- When finished, allow time for the students to share their work.

III. Technology Integration

- Students can go to the following class zone website and see the animation on similar triangles.
- www.classzone.com/cz/books/geometry_2007_na/get_chapter_group.htm?cin=2&rg=animated_math&at=animatic
- This is a fun interactive way to see the work done.
- Because class zone is affiliated with another textbook, the students can have a difficult time navigating the site.
- Use the link above for it.
- This will bring the students to the animation.
- If you don't wish to use class zone, students can also go to futureschannel.com and see a short movie on triangles and architecture.

IV. Notes on Assessment

- Assess each group's poem or story.
- Does it explain how to figure out if triangles are similar?
- Is each theorem well explained?
- Provide students with feedback as needed.

Proportionality Relationships

I. Section Objectives

- Identify proportional segments when two sides of a triangle are cut by a segment parallel to the third side.
- Divide a segment into any given number of congruent parts.

II. Cross- curricular-Proportional Divisions

- Have students participate in a hands- on activity to explore the section objectives.
- Students are going to work with several different triangles.

- The triangles should all be the same size.
- You can either prepare the triangles ahead of time or have the students cut them out themselves.
- Then have students work in small groups.
- In each group, the students are going to explore the proportional segments that are created when two sides of a triangle are cut by a segment parallel to the third side.
- They should try this will three different line segments each parallel to a different side.
- This means that the activity will get repeated with three different triangles.
- The students need to measure each side and write proportions to represent the different sections of the triangle.
- For example, when the triangle is cut, there are two polygons- how do the side lengths compare? Are they in proportion?
- Students need to make notes on these comparisons and share them with the other students.

III. Technology Integration

- Use Wikipedia to explore the concept of proportionality.
- www.en.wikipedia.org/wiki/Proportionality
- Students can look at proportionality in mathematics, but also in human design and architecture.
- There are several different links to explore.

IV. Notes on Assessment

- Assess student understanding by observing their work in small groups.
- Were the students able to successfully cut the triangles into proportions?
- Were they able to write proportions that demonstrate that the two polygons are similar?
- Provide feedback as needed.

Similarity Transformations

I. Section Objectives

- Draw a dilation of a given figure.
- Plot the image of a point when given the center of dilation and scale factor.
- Recognize the significance of the scale factor of a dilation.

II. Cross- curricular- Art

- The name of this activity is “Honey I Shrunk the Polygon!”

- Students are going to take any polygon that they would like to and create an art piece that shows the dilations of the polygon.
- The polygon that is the beginning polygon should be in red.
- That way you can tell which polygon is being transformed.
- Students should create dilations which are smaller and larger.
- The scale factor can be decided by the student.
- The scale should be the same whether the polygon is being dilated smaller or larger.
- Allow students time to work.
- Display student work when finished.

III. Technology Integration

- To look at different dilations, students can do some research on Christmas Tree Farms.
- Because farms often use the same kind of tree, there will be small versions of the tree and large versions of the tree.
- This is a real life look at dilations.
- Students can do some work drawing different trees.
- Have them choose one to begin with and then dilated two or three times.
- This will show a "growth progression" of the tree.

IV. Notes on Assessment

- Ask the students to share their dilated polygons.
- What works about the polygon and what doesn't work?
- Is there an accurate scale factor?
- Are both images correctly dilated?
- Provide students with feedback.

Self- Similarity (Fractals)

I. Section Objectives

- Appreciate the concept of self- similarity.
- Extend the pattern in a self- similar figure.

II. Cross- curricular- T-shirt Design

- Review the concept of fractals and what makes a fractal image.

- Then show students the image on this website.
- This is Figure 07.08.01
- www.redbubble.com/people/archimedesart/art/3390955-4-bright-lights
- Then show students this second fractal.
- This is Figure 07.08.02
- www.zazzle.com/right_angles_tshirt-235230222951842274
- Discuss these fractals with the students.
- Notice the quadrilaterals in the image.
- This is a T- shirt design.
- Have students design their own fractal t- shirt.
- This can be as complicated or simple as you wish.
- Students can use fabric paint and fabric markers to actually draw their fractal on their shirt.
- They could also create a pattern with a piece of cardboard and then use fabric paint to paint over the image and have it displayed on the shirt.

III. Technology Integration

- Have students research vegetable fractals.
- There are so many interesting images of fractals.
- Ask the students to select a few and write about why they chose the one that they did.
- Also, ask the students to explain, to the best of their ability, how the image is a fractal.
- What characteristics/qualities make it a fractal?
- Allow time for students to share their thinking when finished.

IV. Notes on Assessment

- When looking at student t-shirt designs, you are looking for a representation of a fractal.
- This can be assessed by looking at each t- shirt.
- Provide students with feedback when finished.

1.8 Right Triangle Trigonometry

The Pythagorean Theorem

I. Section Objectives

- Identify and employ the Pythagorean Theorem when working with right triangles.
- Identify common Pythagorean triples.
- Use the Pythagorean Theorem to find the area of isosceles triangles.
- Use the Pythagorean Theorem to derive the distance formula on a coordinate grid.

II. Cross- curricular-Toy Construction

- If possible, complete this after watching the movie.
- Divide the students into groups of three or four.
- You will need Kynex for this activity.
- Students may be able to bring in some from home.
- If Kynex are not available, just have this be a design project.
- Tell the students that they are going to be designing a toy that has a right triangle as its core component.
- Students can use other shapes as well, but the triangle is central.
- Students are to draw a design of their toy.
- Then, students are to build a model using the Kynex.
- Allow time for students to share their work when finished.

III. Technology Integration

- Use the following website so that students can watch a short movie on creating triangular toys.
- www.thefutureschannel.com/dockets/realworld/inventing_toys/
- This video shows how two designers working for Kynex design toys.
- Tell the students to notice all of the uses of polygons and triangles in the designs.
- When finished, discuss the video.
- What did the students observe?
- What did they notice about the shapes used in the toy designs?
- How did patterns impact the work of the designers?
- How does geometry impact their work?

IV. Notes on Assessment

- Assess each toy design and construction.
- You may want to create a rubric for grading the toys.
- Observe students as they work.
- Provide students with feedback when necessary.

Converse of the Pythagorean Theorem

I. Section Objectives

- Understand the converse of the Pythagorean Theorem.
- Identify acute triangles from side measures.
- Identify obtuse triangles from side measures.
- Classify triangles in a number of different ways.

II. Cross- curricular-Architecture/Design

- Use the following image from Wikipedia to show students an image of St. Basil's Cathedral.
- This is Figure 08.02.01
- www.en.wikipedia.org/wiki/File:RedSquare_SaintBasile_(pixinn.net).jpg
- You can either use this image as a discussion point or have students work with it in small groups.
- In small groups, have the students identify the equilateral and acute triangles in the cathedral.
- There are many of them to choose from.
- Then ask the students to identify how they know that these are equilateral and acute.
- The students should be able to discuss the different characteristics of what makes an acute triangle acute and what makes an equilateral triangle equilateral.
- Have students discuss this in small groups.

