PreCalculus Honors
Curriculum
Sayreville War Memorial High School
Full Year

Statement of Purpose

PreCalculus Honors is the next course in the mathematics sequence for students who have completed Algebra 2 and intend to take Advanced Calculus and/or Statistics the following year. In each topic studied, multiple perspectives (verbal, algebraic, graphical, and numeric) are explored to allow students to develop creative problem-solving skills and recognize the equivalence of different representations.

The students will engage in relevant activities that will utilize their reasoning and critical thinking strategies as they apply them in problem solving both independently and in-group. Students will encounter several types of assessment within this course: unit quizzes, tests, exams and projects which will require more details and work outside of the classroom. The honors course will be a rigorous course, preparing all of its students to take Advanced Math courses the following year. It will be taught at a faster pace to further challenge a student who has mastered all of the algebra 2 concepts.

Summary of Course

Honors PreCalculus is the fourth course in the honors college preparatory sequence. This course is designed for students who have the appropriate background to understand the concepts and techniques in advanced college preparatory mathematics. The topics covered include logarithms, trigonometric functions, and identities, solving trigonometric equations, applications involving triangles, inverse trigonometric functions, trigonometric addition formulas, advanced graphing techniques, polar coordinates, vectors, sequences and series, and limits. This course is intended to prepare students for a post-secondary education. It emphasizes higher-level mathematical thinking necessary to pursue the study of Advanced Placement Calculus and/or Statistics.

Table of Contents

Unit 01 Trigonometric Functions

Content Area: **Mathematics**
Course(s): **Adv. Concepts in Com. Sci. (s), English 9, English 9 CP**
Time Period: **1st Marking Period**
Length: **30-35 Days**
Status: **Not Published**

Summary of the Unit

Analyze, describe different types of angles. Analyze and describe angles and angular movement and relate this information to real life phenomena.

MA.F-TF.A.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosines, and tangent for π – □, π + □, and 2π – □ in terms of their values for □, where □ is any real number.
MA.F-TF.A.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
MA.G-SRT.C.7	Explain and use the relationship between the sine and cosine of complementary angles.
MA.G-SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
MA.F-TF.A.1	Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
MA.F-TF.A.2	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

Enduring Understandings

Students will understand that…

- An angle is determined by rotating a ray about its endpoint and can be measured in degrees, radians, and revolutions.
- The co-terminal relationship can be used to model infinitely many angles.
- The formula for the length of a circular arc can be used to analyze the motion of a particle moving at a constant speed along a circular path.
- Trigonometry describes the relationship between the sides and angles in right triangles.
- Many relationships exist between angles in trigonometry that can be used to make predictions about trigonometric values at a variety of angles.
- Reference angles are used to model and make predictions about trigonometric functions of any angle.

Essential Questions

How do you describe angles and angular movement?

What are real world applications of linear and angular speed?

How do you use trigonometry to find unknown side lengths and angles in right triangles?

How can the different trigonometric functions be used to solve real world applications?

How do you evaluate trigonometric functions at any angle?

How do you evaluate trigonometric functions by using the unit circle?

Summative Assessment and/or Summative Criteria

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

Resources

- Cengage Learning: Precalculus with Limits - A Graphing Approach, Sixth Edition
- https://www.ixl.com/standards/new-jersey/math/high-school
- http://www.mathwords.com/index_adv_alg_precal.htm
- http://www.hershey.k12.pa.us/Page/3608
- https://sites.google.com/a/evergreenps.org/ms-griffin-s-math-classes/updates
- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC- ALG/?referrer=featured_content
- Statistics Education Web (STEW). http://www.amstat.org/education/STEW/
- The Data and Story Library (DASL). http://lib.stat.cmu.edu/DASL/

Unit Plan

Topic/Selection	General Objectives	Instructional Activities	Be

Timeframe			
Angles and angular movement. 6 days	SWBAT describe angles and use raidan measure. SWBAT use degree measure and convert between degree and radian measure. SWBAT will use angles to model and solve real-life problems.	Remind students of different types of angles, complementary and supplementary. Using a regular analog clock Have students create a set of directions using terms such as clockwise, counterclockwise, positive, negative, etc, to describe a time on the clock. Then another student will take the directions and try to guess the time. Show the definition of arc length as suggested in technological innitiaves. Illustrating the radius of a circle traveling the length of the intercepted arc.	Group assign sourc Home textbo sourc Introd Activ day to know under Quiz
The Unit Circle 7days	SWBAT will identify the unit circle and descrive its relationships to real numbers. SWBAT will evaluate trigonometric functions using the unit circle. SWBAT will use domain and period to evaluate sine and cosine functions and use a calculator to evaluate trigonometric functions.	Using a paper plate, ruler, and protractor recreate the unit circle and the found quadrants. Using the class room floor as a a coordinate plane, have the students lay out all the particular values of the unit circle until the entire circle is complete. Each students will be responsible for certain values. Do not begin with the first quadrant as it will be too easy for the studens to complete and will require them not to think too deeply.	Group assign sourc Home textbo sourc Introd Activ day to know under Quiz
Functions of Any Angle 9 days	SWBAT will evaluate trigonometric functions of any angle. SWBAT will find reference angles. SWBAT will evaluate trigonometirc functions of real numbers.	Sketching several angles with their reference angles helps reinforce the fact tht the reference angle is the acute angle formed with the horizontal.	Group assign sourc Home textbo sourc Introd Activ day to know under