III. Technology Integration

- Ask students to research triangles and bridge designs.
- What is the most common type of triangle used in bridge designs?
- Why is it the most common?
- Have the students do some research on this and then report on their findings.
- Students should keep track of any websites they visit to refer back to when reporting on their findings.

IV. Notes on Assessment

- Observe students as they work.
- Listen to the discussions and you will hear whether the students have an understanding of acute, obtuse and equilateral triangles.
- Ask questions to expand student thinking.

Using Similar Right Triangles

I. Section Objectives

- Identify similar triangles inscribed in a larger triangle.
- Evaluate the geometric mean of various objects.
- Identify the length of an altitude using the geometric mean of a separated hypotenuse.
- Identify the length of a leg using the geometric mean of a separated hypotenuse.

II. Cross- curricular-Triangular Lodge

- Have students use this website, or show them the image and give them the measurements that they will need to work with.
- www.daviddarling.info/encyclopedia/T/Triangular_Lodge.html
- This is a building that is composed on a triangle.
- We know that each side of the triangle is 33 feet long.
- If this is the case, what is the altitude of the building?
- Have student work in small groups or pairs to solve this problem.
- Students will need to work through the formula for geometric mean in the text.
- If they are having trouble, refer them back to the text for this information.
- Solution:
- $33 \times 33 = 1089$ feet
- $\sqrt{1089} = 33$ feet
- Be sure that the students understand how the measurements are all the same.
- Allow time for questions and feedback.

III. Technology Integration

- Have students complete some research on circus tents.
- Circus tents use poles and canvas to hold up the tent.

- The use of the poles impacts the height or altitude of the tent.
- Ask the students to report on the most common design of a circus tent.
- Have them make a list of the websites that they visit and to select one type of tent or image to discuss.
- You can conduct a discussion about how geometric mean, altitude and triangles connect with circus tents.
- How are they interconnected?
- This will require the students to use higher level thinking skills since the connections may not be obvious.

IV. Notes on Assessment

- Assess student understanding through discussion.
- Try to have time for each group to share.
- You will see how much the students understand through their sharing and conversation.

Special Right Triangles

I. Section Objectives

- Identify and use the ratios involved with right isosceles triangles.
- Identify and use the ratios involved with $30-60-90$ triangles.
- Identify and use ratios involved with equilateral triangles.
- Employ right triangle ratios when solving real- world problems.

II. Cross- curricular-Sports

- Use the following image of a baseball diamond from Wikipedia.
- This is Figure 08.04.01
- www.en.wikipedia.org/wiki/File:Baseball_diamond_marines.jpg
- This is a problem to solve.
- Here is the problem.
- If the distance between the bases is 90 feet, how far will the first baseman throw the ball to reach the third baseman?
- Solution:
- To solve this problem, you can use the Pythagorean Theorem since each of the bases is at a 90° angle.
- Therefore, you can split up the baseball diamond into $45-45-90$ triangles.
- $90^2+90^2=c^2$

- $8100 + 8100 = c^2$
- $16200 = c^2$
- 127.2 feet is the distance from first to third base.

III. Technology Integration

- Have the students complete a websearch on baseball fields across the United States.
- Students can select their favorite one and report on its dimensions.
- Does the Pythagorean Theorem work for all baseball diamonds?
- Conduct a discussion exploring the angles and dimensions of baseball diamonds.

IV. Notes on Assessment

- Were the students able to solve the problem?
- Were there struggles?
- Did the students see the right angles in the diamond?
- Did they notice that they could divide the diamond into two $45 - 45 - 90$ triangles?
- Where is the hypotenuse of the triangles?
- Assess student work and provide feedback as needed.

Tangent Ratios

I. Section Objectives

- Identify the different parts of right triangles.
- Identify and use the tangent ratio in a right triangle.
- Identify complementary angles in right triangles.
- Understand tangent ratios in special right triangles.

II. Cross- curricular-Art/Furniture Making

- Have the students look at the website or show them the images of the triangle table.
- You can use this as a discussion piece.
- Ask the students to identify the parts of the right triangle.
- Then ask them to identify the tangent ratio of the right triangle.
- Finally, students can be given the task of constructing their own right triangle table.
- Students will need tools and saws to do this.

- You may want to see if you can combine this activity with woodshop, if offered in your school.
- Have the students share their work when finished.

III. Technology Integration

- Have the students explore the concept of dragon tiles that have right angles in them.
- The students can go to the following website to explore this.
- www.ecademy.agnesscott.edu/~lriddle/ifs/levy/tiling.htm
- This will provide students with step by step directions on how to complete the dragon tiles.
- Have students work in small groups.
- When the students have finished studying the information on the website, have them go ahead and create their own pattern of dragon tiles.
- Students can work in pairs on this.
- They can either draw in each tile, or create a pattern to trace.
- Either way, the dragon tiling will be completely made of right triangles.

IV. Notes on Assessment

- Assessment can be completed by looking at each student's work product.
- If you built triangle tables, are the measurements of the table accurate?
- Is the table a right triangle?
- If you completed a dragon tiling, is it accurate?
- Does it show right triangles?
- Offer students feedback as needed.

Sine and Cosine Ratios

I. Section Objectives

- Review the different parts of right triangles.
- Identify and use the sine ratio in a right triangle.
- Identify and use the cosine ratio in a right triangle.
- Understand sine and cosine ratios in special right triangles.

II. Cross- curricular-Land Surveying

- Find a local land surveyor and ask him/her to visit the classroom.

- This is an opportunity to have a speaker come and teach the students about how geometry can be applied in real life situations.
- Ask the speaker to be prepared to show the connection between land surveying and geometry.
- Also ask him/her to please bring tools for students to see.
- Students will need to complete some research on land surveying prior to the speakers presentation.
- Have the students prepare five questions each to ask the speaker, and be sure that the students ask questions of the speaker when he/she is there.
- Students can prepare a written report sharing how land surveying is connected to geometry following the presentation.

III. Technology Integration

- Use the internet to research land surveying.
- Be sure that the students understand what land surveyors do, some of the tools used, and how right triangles play a part in land surveying.
- There are several websites that students can visit to do this.
- They will find a lot of information simply by using google or Wikipedia.

IV. Notes on Assessment

- Read each students report on the speaker.
- Assess student knowledge and ability to connect this career with geometry.
- Did the students simply repeat the presentation, or did he/she bring their own thoughts and opinions into the paper?
- Provide students with feedback on their work.

Inverse Trigonometric Ratios

I. Section Objectives

- Identify and use the arctangent ratio in a right triangle.
- Identify and use the arcsine ratio in a right triangle.
- Identify and use the arccosine ratio in a right triangle.
- Understand the general trends of trigonometric ratios.

II. Cross- curricular-Environmental Studies

- Use the following page of information to show students how tangents and arctangents are used in real world applications.

- www.e-education.psu.edu/natureofgeoinfo/c7_p10.html
- This website shows the students that when people are studying the environment and changes in elevation, that they use the measurements of slope to do this.
- Review slope with the students.
- Then you can move on to connecting slope with the tangent ratios.
- These ratios can show how a slope or how elevation is changing over time.
- For example, take beach erosion.
- When the beach or coast is eroding away due to a storm or hurricane, the slope of the land before the storm and after the storm can be compared.
- In the same example, the change in the degrees of the triangle (the arctangent) can be used to compare or demonstrate change as well.
- Have the students think of other types of elevation changes.
- Brainstorm examples and write them on the board.

III. Technology Integration

- Here is a great video showing a word problem and how to figure it out.
- www.video.yahoo.com/watch/3008744/8600194
- Students can watch this video for some extra practice on solving trigonometric word problems.
- Then they can practice writing their own.
- Have the students write an answer key too.
- When finished, collect the word problems for further use.

IV. Notes on Assessment

- Collect student word problems.
- Read them and assess whether or not the students have a good grasp of the material.
- Use the word problems for a quiz or homework assignment.
- Provide students with feedback as needed.

Acute and Obtuse Triangles

I. Section Objectives

- Identify and use the Law of Sines.
- Identify and use the Law of Cosines.

II. Cross- curricular-Comic Strip

- Students are going to write a comic strip that tells what happens when someone breaks the Law of Sines.
- Students can make this comical and draw characters to go with it.
- It is a creative assignment, but one that also incorporates mathematical information in it.
- It should be considered a fun assignment, but one that also needs to be accurate.
- Students can work on their comic strip in pairs.
- Allow time for students to work.
- Each strip should have writing and animation with it.
- When finished, allow time for the students to share their work.

III. Technology Integration

- Here is a movie that students can watch about landscape architecture and triangulation.
- www.thefutureschannel.com/hands-on_math/survey_team.php
- After watching the film, conduct a discussion on the film and what students learned about geometry and being a landscape architect.

IV. Notes on Assessment

- Collect each comic strip.
- Read them and assess them on two levels.
- 1. Is the mathematical content accurate?
- 2. Is it presented in a creative way?
- Provide students with feedback/correction as needed.

1.9 Circles

About Circles

I. Section Objectives

- Distinguish between radius, diameter, chord, tangent, and secant of a circle.
- Find relationships between congruent and similar circles.
- Examine inscribed and circumscribed polygons.
- Write the equation of a circle.

II. Cross- curricular-Nature

- Look at the following examples of circles in nature.
- These images are Figure 09.01.01
- www.naturesmightypictures.blogspot.com/2006/06/circles-in-nature.html
- While these don't specifically name all of the parts of a circle, use these images to discover the different parts of a circle.
- Where is the radius or the diameter?
- Is there a polygon inscribed in any of the circles?
- For example, look at the sunflower or the rose.
- Are any of the circles similar?
- For example, look at the patterns in the different images. Do you see any similar circles?
- Have a discussion with the students that broadens their thinking about circles and the parts of a circle.
- Then ask the students to find an example of circles in nature.
- Bring it into class the next day.

III. Technology Integration

- Students are going to be working to make connections between circles and real world activities.
- How are circles used in different careers?
- This first example is a designer who makes wheels.
- This designer makes wheels that are used in performance racing.
- As students watch this video, have them make notes on the different geometric elements that are mentioned in the video.
- Then following the video, conduct a discussion on how geometry and wheel design are related.
- www.thefutureschannel.com/hands-on_math/spoke_math.php

IV. Notes on Assessment

- Assessment is completed through class discussion.
- Work to have all students participate in the discussion.
- Ask questions of the students and provide feedback as needed.

Tangent Lines

I. Section Objectives

- Find the relationship between a radius and a tangent to a circle.
- Find the relationship between two tangents draw from the same point.
- Circumscribe a circle.
- Find equations of concentric circles.

II. Cross- curricular-Design

- Have students look at the following image from Wikipedia.
- This is Figure 09.02.01
- www.en.wikipedia.org/wiki/File:Concentric_(PSF).png
- This is a picture of concentric circles.
- Have students discuss the characteristics of concentric circles.
- Are they similar?
- How can we design a concentric circle?
- Ask the students to create a black and white art design using concentric circles.
- Students will need white paper, black pencil or marker, a compass.
- Have the students work to create their own design.
- Also have them insert one tangent line somewhere in the design.
- Allow time for students to share their work when finished.

III. Technology Integration

- This is a very fascinating website for students to explore.
- www.cut-the-knot.org/Curriculum/Geometry/TangentTwoCirclesI.shtml
- In working with this website, students will be manipulating the center of one of the circles.
- They can click on the center and drag the center anywhere that they wish to.
- When they do this, they will alter the diagram of the two circles and their tangents.
- It is a great visual and very interactive.

IV. Notes on Assessment

- Assess student work with the art design.

- Is the design of the concentric circles accurate?
- Are the circles organized around a common center?
- Is there a tangent in the design?
- Does the student understand what a tangent is based on what he/she has drawn?
- Provide students with feedback as needed.

Common Tangents and Tangent Circles

I. Section Objectives

- Solve problems involving common internal tangents of circles.
- Solve problems involving common external tangents of circles.
- Solve problems involving externally tangent circles.
- Solve problems involving internally tangent circles.
- Common tangent

II. Cross- curricular-Mad Tea Party

- Use the following images from Wikipedia on the Mad Tea Party.
- This is Figure 09.03.01
- www.en.wikipedia.org/wiki/Mad_Tea_Party
- Students can even complete the technology integration first to see some real pictures of the tea cups in action.
- Tell the students that their task is to draw the design of the Mad Tea Party using circles that are connected.
- The design of the Mad Tea Party consists of three small turntables, which rotate counter clock-wise, each holding six teacups, within one large turntable, rotating clockwise.
- Students are to draw this design and how they hypothesize that the circles are or are not connected.
- Do the students think that tangents play a role in this?
- Why or why not?
- Ask the students to write a short paragraph explaining their thinking about the ride.

III. Technology Integration

- Have students complete a websearch for the Mad Tea Party at Disney World.
- Students will see images and can even see a film clip of the ride on youtube.
- Students can use this information to assist them in drawing the design of the ride.

IV. Notes on Assessment

- Assess student work.
- How did the students draw the design of the ride?
- What was the student's hypothesis about tangents?
- Does the reasoning make sense?
- Provide students with comments on their work.

Arc Measures

I. Section Objectives

- Measure central angles and arcs of circles.
- Find relationships between adjacent arcs.
- Find relationships between arcs and chords.

II. Cross-curricular-Plate Design

- Use the image of the dinner plate with the stripes by Cynthia Rowley.
- This is Figure 09.04.01
- www.prontohome.com/product/whim-by-cynthia-rowley-melamine-p_1213285046
- Use this to show the students where there are arcs and chords.
- Then show them major and minor arcs as well.
- The assignment is for the students to design their own plate design using lines, chords and circles.
- Tell the students that they are free to design the plate however they would like as long as they label the major arcs and the minor arcs.
- They also need to figure out the measure of one of the arcs and explain how they completed this task.
- Allow time for the students to share their work when finished.