			Quiz
Right Triangle Trigonometry 5 days	SWBAT will evaluate trigonometric functions of acute angles and use a calculator to evaluate trigonometric functions. SWBAT will use the fundamental trig identities. SWBAT will use trigonometric functions to model and solve real-life problems.	Multiple activities that have both degree and radian mode type quesitons so students begin to differentiate between the two. Create visuals to better represent angles of elevation and depression.	Group assign sourc Home textbo sourc Introd Activ day to know under Quiz

Suggested Modifications for Special Education, ELL and Gifted Students

- Have students work in pairs for exploration activities and classwork assignments. This will allow students to bounce ideas off of each other and gain confidence with the material.
- Provide the opportunity for students to practice problems both with and without graphically calculator technology.
- Assign problems at varying levels of difficulty to challenge all learners.
- Create differentiated groups for application based activities, assigning harder problems to groups who have demonstrated understanding of the material.
- Provide a list of resources, like the ones listed in the technology section, for students to turn to for additional help, if needed.
- Assign challenge problems on the related topic for those students who finish early.

Suggested Technological Innovations/Use

The following links can provide visual and interactive models for understanding what a radian is and why it is important. Students can follow along using their chromebooks:

http://zonalandeducation.com/mmts/trigonometryRealms/radianDemo1/RadianDemo1.html

http://www.mathsisfun.com/geometry/radians.html

The following video demonstrates what linear and angular velocity are and how they are affected by different size circles. Students who are struggling with the difference can view this video for extra help. The link can be placed on the teacher's google classroom or OnCourse Connect Classroom:

https://www.youtube.com/watch?v=yDHM6rd8P94

Cross Curricular/21st Century Connections

Social Studies and ELA Literacy Connection:

• Name of Task: Americans' spending: NJCCCS: 9.1.12.A.9; W.11-12.1

From July 1998 to July 1999, Americans' spending rose from 5.82 trillion dollars to 6.20 trillion dollars

a. Let x = 0 represent July 1998, x = 1 represent August 1998, ..., and x = 12 represent July 1999. Write a linear equation for Americans' spending in terms of the month x

b. Use the equation in (a) to predict Americans' spending in July 2002.

c. Based on the model created in (a) when would the aggregate expenditure exceed 10 trillion dollars?

d. What part of the US GDP is spent by the Americans in 2013?

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP6	Demonstrate creativity and innovation.

Unit 02 Graphs of Trigonometric Functions

Content Area: **Mathematics**
Course(s): **Adv. Concepts in Com. Sci. (s), English 9, English 9 CP, Pre Calculus Honors**
Time Period: **1st Marking Period**
Length: **18 - 20 Days**
Status: **Not Published**

Summary of the Unit

Analyze, describe different types of angles. Model and make predictions about periodic behavior using the graphs of trigonometric functions.

MA.F-TF.A.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
MA.F-TF.B.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
MA.F-IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MA.F-IF.B.6	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Enduring Understandings

- There exists a relationship between the graphs of sine and cosine.
- The amplitude of a sine or cosine graph is useful when making predictions about the vertical shrink or stretch of the graph.
- Sine and cosine functions are used to model waves and periodic behavior.
- There exists more than one way to write the equation of a sinusoidal function given its graph.
- The domain and range of a function are useful in predicting the graph of a function.
- The domains of sine, cosine, and tangent must be restricted in order for the function to be one-to-one and have an inverse.
- Inverse functions are necessary to determine the angle for a given trigonometric value which has uses in many real life applications.
- Inverse properties are useful when making predictions.
- The relationship between the sides and angles of right triangles can be used when converting a trigonometric expression into an algebraic expression

Essential Questions

How are the graphs of sine and cosine related?

How can the amplitude and period of a sinusoidal function be used to sketch its graph?

How is the graph of a sinusoidal function related to its equation?

What real life scenarios are best modeled by trigonometric functions?

How is the graph of a trigonometric function a useful tool for modeling and interpreting data?

How are domain and range useful when analyzing trigonometric graphs?

What is the relationship between a function and its inverse?

What does finding the inverse of a function mean graphically?

Why is finding the inverse of a function useful?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically
Identify Key Building Blocks
Make Connections (between and among key building blocks)
Short/Extended Constructed Response Items
Multiple-Choice Items (where multiple answer choices may be correct)
Drag and Drop Items
Use of Equation Editor Quizzes
Journal Entries/Reflections/Quick-Writes
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Projects Portfolio
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Teacher-Student and Student-Student Conferencing Homework

Resources

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- https://www.ixl.com/standards/new-jersey/math/high-school
- http://www.mathwords.com/index_adv_alg_precal.htm
- http://www.hershey.k12.pa.us/Page/3608
- https://sites.google.com/a/evergreenps.org/ms-griffin-s-math-classes/updates
- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC- ALG/?referrer=featured_content
- Statistics Education Web (STEW). http://www.amstat.org/education/STEW/