III. Technology Integration

- Have students go to www.brittanica.com the encyclopedia Brittanica's website and search for Eratosthenes of Cyrene.
- Have them research how he used arcs to figure out the circumference of the earth.
- This may be challenging for the students to understand, so you may want to either allow them to work in small groups or to discuss this as a whole class.
- Begin by having them take notes on their own, then begin the discussion.

IV. Notes on Assessment

- Assess each plate design.
- Is it creative?
- Does it use the concepts of chords and arcs?
- Are the major and minor arcs labeled?
- Did the students figure out the measure of one of the arcs?
- Is the work written out and explained?
- Provide students with comments/feedback on their work.

Chords

I. Section Objectives

- Find the lengths of chords in a circle.
- Find the measure of arcs in a circle.

II. Cross- curricular-Archimedes

- Use the image and information at the following website.
- Display this image for the students to see.
- This is Figure 09.05.01
- Now have the students copy this image on a piece of paper.
- In small groups, the students need to use this image to prove that the sum of the intercepted opposite arcs is equal.
- Students can use the text to refer back to the information that they have learned.
- They need to write five statements that demonstrate that this is a true statement.
- Students should be prepared to present their findings.

III. Technology Integration

- Begin with this statement, "It could be said that a spoke is the chord of a wheel."
- Use different wheel designs to demonstrate how this is true or untrue.
- You may use a drawing program to draw and design support for your answer.
- You may also use a collection of images to support your answer.
- Be prepared to share your work when finished.

IV. Notes on Assessment

- When the students present their findings, listen to their reasoning.
- Challenge the others in the class to do the same thing.
- How does it support what we know about perpendicular lines and angles?
- How does it support what we have learned about arcs?
- Does the reasoning of the group make sense or is something missing?
- Is there a diagram to support their thinking?
- Did the students complete any measurements?
- Provide students with feedback on their work.

Inscribed Angles

I. Section Objectives

- Find the measure of inscribed angles and the arcs they intercept.

II. Cross- curricular-Theater

- This is a problem that needs to be solved. It will require the students to use angle measures.
- This is picture of a seating chart for the Fichander Theater.
- This is Figure 09.05.01
- www.gotickets.com/venues/dc/fichandler_theatre.php
- Be sure that each student has a copy of the image.
- Show students how this is a theater in the round.
- The seating is arranged in a circle.
- The students need to use what they have learned about angles and arcs to determine which seats have the best angle to see the stage.
- Note: Students may determine right away that all of the seats are equal due to their angles. Why is this? Have them prove their thinking.

III. Technology Integration

- Students can go to the following website for a worksheet where they can practice finding the measure of inscribed angles.
- This is a great site for simple practice and drill of skills already learned.
- www.regentsprep.org/Regents/math/geometry/GP15/PcirclesN.htm

- Students can also go to any of several websites to find further explanation of inscribed angles and of the measure of those angles.
- Any of these sites will support students in expanding their understanding.

IV. Notes on Assessment

- Walk around and observe students as they work.
- Then have the students share their thinking about the theater problem.
- Be sure students are able to articulate their reasoning by using content from geometry.
- Diagrams are an excellent way for students to share their thinking.

Angles of Chords, Secants and Tangents

I. Section Objectives

- Find the measures of angles formed by chords, secants and tangents.

II. Cross- curricular-Poetry

- Students are assigned the task of writing a poem or rap about the theorems in the text.
- Students can choose to write their poem about one of the theorems or all of the theorems.
- Students could also write a poem that defines and explains the relationship between chords, secants and tangents.
- It isn't necessary to give too many directions for this assignment.
- Let the students work in small groups, and they will illustrate their level of understanding of the material through the poem.
- When finished, allow students time to present their work.

III. Technology Integration

- Have students complete this chapter by completing a websearch on circles in architecture.
- They can google this topic.
- Have the students keep track of the sites that they visit.
- They need to select three different images that best illustrates the content of the chapter.
- The students need to write a paragraph explaining how each one illustrates the concepts of the chapter, and which concepts it illustrates.
- Have students share their work when finished.

IV. Notes on Assessment

- Assess student work through their presentations.
- How well does the poem explain the theorem or theorems?
- How well does the poem explain the definitions from the text?
- Are the images that the student selected in line with the content from the chapter?
- Did the student explain which concepts are illustrated in the image?
- Is the information accurate?
- Provide students with feedback on their work.

Segments of Chords, Secants and Tangents

I. Section Objectives

- Find the lengths of segments associated with circles.

II. Cross- curricular- Circus math

- This is a problem having to do with the circus.
- Here is the problem.
- A circus ring has a diameter of 42 feet.
- A high wire is stretched across the diameter of the circle
- A second wire is stretched across the diameter of the circle.
- The two wires intersect at one point.
- On the first wire, the lengths of the wire are ten feet and eight feet.
- On the second wire, only one section of the wire is known and that is five feet.
- What is the length of the second section of the wire?
- Have students work in small groups on this problem.
- It is a great idea to have students draw a diagram of the solution of the problem.
- Solution:
- $10 \times 8 = 5x$
- $80 = 5x$
- $x = 16$ feet
- The diameter of the circle has no impact on the answer of this problem.

III. Technology Integration

- Have students go to the following website to do some research about high wire acts in the circus.

- www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/hwire.html
- What kind of math is involved in this art?
- Does the diameter of the wire impact the act?
- Have students write a short report on what they have learned about math and the high wire.
- Students can even complete the activity at the end of the web page and experience walking a "high wire" of sorts themselves.

IV. Notes on Assessment

- Check the solution to the problem.
- Did the students use a diagram?
- Is the diagram accurate?
- Were they able to solve the problem accurately?
- Provide students with feedback and comments.

1.10 Perimeter and Area

Triangles and Parallelograms

I. Section Objectives

- Understand the basic concepts of the meaning of area.
- Use formulas to find the area of specific types of polygons.

II. Cross- curricular-Reflecting Pool dimensions

- Use the following image from Wikipedia of the Reflecting Pool in Washington, DC.
- This is Figure 10.01.01
- www.en.wikipedia.org/wiki/File:Reflecting_pool.jpg
- Here is the problem.
- According to Wikipedia, the dimensions of the Reflecting Pool are 2029 ft long and 167 feet wide.
- Given this information, what shape is the Reflecting Pool?
- What is the perimeter of the pool?
- What is the area of the pool?
- Draw a diagram to explain your answer.
- Solution:

- The shape is a rectangle.
- The perimeter is $2029 + 2029 + 167 + 167 = 4392$ ft.
- The area is $2029 \times 167 = 338,843$ sq. ft.

III. Technology Integration

- There are two great short videos on this website for area and length.
- One is an architect and one is on an apartment design.
- www.thefutureschannel.com/hands-on_math/apartment.php
- Have students watch the videos.
- Then you can expand on this by having the students draw a design of their room at home.
- Students will need to go home and do some measurements and then come back with the area and perimeter of their room.
- Rooms with unconventional shapes will be the most fun and challenge.
- Allow time for students to share their work.

IV. Notes on Assessment

- Assess student work on the Reflecting Pool problem.
- Is the diagram accurate?
- Did the students calculate the area correctly?
- Did the students calculate the perimeter correctly?
- Provide students with feedback on their work.

Trapezoids, Rhombi and Kites

I. Section Objectives

- Understand the relationships between the areas of two categories of quadrilaterals: basic quadrilaterals and special quadrilaterals.
- Derive area formulas for trapezoids, rhombi and kites.
- Apply the area formula for these special quadrilaterals.

II. Cross- curricular-Room Design

- Tell students that they are going to design a room that has a trapezoidal shape.
- Students can complete this in connection with the Technology Integration if you choose.

- If not, have the students use the dimensions of their own bedroom (they did this in the last lesson), or the classroom or a standard size bedroom (11×10) for example.
- Students are going to redesign this area as a trapezoid.
- They want to come as close to the original area as possible.
- So if the room was 11×10, the area is 110 sq feet.
- How can you come close to the same area if the shape of the room is a trapezoid?
- Students should draw their design on grid paper and explain their thinking.
- Allow time for students to share their work when finished.

III. Technology Integration

- This is a website that shows a house designed as a trapezoid.
- www.momoy.com/2009/04/02/l-house-beautiful-trapezoid-house-design-by-philippe-steubi-architekten-gmbh/
- Students can look at the trapezoid shape of the house and the floor plan is also included.
- There are views of the inside of the house and the outside of the house as well as some of the rooms.
- Conduct a discussion about the house. What would be the challenges of designing and building such a house?

IV. Notes on Assessment

- Assessment will come with student presentations and work product.
- What did students learn about the relationship between rectangles and trapezoids?
- Were they able to come up with a room with an area close to the original?
- Who got the closest?
- Provide students with feedback on their work.

Area of Similar Polygons

I. Section Objectives

- Understand the relationship between the scale factor of similar polygons and their areas.
- Apply scale factors to solve problems about areas of similar polygons.
- Use scale models or scale drawings.

II. Cross- curricular-National Mall Mapping

- Ask students to use the Wikipedia image of the National Mall to create a map of it.

- This is Figure 10.03.01
- www.en.wikipedia.org/wiki/National_Mall
- Then tell the students that the mall is 1.9 miles $\times$ 1.2 miles.
- They are going to use what they have learned about scale and measurement to create their own map of the mall.
- They need to choose a scale to work with.
- Then they use grid paper to design the mall.
- When students have the area of the mall correct, they can draw in as many different museums and monuments as they can.
- Extra details add extra credit to their work.
- When finished, allow time for students to share their work.

III. Technology Integration

- Use the following website on the National Mall in Washington DC.
- www.en.wikipedia.org/wiki/National_Mall
- Have students complete some research about the mall.
- Possible questions include:
- Who designed it?
- When was it built?
- What is at the North end?
- What is at the South end?
- How many different museums can you visit there?
- Have you been to the mall?
- Which museum would you most like to visit or did you enjoy and why?

IV. Notes on Assessment

- Assess each student map.
- Is the use of scale done correctly?
- Are the measurements correct?
- Is the map accurate?
- Has the student take the time to add in details?
- Provide students with feedback on their work.

Circumference and Arc Length

I. Section Objectives

- Understand the basic idea of a limit.
- Calculate the circumference of a circle.
- Calculate the length of an arc of a circle.

II. Cross- curricular-The Pantheon

- Have students use the image of the floor plan of the rotunda of the Pantheon to calculate the circumference of it.
- This is Figure 10.04.01
- www.en.wikipedia.org/wiki/Pantheon,_Rome
- The diameter of the dome is 142 ft.
- Given this measurement, what is the circumference?
- Have the students draw a diagram to explain their work.
- Allow time for students to share their diagrams in small groups.

III. Technology Integration

- Have students use the following Wikipedia site to research information on the Pantheon.
- www.en.wikipedia.org/wiki/Pantheon,_Rome
- Students can use this information to write a short essay.
- Students should hunt for mathematical information about the Pantheon for their essay.
- For example, height of the columns.
- What is a portico?
- What is a rotunda?
- Have the students complete this work and then collect it for your review.
- Extension on initial exercise- have students research the dimensions of the rectangle that connect the portico and the rotunda.
- What is the area of the rectangle?
- What is the perimeter?

IV. Notes on Assessment

- Look at student work.
- Is it accurate?
- Does the diagram represent student work?
- Provide students with feedback on their work.

Circles and Sectors

I. Section Objectives

- Calculate the area of a circle.
- Calculate the area of a sector.
- Expand understanding of the limit concept.

II. Cross- curricular-History

- Use the following image from the round table used by King Arthur.
- This is Figure 10.05.01
- www.crystalinks.com/roundtable.gif
- The diameter of the round table was 18 feet.
- Given this measurement, calculate the area of the round table.
- If the table was divided between each of the knights evenly, what is the area of one of the sectors?
- Draw a diagram to explain your work.
- Allow students time to share their diagrams when finished.

III. Technology Integration

- Have students use the following website as a tutorial on area and circumference of circles.
- www.mathgoodies.com/lessons/vol2/circle_area.html
- Students can review already learned material.
- There is also a worksheet section for them to work with and practice solving problems.

IV. Notes on Assessment

- Examine student diagrams.
- Were they able to find the correct area of the table?
- How about the sectors?
- Does the diagram accurately show their work?
- Is there anything missing?
- Provide students with feedback/correction on their work.

Regular Polygons

I. Section Objectives

- Recognize and use the terms involved in developing formulas for regular polygons.
- Calculate the area and perimeter of a regular polygon.
- Relate area and perimeter formulas for regular polygons to the limit process in prior lessons.

II. Cross- curricular-Architecture

- Use the following image of a roof in the shape of a hexagon.
- This is Figure 10.06.01
- www.space-frames.com/commercial buildings/xha28.htm
- Have the students use the dimensions of this design to figure out the area of the roof of this hexagon.
- Then have the students draw a diagram and explain how they figured out the area of the hexagon.
- Allow time for students to share their work when finished.

III. Technology Integration

- Have students complete some research on where to find hexagons and pentagons.
- Students can search architecture, nature or their own subject.
- Ask the students to keep track of the websites that they visit.
- Students should prepare a presentation of at least five examples of pentagons or hexagons in their given subject area.
- Students should include diagrams or images with their work.

IV. Notes on Assessment

- Assess student diagrams.
- How did the students figure out the area of the roof?
- Does their method make sense?
- Did they divide it into triangles?
- Did they divide it into trapezoids?
- Provide students with feedback on their work.

Geometric Probability

I. Section Objectives

- Identify favorable outcomes and total outcomes.
- Express geometric situations in probability terms.
- Interpret probabilities in terms of lengths and areas.