- The Data and Story Library (DASL). http://lib.stat.cmu.edu/DASL/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	E
Graphing Basic Sine and Cosine Curves 4 days	SWBAT define Amplitude, period, zeros, maximum and minimum values. SWBAT determine when a graph is a typical or image (reflection) curve.	To emphasize determining and locating key pionts have student mark each point on their graphs and then check their graphs with their graphing utilities. Relate graphing as being very closely related to an algebraic 5 point process. Stress points as beginning, middle and end, one-quarter, and three-quarter cycle.	Grou assig sour Hom textb sour Intro Acti day t know unde Quiz
Translations of graphs of sine and cosine curves. 6 days	SWBAT describe both horizontal and vertical translations to a graph. SWBAT graph functions over multiple cycles and intervals.	While the "C" term may introduce the shift of a curve, a student can set up two specific equations to algebraically determine both the "shifted" starting and end point of a particular curve for one cycle. Have students graph additional cycles by adding the appropriate values of "pi".	Grou assig sour Hom textb sour Intro Acti day t know unde Quiz
Graphiing reciprocal	SWBAT sketch graphs of tangent functions.	Relate the equations as reciprocals. Talk about undefined terms and where they are on the graph.	

trigonometric functions. 6 days	SWBAT sketch graphs of cotangent functions. SWBAT sketch graphs of secant and cosecant. SWBAT sketch the graph of damped trigonometric functions.	Discuss asymptotes and boundaries.	Grou assig sour Hom textb sour Intro Acti day t know unde Quiz
Inverse Trigonometric Functions 5 days	SWBAT evaluate and graph inverse sine functions. SWBAT evaluate and graph other inverse functions. SWBAT evaluate composition of functions.	Activity in writing in the 2 alternate forms. Students must be comfortable and familiar with both. Activity relating to and increasing the understanding of the inverse functions by relating them to triangle definitions of the trigonometric functions. Discuss range of trig functions and how they vary. Students should know these ranges well to ensure that their answers are within the correct range. Referencing the graphs of the inverse functions is also helpful. .	Grou assig sour Hom textb sour Intro Acti day t know unde Quiz

Suggested Modifications for Special Education, ELL and Gifted Students

- Have students work in pairs for exploration activities and classwork assignments. This will allow students to bounce ideas

off of each other and gain confidence with the material.

- Relate the trigonometric graphs to numerical and analytical approaches to solving applications.
- Provide the opportunity for students to practice problems both with and without graphically calculator technology.
- Assign problems at varying levels of difficulty to challenge all learners.
- Create differentiated groups for application based activities, assigning harder problems to groups who have demonstrated understanding of the material.
- Provide a list of resources, like the ones listed in the technology section, for students to turn to for additional help, if needed.
- Assign challenge problems on the related topic for those students who finish early.

Suggested Technological Innovations/Use

- Have students complete a Graphing Calculator Discovery Lab on their own to test hypotheses on how the equation of a sine or cosine function relates to its graph. This can be done to illustrate amplitude, period, and vertical and phase shifts. For example, to illustrate amplitude, students should compare the graphs of y = sin x , y = 3sin x , y =-3sin x , and y = -1/2 sin x. Teachers should make sure students set their calculators in radian mode and have a uniform window.
- In pairs, have students complete an Applications of Sine and Cosine Functions Project. Students will be assigned applications of sine and cosine functions and will solve and fully explain their solutions through a ShowMe video on their chromebook.
- Have students graph y =tan x , y = csc x , y =sec x , and y = cot x on their graphing calculator. Have them state the domain, range, period, and asymptotes of each of these functions. Then, discuss results and conclusions as a class.

Cross Curricular/21st Century Connections

Science Connection:

• Name of Task: Myoglobin and Hemoglobin: NJCCCS: HS-LS1-2; HS-LS1-4

Myoglobin and hemoglobin are oxygen-carrying molecules in the human body. Hemoglobin is found inside red blood cells, which flow from the lungs to the muscles through the bloodstream. Myoglobin is found in muscle cells. The function □ = □(□) = □ 1+□ calculates the fraction of myoglobin saturated with oxygen at a given presure p Torrs. For example, at a pressure of 1 Torr, M(1) = 0.5, which means half of the myoglobin (i.e. 50%) is oxygen saturated. (Note: More precisely, you need to use something called the “partial pressure”, but the distinction is not important for this problem.) Likewise, the function calculates the fraction of hemoglobin saturated with oxygen at a given pressure p. [UW]

a. The graphs of M(P) and H(P) are given here on the domain $0 \leq \square \leq 100$ Which is which?

b. If the pressure in the lungs is 100 Torrs, what is the level of oxygen saturation of the hemoglobin in the lungs?

c. The pressure in an active muscle is 20 Torrs. What is the level of oxygen saturation of myoglobin in an active muscle? What is the level of hemoglobin in an active muscle? d. Define the efficiency of oxygen transport at a given pressure p to be M(p) – H(p) . What is the oxygen transport efficiency at 20 Torrs? At 40 Torrs? At 60 Torrs? Sketch the graph of M(p) – H(p) ; are there conditions under which transport efficiency is maximized (explain)?

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP3	Attend to personal health and financial well-being.

Unit 03 Analytic Trigonometry

Content Area: **Mathematics**
Course(s): **Adv. Concepts in Com. Sci. (s), English 9, English 9 CP, Pre Calculus Honors**
Time Period: **1st Marking Period**
Length: **8 - 10 Days**
Status: **Not Published**

Summary of the Unit

Model real-life scenarios using trigonometric equations and solve the equation using trigonometric relationships and algebraic techniques.

MA.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
MA.A-REI.B.4	Solve quadratic equations in one variable.
MA.A-SSE.A.2	Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.
MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
MA.F-TF.C.8	Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.A-SSE.B.4	Derive and/or explain the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.
MA.A-REI.A.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
MA.A-REI.A.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Enduring Understandings

There exists many relationships between trigonometric functions that can be rewritten to evaluate or simplify trigonometric expressions and verify trigonometric identities.