II. Cross- curricular-Target Practice

- Use the following image of a dartboard.
- This is Figure 10.07.01.
- www.home.wlu.edu/~mcraea/GeometricProbabilityFolder/Introduction/Problem0/images/images/dartboard.gif
- Here is the problem.
- What is the geometric probability of hitting the center of the internal square of the dartboard?
- Use probability to figure this out.
- Show your work with a diagram and be prepared to explain your answer.
- Allow time for students to share their work when finished.

III. Technology Integration

- Visit the same website that the image came from and explore the solution to the problem.
- www.home.wlu.edu/~mcraea/GeometricProbabilityFolder/Introduction/Problem0/images/images/dartboard.gif
- The answer to the problem that the student solved above is there.
- Have students use this to correct their own work.
- Show any changes/corrections that they completed.
- Then explore the other problems on the site.

IV. Notes on Assessment

- Because students are going to correct their own work during the technology integration, use this as a time to assess student work through observation.
- Are the students able to apply the concepts of probability to geometry?
- Refer students back to the text if they are having difficulty.

1.11 Surface Area and Volume

The Polyhedron

I. Section Objectives

- Identify polyhedral.
- Understand the properties of polyhedral.
- Use Euler's formula to solve problems.
- Identify regular (Platonic) polyhedral.

II. Cross- curricular-Cubic Houses

- Use the following image from the Wikipedia website.
- This is Figure 11.01.01
- www.en.wikipedia.org/wiki/File:Rotterdam_Cube_House.jpg
- Use the image of the cubic houses to conduct a discussion with the students about the different parts of the polyhedron.
- Students should be able to identify some of the edges, the vertices and the faces of the cubes.
- Have the students identify what is unique about these houses.
- Brainstorm a list and write them on the board.
- When finished, have the students move on to drawing their own design of a cubic house.
- Have them label the faces, edges and vertices of their house design.

III. Technology Integration

- Have students select one specific polyhedron to research.
- Then have them research this polyhedron as it is connected to a theme such as photography, architecture or nature.
- Ask the students to keep track of the websites that they visit.
- Have the students take notes on where and how they discover their specific solid.
- Then have them share their findings in small groups.

IV. Notes on Assessment

- Assess student work through their house design.
- Did the students identify the faces, edges and vertices?
- Were the students creative in their design?

- Also look at the technology integration section.
- Did the students find examples of their solid according to theme?
- Were any of the results surprising?
- Assess student understanding through their sharing.

Representing Solids

I. Section Objectives

- Identify isometric, orthographic, cross- sectional views of solids.
- Draw isometric, orthographic, cross- sectional views of solids.
- Identify, draw and construct nets for solids.

II. Cross- curricular-Designs of Polyhedrons

- This is also the Technology Integration section because this activity depends on the technology.
- Use the following website for nets of polyhedrons. This website also contains different patterns for many different polyhedrons.
- www.korthalsaltes.com/
- The patterns can be downloaded in pdf form and printed.
- Students will require access to a computer and printer.
- Have each student select two different polyhedrons to work with.
- After printing out the pattern, have the student create/build a model of each solid.
- Then each student is to draw orthographic, cross- sectional views of each solid.
- Students need to be sure that their work is complete and that the solid is correctly represented.
- Then have the students create their own model of a third solid.
- For this one, they can't use the already created patterns.
- They must create their own model using what they have already learned.
- When finished, allow time for students to share their work.

IV. Notes on Assessment

- Begin by observing students as they work.
- Do the students understand the difference between the different views of the solid?
- Did the students successfully create each model?
- Is the orthographic, cross- sectional view of each solid accurate?
- Provide students with feedback on their work.

Prisms

I. Section Objectives

- Use nets to represent prisms.
- Find the surface area of a prism.
- Find the volume of a prism.

II. Cross- curricular-Prism Collage

- Have students use magazines to find pictures of different prisms.
- For example, a triangular prism could be piece of pie, a rectangular prism could be a box, etc.
- Students will need scissors, magazines of all kinds, glue and large posterboard.
- Have students identify the prisms in their collage.
- When finished, allow time for the students to share their work.

III. Technology Integration

- Use the following image of a deck prism
- This is Figure 10.03.01
- www.defender.com/expanded.jsp?path=-1|74081|316411&id=86235
- Have the students go to Wikipedia and research what a deck prism was and what it was used for.
- Then have the students write a short paragraph explaining the purpose of a deck prism.
- After the students have finished this, have them draw a diagram of a ship with a deck prism to illustrate where the deck prism would have been placed and the function that it would serve.
- When finished, allow students time to share their work.

IV. Notes on Assessment

- Assess the student collages.
- Are the pictures in the collage all prisms?
- Did the students label the different prisms?
- Assess student work on the deck prism and the ship.
- Do the students understand the purpose of the prism?
- Is it drawn correctly on the ship?
- Provide students with comments/feedback on their work.

Cylinders

I. Section Objectives

- Find the surface area of cylinders.
- Find the volume of cylinders.
- Find the volume of composite three- dimensional figures.

II. Cross- curricular-Cheese Press

- Use an image from the technology section to have a picture to work with for the following problem.
- Here is the problem.
- Given the following dimensions, figure out the surface area and the volume of the cylinder of the cheese press.
- 8.5 in high
- Diameter of 6 inches
- Base Area of 72 sq. inches
- Draw a diagram to explain your work on both parts of the problem.
- Be sure to show your work.
- Allow time for students to share their work when finished.

III. Technology Integration

- Use the following website for information on a cheese press that makes cheese.
- www.thegrape.net/browse.cfm/4,10188.html
- This will give you an image to work with for the first activity.
- Then research the cheese press.
- How does it work?
- When was it first used?
- What are the necessary ingredients for making cheese?
- How long does it take?
- Write a short essay on the cheese press to accompany your mathematical work.
- Students can also go to this website and watch a video about how volume impacts space flight.
- www.thefutureschannel.com/dockets/hands-on_math/orion_space_capsule/

IV. Notes on Assessment

- Assess student work and diagrams.
- Is it accurate?
- Were the students able to figure out the surface area of the cylinder?
- Were the students able to figure out the volume of the cylinder?
- Provide students with feedback/comments on their work.

Pyramids

I. Section Objectives

- Identify pyramids.
- Find the surface area of a pyramid using a net or formula.
- Find the volume of a pyramid.

II. Cross- curricular-Pyramids

- Begin by using this image to show students an aerial view of three pyramids.
- This is Figure 11.05.01.
- www.alienworld.files.wordpress.com/2008/09/pyramids.jpg
- Looking at this image will also give students a great idea of what a net of a pyramid can look like.
- Students are going to be working on drawing nets of different sized pyramids.
- Assign them the task of drawing three nets for three different sized pyramids.
- They can choose which type of pyramids they wish to draw too.
- Have the students label each net with the type of pyramid and be sure that the pyramids are proportional.
- Allow time for students to share their work when finished.

III. Technology Integration

- This is a great website to explore the volume of a pyramid.
- www.mathsisfun.com/geometry/pyramids.html
- It is very simple and basic in its approach.
- It would be excellent for a student who is having difficulty with the concepts or who just needs more practice.

IV. Notes on Assessment

- Assess the nets of the pyramids.

- Are the pyramids labeled to show the type of pyramid that they are?
- Are the pyramids accurately drawn?
- Are they proportional?
- Provide students with comments/feedback on their work.

Cones

I. Section Objectives

- Find the surface area of a cone using a net or formula.
- Find the volume of a cone.

II. Cross- curricular-Sculpture

- Students are going to design their own sculpture using different cones.
- These can be cones that they create out of paper, or cones from nature such as a pine cone.
- Begin by conducting a discussion about cones.
- Be sure to review the parts of a cone.
- Tell students that they need to present work to show the surface area and volume of one of the cones that they create.
- Then let them work on their sculpture.
- Students will need paper, markers, colored paper, a surface to build on and glue.
- When finished, allow time for students to share their work.

III. Technology Integration

- Students can go to the following website and look at many different images of cones in architecture.
- www.fiveprime.org/hivemind/Tags/architecture,cone
- They need to select one cone to work with.
- Cones of specific buildings are named. Students can use this information to research about the specific cone.
- Students should write a short essay on their cone and draw a design to represent the cone that they have chosen.
- Allow time for students to share their work when finished.

IV. Notes on Assessment

- Assess student work.

- Is the work creative?
- Are the cones accurate?
- Is there anything that the student needs to improve upon?
- Provide students with feedback/comments.

Spheres

I. Section Objectives

- Find the surface area of a sphere.
- Find the volume of a sphere.

II. Cross- curricular-Spheres for Space

- Begin with the article on MIT and space spheres.
- Print the article and either have the students read it silently or read it as a whole class.
- Tell the students that they are going to be designing spheres for this space project.
- The spheres need to be the same size as a volleyball.
- You will need some volleyballs and tape measures for this class.
- Have students measure each model and then build a model of their space sphere.
- Students should create a 3D model and draw a design of their space sphere as well.
- Have students work in groups of three.
- Allow time for students to share their work when finished.

III. Technology Integration

- Begin by having students look at this website which looks at MIT students who are designing spheres to go into space.
- www.spacedaily.com/news/microsat-00e.html
- This is a great video which show architecture and space together.
- The engineers in the video work with spheres and also explain how area and volume impact the design of anything that is sent into space.
- www.thefutureschannel.com/dockets/hands-on_math/space_architecture/
- This is a great place to begin a discussion with students about careers that use mathematics.
- Here is another fun website that looks at spheres.
- www.cotf.edu/ete/modules/msese/earthsysflr/spheres.html

IV. Notes on Assessment

- Assess each work product.
- Were the directions followed?
- Did students accomplish the objective?
- Provide students with feedback on their work.

Similar Solids

I. Section Objectives

- Find the volumes of solids with bases of equal areas.

II. Cross- curricular-Kaleidocycles

- For this activity, you will need to use the information at the following website.
- www.mathematische-basteleien.de/kaleidocycles.htm
- This website provides pictures and directions of how to make different kaleidocycles.
- It is a great way for students to see how similar solids can be combines together.
- Some of the solids are congruent and some are similar.
- Become familiar with some of the patterns and designs before assigning this to the students.
- Then give them the instructions, by printing or providing technology and let them go to work.
- Students need to select at least two different kaleidocycles to create.
- They can also design their different ones.
- Allow time for students to present their work when finished.

III. Technology Integration

- The activity above integrates technology into the making of kaleidocycles.
- www.maa.org/mathland/mathtrek_11_13_06.html
- Have students explore the website on the math trek.
- Discuss the different aspects of the trek.
- You could even take your students on a math trek around the school or town.
- Have the students make notes of all of the different places where mathematics/geometry can be found.

IV. Notes on Assessment

- For this activity, assessment can be completed through observation.
- Be sure to interact with students as they work.
- Offer assistance where needed.

1.12 Transformations

Translations

I. Section Objectives

- Graph a translation in a coordinate plane.
- Recognize that a translation is an isometry.
- Use vectors to represent a translation.

II. Cross- curricular-Sculpture

- Use this image of Rinus Roelof's tetrahedron sculpture.
- This is Figure 12.01.01
- www.mathpaint.blogspot.com/2007/04/structures-by-rinus-roelofs.html
- Use this to show the students the vectors that can be drawn from one tetrahedron to the next tetrahedron.
- This shows length and direction.
- Discuss the various components of the sculpture.
- Ask students to identify all of the different elements of the sculpture.
- Students can then draw a design of their own using different three- dimensional solids or one solid as Roelof did.
- Have students identify any and all solids as well as the vectors in the design.
- Allow time for the students to share their designs.

III. Technology Integration

- This is a great website to explore translations.
- www.cut-the-knot.org/Curriculum/Geometry/Translation.shtml
- Students can read all about vectors and isometry.
- Then there is an interactive section where the students can manipulate the figure in the box.
- Students can use this to demonstrate their understanding.
- Have students work in pairs on this task.

IV. Notes on Assessment

- Assess student understanding through discussion.
- Ask questions to be sure that the students understand the key elements of this lesson.
- They should have an understanding of isometry, vectors and translations.

Matrices

I. Section Objectives

- Use the language of matrices.
- Add matrices.
- Apply matrices to translations.

II. Cross- curricular-Progressive Matrices

- This website has an image of a progressive matrix.
- www.en.wikipedia.org/wiki/File:RavenMatrix.gif
- Have the students discuss the elements of how this image is representative of a matrix.
- Then have them use this as a model to create their own matrix pattern.
- Students should complete at least three steps of the progressive matrix.
- Students can use black and white or color.
- Students could expand this idea into a design with dimensions.
- Students can also use paint chips from a hardware store, or small mosaic tiles.
- Students could use elements of nature such as rocks or small leaves.
- This could be a very creative assignment.
- Allow time for the students to share their work when finished.

III. Technology Integration

- Complete a research assignment on how the banking industry uses matrices.
- Students will need to visit several different websites to do this.
- Have them write a short essay and include examples on how the banking industry relies on matrices to support their work.

IV. Notes on Assessment

- Assess each design.
- Is it modeled off of the example on Wikipedia?
- Does it show a progression?
- What would be the next step in the progression?
- Provide students with feedback on their work.

Reflections

I. Section Objectives

- Find the reflection of a point in a line on a coordinate plane.
- Multiple matrices.
- Apply matrix multiplication to reflections.
- Verify that a reflection is an isometry.

II. Cross- curricular-Art

- Students are going to create a reflection.
- They can choose a picture, a symbol, a shape or an image.
- The key thing is that they can reproduce it as a reflection.
- The students are going to show how this image is reflected in a horizontal or vertical plane.
- They can work in small groups on this.
- The task will involve spatial thinking and organization to be sure that the students can "see" the correct positioning of the image.
- Then they need to reproduce this.
- Students can choose to use as simple or as complicated an image as they choose.
- The key is that they need to be able to explain their work and have it be accurate.
- Allow time for students to share their work when finished.