Many previously learned algebraic methods can be used to solve trigonometric equations.

Due to the periodic nature of trigonometric functions, trigonometric equations often have infinitely many solutions that can be expressed using general solution format.

The solutions to trigonometric equations can be approximated using graphing technology.

There is a direct relationship between k in a multiple angle equation the period the graph of the equation.

Trigonometric equations can be used to solve real-life scenarios that are periodic in nature.

The sum and difference formulas can be used to find exact values of trigonometric expressions at additional angles on the unit circle.

Essential Questions

- How do you use relationships to rewrite trigonometric expressions in order to simplify and evaluate trigonometric functions?
- How do you use trigonometric relationships and algebraic methods to verify trigonometric identities?
- How can algebraic techniques be applied to solving trigonometric equations?
- How are the graphs of trigonometric functions related to the solutions of the corresponding trigonometric equation?
- What real life problems can be modeled by and solved using trigonometric equations?
- Describe a situation where extraneous solutions may exist. How do you verify if a solution is extraneous to an equation?
- How can you use trigonometry to apply the sum and difference formulas to find exact values of angles?
- How are multiple angle formulas used to transform a trigonometric equation and create a new method to solve the equation?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically
Identify Key Building Blocks
Make Connections (between and among key building blocks)
Short/Extended Constructed Response Items
Multiple-Choice Items (where multiple answer choices may be correct)
Drag and Drop Items
Use of Equation Editor Quizzes
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Teacher-Student and Student-Student Conferencing Homework

Resources

- Cengage Learning: Precalculus with Limits - A Graphing Approach, Sixth Edition
- https://www.ixl.com/standards/new-jersey/math/high-school
- http://www.mathwords.com/index_adv_alg_precal.htm
- http://www.hershey.k12.pa.us/Page/3608
- https://sites.google.com/a/evergreenps.org/ms-griffin-s-math-classes/updates
- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks

- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC- ALG/?referrer=featured_content
- Statistics Education Web (STEW). http://www.amstat.org/education/STEW/
- The Data and Story Library (DASL). http://lib.stat.cmu.edu/DASL/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities
Applying the fundamental Trigonometric Identities 5 days	SWBAT recognize and write the fundamental trigonometric identities. SWBAT use the fundamental trigonometric identiities to evaluate trigonometric functions, simplify trigonometric expressions, and rewrite tgrigonometric expressions.	For these fundamental identities stress that "u" can be real number, or a variable. When simplifying expressions, remind students that an introduced must be a known trigonometric identity or a identity. Use graphing utility to check answers. Y1 would be the expression Y2 would be the simplified expression. Sele for Y1 and path style for Y2. Graph both in same viewin the two graphs appear to coincide the expressions are For auditory learners, instruct them to read each identi that they can hear how it is used in the expression. Na identity as it is implemented will help students better r case in which each identity is used.
Verifying trigonometric identities. 5 days	SWBAT verify trigonometric identities by proving one side is equivalent to an other side.	Remind students to work with one side of equation onl is often better to use the more complicated side. Look for opportunities to factor expressions, add fracti binomial, or create a monomal denominator. Look for opportunities to use the fundamental idenities "a little algebra a little identity" The Ping Pong Method If no algebra or direct identities can be applied Convert sines and cosines. Stress to students always to try and do something. Have class discussion about conditional equations over expressions.
Solving trigonometric equations	SWBAT use common algebraic techniques to solve trigonometric equations. SWBAT solve trigonometric equations of the	Conduct discussion about exact "pi" answers opposed approximations. Including discussion on using values fr quadrants. Stress checking against the range of the fun

7 days	quadratic type. SWBAT solve trigonometric equations involving multiple angles. SWBAT use inverse trigonometric functions to solve trigonometric equations.	interval specified. If no interval is stated, solutions mus multiples beyond the first period. For students having difficulty working with the equatio setting, suggest turning the equation into an algebraic then solve for x. Students can convert everything back solution is gained. Include discussions of dividing by a trig function is the s dividng by a variable and how solutions can be lost. Use graphing utilities to confirm solutions. Graph both equation and find the x coordinates of the points at wh intersect. Then graph a combination of the sides and fi intercepts of the graph.
Applying the sum and difference formulas. 5 days	SWBAT use the sum and difference formula to evaluate trig functions, verify trigonometric identities, and solve trigonometric equations.	Activity on radical operations and exact values rather a decimal form. Graphing utility activty graphing trig functions added a together to see is the forms are equivalant i.e. sin(x + 4 4

Multiple angle formulas 5 days	SWBAT apply the double angle formulas to rewrite and evaluate trigonometric functions. SWBAT apply the sum to product and product to sum formulas to rewrite and evaluate trigonometric functions.	Activity showing the equivalence of all three forms of th angle formula of cos 2u. Graphing utility activity where in the same viewing win that coincided are equivalent.

Suggested Modifications for Special Education, ELL and Gifted Students

- Have students work in pairs for exploration activities and classwork assignments. This will allow students to bounce ideas off of each other and gain confidence with the material.
- Relate the solutions of a trigonometric equation to its corresponding graph.
- Provide the opportunity for students to practice problems both with and without graphically calculator technology.
- Assign problems at varying levels of difficulty to challenge all learners.
- Create differentiated groups for application based activities, assigning harder problems to groups who have demonstrated understanding of the material.
- Provide a list of resources, like the ones listed in the technology section, for students to turn to for additional help, if needed.
- Assign challenge problems on the related topic for those students who finish early.