III. Technology Integration

- Have students use the following website to work on reflections.
- www.mathwarehouse.com/transformations/compositions/reflections-in-math.php
- The website provides a tutorial on how to create a reflection.
- It also provides students with an interactive way to work on reflections.
- Students can practice designing reflections.
- Provide an opportunity for students to ask questions as they work.

IV. Notes on Assessment

- Check student work on reflections.
- Is the reflection accurate?
- Is there anything missing in its representation?
- Is the image too complicated?
- Provide students with feedback on their work.

Rotations

I. Section Objectives

- Find the image of a point in a rotation in a coordinate plane.
- Recognize that a rotation is an isometry.
- Apply matrix multiplication to rotations.

II. Cross- curricular- Sports

- Provide students with three or four copies of this image of a skateboarder.
- www.en.wikipedia.org/wiki/File:Skateboarder1.jpg
- This is Figure 12.04.01.
- Tell the students that they are to use these images to create a scene showing the rotations of a skateboarder.
- Students can create this any way that they choose.
- Ask for students who are knowledgeable about skateboarding.
- Pair these students up with students who don't consider themselves knowledgeable.
- Then have the students work together to create the scenes.
- Students can show as many different rotations as they would like.
- Be sure to give students an opportunity to share their work.
- Some students may want to extend this scene to include other skateboarding images- that is fine as long as the concept of rotations is included.

III. Technology Integration

- A great website to explore rotations.
- www.cut-the-knot.org/Curriculum/Geometry/Rotation.shtml
- Students can review information on rotations here.
- Then they can work to manipulate and create different rotations.
- There are directions on the screen which help them in accomplishing this task.
- You can use this as extra practice or for a student who needs remedial work in this area.

IV. Notes on Assessment

- Assess the student rotation scenes.
- Did the students accomplish the task of showing the skateboarder in different rotations?
- If not, what would have worked better?
- Did the students expand on the assignment?
- Were the students able to explain the use of rotations in their scene?
- Provide students with feedback on their work.

Composition

I. Section Objectives

- Understand the meaning of composition.
- Plot the image of a point in a composite transformation.
- Describe the effect of a composition on a point or polygon.
- Supply a single transformation that is equivalent to a composite of two transformations.

II. Cross- curricular-Movie Posters

- Have students watch the video first.
- Discuss the elements of a great movie poster.
- What works and what doesn't work.
- Tell the students that their job is to create a movie poster for a new movie.
- You can use one that is popular with the students at this time or use an old favorite like "Star Wars" that probably all of the students have seen.
- Tell the students that they are going to create a poster for this movie using the elements of transformations.
- There needs to be a use of rotation, translation and reflection in their posters.
- Students can work in pairs on this task.
- Have students share their work when finished.

III. Technology Integration

- If possible, have the students watch this short video first.
- www.thefutureschannel.com/dockets/hands-on_math/movie_posters/
- You want the students to be looking for elements or transformations in the posters.
- Students are going to use this information in the activity.

IV. Notes on Assessment

- Assess student work based on the student's use of transformations.
- Are there rotations in the poster?
- Are there translations in the poster?
- Are there reflections in the poster?
- Did the student focus on one or all of the elements?
- How successful were they?
- Provide students with feedback on their work.

Tessellations

I. Section Objectives

- Understand the meaning of tessellation.
- Determine whether or not a given shape will tessellate.
- Identify the regular polygons that will tessellate.
- Draw your own tessellation.

II. Cross- curricular-Honeycombs

- Show students the following images of honey combs.
- This is Figure 12.06.01.
- www.en.wikipedia.org/wiki/File:Cubic_honeycomb.png
- This is Figure 12.06.02
- www.en.wikipedia.org/wiki/File:Honey_comb.jpg
- This is Figure 12.07.03
- www.en.wikipedia.org/wiki/File:Apis_florea_nest_closeup2.jpg
- Tell students that their task is to create a honeycomb piece of art.
- They can use any shape that will tessellate as they saw with the cubic honeycomb.
- The key is that the honeycomb, according to a Wikipedia definition, is a space *filling* or *close packing* of polyhedral or higher-dimensional *cells,* so that there are no gaps.
- Students can use any size that they choose and can incorporate color too.
- They will need rulers, pencils, colored pencils or markers, paper and scissors.

III. Technology Integration

- Have students study the work of M.C. Escher who was famous for his tessellations.
- www.en.wikipedia.org/wiki/M._C._Escher
- They can begin with the Wikipedia site, but there are so many other sites to work with as well.
- Have the students select one piece of his work as a favorite piece and share in small groups the elements that tessellate and how they tessellate.
- Conduct a small group discussion on the power of tessellations.

IV. Notes on Assessment

- Assess student honeycombs.
- Were they successful in their tessellations?
- Provide students with feedback on their work.

Symmetry

I. Section Objectives

- Understand the meaning of symmetry.
- Determine all the symmetries for a given plane figure.
- Draw or complete a figure with a given symmetry.
- Identify planes of symmetry for three- dimensional figures.

II. Cross- curricular-Puzzle Creation

- Review the basics of symmetry with the students.
- Have them define symmetry and describe what makes something symmetrical.
- Review symmetry in nature or in other objects or buildings.
- Then assign students the task of taking a symmetrical image and making it into a puzzle.
- Students can use an image from a magazine, a computer image, or a hand drawn image.
- They are going to use cardboard to create a puzzle.
- They can make it as simple or complex as they wish.
- Have students create their puzzle and then exchange puzzles with a peer and work to assemble the other person's puzzle.
- Allow time for students to share their work when finished.

III. Technology Integration

- Explore the sculptures of Quark Park on the following website.
- www.symmetrymagazine.org/cms/?pid=1000396
- Have the students work to discuss each different sculpture in small groups.
- Students should make notes on the symmetrical elements of each sculpture and be prepared to share them with the class.

IV. Notes on Assessment

- Assess student work through observation.
- Observe students as they create their puzzles.
- Inquire into how symmetry can assist someone in creating or putting together a puzzle.
- Then listen in as students discuss the symmetrical elements of the sculpture in Quark Park.

Dilations

I. Section Objectives

- Use the language of dilations.
- Calculate and apply scalar products.
- Use scalar products to represent dilations.

II. Cross- curricular-Dilations in context

- Ask the students to think about the concept of dilations and to come up with one career where people would use dilation in their work.
- Students need to write a hypothesis on how they think that this profession would use dilations.
- Have them write down their hypothesis.
- Ask students to make a list of questions that they are going to explore.
- If you have use of technology, complete this with the use of the computer.
- If not, visit the school library so that students can research there.

III. Technology Integration

- Have students research their chosen profession.
- They need to prove that their hypothesis is true or not.
- Each student should have reasons and explanations on how dilations are used in the chosen profession.
- Students need to write a short essay and provide one diagram or image to support their findings.
- Ask students to keep track of websites that they visit for documentation purposes.
- Allow time for students to present their work when finished.

IV. Notes on Assessment

- Assess student work.
- Was the student able to prove their hypothesis?
- What corrections did he/she make?
- Is the essay well written?
- Does it explain how this profession uses dilations?
- Does the diagram support student research?
- Provide students with feedback on their work.