Suggested Technological Innovations/Use

Derivation of Pythagorean Identities at the link below can be used as a guide when deriving the Pythagorean identities as a class: http://www.mathalino.com/reviewer/derivation-of-formulas/derivation-of-pythagorean- identities

Cross Curricular/21st Century Connections

Science Connection:

Name of Task: Moving Boxes NJSLS: 5.2.12.E.1 In a warehouse a box is being pushed up a 15° inclined plane with a force of 2.5lb parallel to the inclined plane.

1- Find the component of the force.

2- Give an interpretation of the horizontal and vertical components of the force.

3- If the box is towed up the inclined plane with a force making a 33° with a horizontal line, Find the force w needed in order for the component of the force parallel to the incline plane to be 2.5 lb. Give the answer in component form

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP6	Demonstrate creativity and innovation.

Unit 04 Oblique Triangles

Content Area: **Mathematics**
Course(s): **Adv. Concepts in Com. Sci. (s), English 9, English 9 CP, Pre Calculus Honors**
Time Period: **1st Marking Period**
Length: **8 - 10 Days**
Status: **Not Published**

Summary of the Unit

Analyze, describe different types of angles. Apply trigonometric formulas to model and solve real life problems involving oblique triangles.

MA.G-SRT.D.9	Derive the formula □ = (1/2)□□ □□□(□) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
MA.G-SRT.D.10	Prove the Laws of Sines and Cosines and use them to solve problems.
MA.G-MG.A.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
MA.G-SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
MA.G-SRT.D	Apply trigonometry to general triangles

Enduring Understandings

- The Law of Sines and the Law of Cosines can be used to solve for missing sides and angles of oblique triangles.
- In order to solve an oblique triangle, you need to know the measure of at least one side and the measures of any two other parts of the triangle – two sides, two angles, or one angle and one side.
- When two sides of a triangle and an angle opposite one of them are given and a second angle is to be derived, the resulting triangle may not be unique, or even exist at all and thus this situation results in ambiguity.
- In surveying and navigation, directions are generally given in terms of bearings.
- Trigonometry can be used to model many real life situations involving navigation and surveying.

Essential Questions

How do you use trigonometry to solve and find the areas of oblique triangles?

What situations create the ambiguous case for the Law of Sines?

What is a directional bearing and how is it applied to real life situations?

How do you use trigonometric functions to solve real life problems?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically

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

Resources

- https://www.ixl.com/standards/new-jersey/math/high-school
- http://www.mathwords.com/index_adv_alg_precal.htm
- http://www.hershey.k12.pa.us/Page/3608
- https://sites.google.com/a/evergreenps.org/ms-griffin-s-math-classes/updates
- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC-ALG/?referrer=featured_content
- Statistics Education Web (STEW). http://www.amstat.org/education/STEW/
- The Data and Story Library (DASL). http://lib.stat.cmu.edu/DASL/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities
Law of Sines 4 days	SWBAT use the law of sines to solve oblique triangles. SWBAT recogonize and understand the ambiguous SSA case and the types of solutons gained. SWBAT use the law of sines to model and solve real-life problems including bearing problems.	Activity on sketching triangles and dimension. Remember that the longest side is opposite the largest angle and shortest opposite the smallest angle. Encourage students to also find the height of the triangle as a reference. Activity on one solution, two solutions, and no solution. Compare to range of functions.

Law of Cosines 7 days	SWBAT will use the law of cosines to solve oblique triangles. SWBAT use the law of cosines to solve real-life problems including bearing problems SWBAT apply Heron's Formula to find area of triangles.	Lesson and activity deriving the third form of the law. Have studdents relate this to the Pythagorean Theorem. students to set up a system where the largest angle/side is always solved for first. Discussion on the alternative forms and how they are algebraically manipulated to better solve for angles. Lesson on the three types of formulas for area of a triangle. All three forms have advantages and disadvantages, depending on the angle or sides given.

Suggested Modifications for Special Education, ELL and Gifted Students

- Have students work in pairs for exploration activities and classwork assignments. This will allow students to bounce ideas off of each other and gain confidence with the material.
- Show analytic and visual proofs of the Law of Sines and Law of Cosines so students understand where each of these formulas comes from and how they relate to solving right triangles.
- Assign problems at varying levels of difficulty to challenge all learners.
- Create differentiated groups for application based activities, assigning harder problems to groups who have demonstrated understanding of the material.
- Provide a list of resources, like the ones listed in the technology section, for students to turn to for additional help, if needed.
- Assign challenge problems on the related topic to those students who finish early.

Suggested Technological Innovations/Use

8.1.12.A.4, 8.1.12.D.5, 8.1.12.E.1, 8.1.12.F.1

Research and Information Literacy

• Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.

Example: Students will be able to produce a position statement about the real world problem by developing systematic plan of investigation with peers and experts synthesizing information from multiple source.

Cross Curricular/21st Century Connections

Social Studies Connection:

Name of Task: INCA Dwelling NJSLS: 9.1.12.A.9

Inca dwelling found in Machu Picchu, about 50 miles northwest of Cuzco, Peru.

All that remains of the ancient city today are stone ruins. 1- Express the area of the triangular portion of the side of the dwelling as a function of sin(□ 2) □□□ cos(□ 2)

2- Express the area as a function of sin □. Then solve for □ assuming that the area is 132 square feet. 73

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.

Unit 05 Vectors

Content Area: **Mathematics**
Course(s): **Pre Calculus Honors**
Time Period: **3rd Marking Period**
Length: **13 - 15 Days**
Status: **Not Published**

Summary of the Unit

The study of vectors is crucial in applied mathematics. Vectors relate to geometry, trigonometry, and physics.

MA.N-VM.B.5a	Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as □(□$_x$, □ subscript □) = (□□$_x$, □□ subscript □).
MA.N-VM.B.4c	Understand vector subtraction □ − □ as □ + (−□), where –□ is the additive inverse of □, with the same magnitude as □ and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.
MA.N-VM.A	Represent and model with vector quantities.
MA.N-VM.A.1	Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., □, |□|, ||□||, □).
MA.N-VM.A.2	Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
MA.N-VM.A.3	Solve problems involving velocity and other quantities that can be represented by vectors.
MA.N-VM.B.4	Add and subtract vectors.
MA.N-VM.B.5	Multiply a vector by a scalar.
MA.N-VM.B.4a	Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.
MA.N-VM.B.4b	Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

Enduring Understandings

Students will be able to

- Represent vectors as directed line segments.
- Write the component forms of vectors.
- Perform basic vector operations and represent vectors graphically.
- Write vectors as linear combination of unit vectors.
- Find the direction angles of vectors.
- Use vectors to model and solve real-life problems.
- Find the dot product of two vectors and use the properties of the dot product.
- Find the angle between two vectors and determine whether two vectors are orthogonal.
- Write vectors as the sums of two vector components.
- Use vectors to find the work done by a force.
- Find the distance between two points in space.

Essential Questions

- What is a vector in the plane?
- How do you represent and perform operations with vector quantites?
- How do you write a vector as a sum of two vector components?
- What is the dot product? How is it used to analyze vectors?
- What makes a vector orthogonal?
- What do vector quantities signify in real life situations?
- How do you locate points, and find distances in three dimentions?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically
Identify Key Building Blocks
Make Connections (between and among key building blocks)
Short/Extended Constructed Response Items
Multiple-Choice Items (where multiple answer choices may be correct)
Drag and Drop Items
Use of Equation Editor Quizzes
Journal Entries/Reflections/Quick-Writes
Accountable talk
Projects Portfolio
Observation
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Role Playing
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- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC-ALG/?referrer=featured_content
- Statistics Education Web (STEW). http://www.amstat.org/education/STEW/

- The Data and Story Library (DASL). http://lib.stat.cmu.edu/DASL/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Be
Vectors in the Plane 6 days	SWBAT represent vectors as directed line segments. SWBAT write the component forms of vectors. SWBAT perform basic vector operations and represent vectors graphically. SWBAT write vectors as linear combination of unit vectors. SWBAT find the direction angles of vectors. SWBAT use vectors to model and solve real-life problems.	Discuss the properties of vectors algebrically and geometrically. Explain and model the definition of two-dimensional vectors. Model vector addition numerically and geometrically. Multiplying a Vector by a Scalar.	Group daily, f Homev textboo Introdu will be student unders Quiz o
Vectors and Dot Products 5 days	SWBAT find the dot product of two vectors and use the properties of the dot product. SWBAT find the angle between two vectors and determine whether two vectors are orthogonal. SWBAT write vectors as the sums of two vector components. SWBAT use vectors to find the work done by a force.	Explain and model the definition of two-dimensional vectors. Geometric Interpretation of Dot Product: Applies the dot product to scenarios such as determining the angle between two vectors and using the dot product to prove if a vector is orthogonal.	Group daily, f Homev textboo Introdu will be student unders Quiz o
The three dimentional Coordinate System 1 day	SWBAT find the distance between two points in space.	Explain and model the definition of two-dimensional vectors.	Group daily, f Homev textboo Introdu will be student unders

			Quiz o Studen assesse concep on two contain which respons questio

Suggested Modifications for Special Education, ELL and Gifted Students

· Anchor charts to model strategies

· Review Algebra concepts to ensure students have the information needed to progress in understanding

· Pre-teach pertinent vocabulary

· Provide reference sheets that list formulas, step-by-step procedures, theorems, and modeling of strategies

· Word wall with visual representations of mathematical terms

· Teacher modeling of thinking processes involved in solving, graphing, and writing equations

· Introduce concepts embedded in real-life context to help students relate to the mathematics involved

· Record formulas, processes, and mathematical rules in reference notebooks

· Graphing calculator to assist with computations and graphing of trigonometric functions

· Utilize technology through interactive sites to represent nonlinear data

· Graphic organizers to help students interpret the meaning of terms in an expression or equation in context

· Translation dictionary

· Sentence stems to provide additional language support for ELL students.

· Introduce vocabulary before lessons, so that ELLs have access to and can build understand of the math language.

· Support ELL students by modeling, creating visuals, describing with words, symbols, or numbers. Chart key vocabulary and examples with students. Leave these anchor-charts up so you and the students can refer back to them.

· Supports such as sentence stems, think-pair-shares, intentional groupings for cooperative learning activities, and guided math

groups so ELLs can be successful.

· The ability to synthesize concepts and make real world and cross- curricular connections through examples for gifted students

· Elevated contextual complexity for gifted students

· Sometimes independent activities, sometimes direct instruction for gifted students

· Inquiry based or open ended assignments and projects for gifted students

· Using supplementary materials in addition to the normal range of resources for gifted students

· Choices for students for gifted students

· Tiered/Multi-level activities with flexible groups (may change daily or weekly) for gifted students

Suggested Technological Innovations/Use

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

Cross Curricular/21st Century Connections

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.

Unit 06 Parametric Equations

Content Area: **Mathematics**
Course(s): **Pre Calculus Honors**
Time Period: **3rd Marking Period**
Length: **8 - 10 Days**
Status: **Not Published**

Summary of the Unit

Parametrics equations can be used to model the path of an object. These objects can be represented by conics (ellipses, parabolas, and hyperbolas). Conics are applied in real-world situations, such as orbits of planets, flashlights, and satellites. Since conics are not always functions, they can be defined using parametric equations.

MA.9-12.I.E	Parametric, polar, and vector functions
MA.9-12.II.E.2	Analysis of planar curves given in parametric form, polar form, and vector form, including velocity and acceleration

Enduring Understandings

Students will be able to

- Evaluate sets of parametric equations for given values of the parameter.
- Graph curves that are represented by sets of parametric equations with and without graphing caculators.
- Rewrite sets of parametric equations as single rectangular equations by eliminating the parameters.
- Use time as a parameter in parametric equations.
- Find parametric equations for curves defined by rectangular equations.

Essential Questions

- How do you write equations to describe the motion of a point in a plane?
- Why the function and relations represented by parameteric equations?
- When is the parametric form of an equations more useful than rectangular equation, and what additional inofrmation it can provide?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically
Identify Key Building Blocks
Make Connections (between and among key building blocks)
Short/Extended Constructed Response Items
Multiple-Choice Items (where multiple answer choices may be correct)
Drag and Drop Items
Use of Equation Editor Quizzes
Journal Entries/Reflections/Quick-Writes

Accountable talk
Projects Portfolio
Observation
Graphic Organizers/Concept Mapping
Presentations
Role Playing
Teacher-Student and Student-Student Conferencing Homework

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- https://sites.google.com/a/evergreenps.org/ms-griffin-s-math-classes/updates
- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC-ALG/?referrer=featured_content
- Statistics Education Web (STEW). http://www.amstat.org/education/STEW/
- The Data and Story Library (DASL). http://lib.stat.cmu.edu/DASL/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Be
Parametric Equations 3 days	SWBAT evaluate sets of parametric equations for given values of the parameter. SWBAT graph curves that are represented by sets of parametric equations with and without graphing calculators. SWBAT rewrite sets of parametric equations as single rectangular equations	When is it advantageous to define curves parametrically: Students will work in groups to determine the orientation of a curve, and thus the usefulness of parametric equations.	Group daily, f Homew textboo Introdu will be studen unders

	by eliminating the parameters. SWBAT use time as a parameter in parametric equations. SWBAT find parametric equations for curves defined by rectangular equations.		Quiz o Studen assesse concep on para All pro include

Suggested Modifications for Special Education, ELL and Gifted Students

· Anchor charts to model strategies

· Review Algebra concepts to ensure students have the information needed to progress in understanding

· Pre-teach pertinent vocabulary

· Provide reference sheets that list formulas, step-by-step procedures, theorems, and modeling of strategies

· Word wall with visual representations of mathematical terms

· Teacher modeling of thinking processes involved in solving, graphing, and writing equations

· Introduce concepts embedded in real-life context to help students relate to the mathematics involved

· Record formulas, processes, and mathematical rules in reference notebooks

· Graphing calculator to assist with computations and graphing of trigonometric functions

· Utilize technology through interactive sites to represent nonlinear data

· Graphic organizers to help students interpret the meaning of terms in an expression or equation in context

· Translation dictionary

· Sentence stems to provide additional language support for ELL students.

· Introduce vocabulary before lessons, so that ELLs have access to and can build understand of the math language.

· Support ELL students by modeling, creating visuals, describing with words, symbols, or numbers. Chart key vocabulary and examples with students. Leave these anchor-charts up so you and the students can refer back to them.

· Supports such as sentence stems, think-pair-shares, intentional groupings for cooperative learning activities, and guided math groups so ELLs can be successful.

· The ability to synthesize concepts and make real world and cross- curricular connections through examples for gifted students

· Elevated contextual complexity for gifted students

· Sometimes independent activities, sometimes direct instruction for gifted students

· Inquiry based or open ended assignments and projects for gifted students

· Using supplementary materials in addition to the normal range of resources for gifted students

· Choices for students for gifted students

· Tiered/Multi-level activities with flexible groups (may change daily or weekly) for gifted students

Suggested Technological Innovations/Use

Technology Operations and Concepts

• Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.

Example: Using technology, students are able to generate plots, regression functions, and correlation coefficients, and to simulate many possible outcomes in statistics and probability in a short amount of time.

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

Cross Curricular/21st Century Connections

Name of Task: Rock Toss NJSLS: HS-LS1-2;

HS-LS1-4 A rock is thrown straight up from level ground. The velocity of the rock at any time t (sec) is t (sec) is v(t)=48-32t ft/sec

1- Graph the velocity function.

2- At what time does the rock reach its maximum height?

3- Find how far the rock has traveled at its maximum height.

4- Graph the pathway followed by the rock 5- How far away from the launching point would the rock land?

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.

Unit 07 Polar Coordinates and Graphs of Polar Equations

Content Area: **Mathematics**
Course(s): **Pre Calculus Honors**
Time Period: **3rd Marking Period**
Length: **13 -15 Days**
Status: **Not Published**

Summary of the Unit

The polar coordinate system builds on the unit circle. Traditionally, we establish a point using horizontal and vertical components. On polar graphs, we instead establish a point using the distance from the origin (pole) and an angle in standard position. The polar coordinate system connects directly with both the rectangular and complex coordinate systems, allowing for conversion between each system.

MA.9-12.I.E	Parametric, polar, and vector functions
MA.9-12.II.E.2	Analysis of planar curves given in parametric form, polar form, and vector form, including velocity and acceleration

Enduring Understandings

Students will be able to

- Plot points and find multiple representations of points in the polar coordinate system.
- Convert points from rectangular to polar form and vice versa.
- Convert equations from rectangular to polar form and vice versa.
- Graph polar equations by point plotting.
- Use smmetry and zeros as sketching aids.
- Recognize special polar graphs.

Essential Questions

- How do you describe the position of a point in a plane using distance and angle rather than x- and y-coordinates?
- How are the rectangular, and polar coordinate system related, algebraically and graphically?
- How do you sketch graphs of polar equations?
- How do you represent conic sections in polar coordinates?
- How does the study of trigonometry and polar graphs relate to real-world?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically
Identify Key Building Blocks

Make Connections (between and among key building blocks)
Short/Extended Constructed Response Items
Multiple-Choice Items (where multiple answer choices may be correct)
Drag and Drop Items
Use of Equation Editor Quizzes
Journal Entries/Reflections/Quick-Writes
Accountable talk
Projects Portfolio
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Resources

- Cengage Learning: Precalculus with Limits - A Graphing Approach, Sixth Edition
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- http://www.mathwords.com/index_adv_alg_precal.htm
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- https://sites.google.com/a/evergreenps.org/ms-griffin-s-math-classes/updates
- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC-ALG/?referrer=featured_content
- Statistics Education Web (STEW). http://www.amstat.org/education/STEW/
- The Data and Story Library (DASL). http://lib.stat.cmu.edu/DASL/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Be
Polar Coordinates 6 days	SWBAT plot points and find multiple representations of points in the polar coordinate system. SWBAT convert points from rectangular to polar form and vice versa. SWBAT convert equations from rectangular to polar form and vice versa.	Explain and model Polar coordinate system. Have students investigate the general representation of a point in polar coordinate system. Students will compare polar coordinates to that of rectangular coordinates. They will locate points on a polar coordinate plane and convert the point to one on a rectangular coordinate plane, and vice versa.	Group daily, f Homev textboo Introdu will be studen unders

			Quiz o
Graphs of Polar Equations 6 days	SWBAT graph polar equations by point plotting. SWBAT use smmetry and zeros as sketching aids. SWBAT recognize special polar graphs.	Introduce Sketching Graphs of Polar Equations by hand and using Desmos. Students will graph and identify characteristics of simple polar equations including lines, circles, cardioids, limacons, and roses	Group daily, f Homev textboo Introd will be studen unders Unit Pr Polar E Desmo Studen comple will be or her

Suggested Modifications for Special Education, ELL and Gifted Students

· Anchor charts to model strategies

· Review Algebra concepts to ensure students have the information needed to progress in understanding

· Pre-teach pertinent vocabulary

· Provide reference sheets that list formulas, step-by-step procedures, theorems, and modeling of strategies

· Word wall with visual representations of mathematical terms

· Teacher modeling of thinking processes involved in solving, graphing, and writing equations

· Introduce concepts embedded in real-life context to help students relate to the mathematics involved

· Record formulas, processes, and mathematical rules in reference notebooks

· Graphing calculator to assist with computations and graphing of trigonometric functions

· Utilize technology through interactive sites to represent nonlinear data

· Graphic organizers to help students interpret the meaning of terms in an expression or equation in context

· Translation dictionary

· Sentence stems to provide additional language support for ELL students.

· Introduce vocabulary before lessons, so that ELLs have access to and can build understand of the math language.

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Suggested Technological Innovations/Use

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

Cross Curricular/21st Century Connections

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.

Unit 08 Limits and Continuity

Content Area: **Mathematics**
Course(s): **Pre Calculus Honors**
Time Period: **3rd Marking Period**
Length: **15 - 18 Days**
Status: **Not Published**

Summary of the Unit

Limits are an essential concept underlying theorems used throughout calculus. The ability to evaluate both one-sided and two-sided limits analytically, graphically, and numerically sets a foundation for differential and integral calculus. Understanding continuity and special limits provides a deeper understanding of how functions work, in addition to special limits.

MA.9-12.I.C.1	Understanding asymptotes in terms of graphical behavior
MA.9-12.I	Functions, Graphs, and Limits
MA.9-12.I.A	Analysis of graphs
MA.9-12.I.B	Limits of functions (including one-sided limits)
MA.9-12.I.B.1	An intuitive understanding of the limiting process
MA.9-12.I.B.2	Calculating limits using algebra
MA.9-12.I.B.3	Estimating limits from graphs or tables of data
MA.9-12.I.C	Asymptotic and unbounded behavior
MA.9-12.I.C.2	Describing asymptotic behavior in terms of limits involving infinity
MA.9-12.I.D	Continuity as a property of functions
MA.9-12.I.D.1	An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.)
MA.9-12.I.D.2	Understanding continuity in terms of limits
MA.9-12.II.B.1	Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.

Enduring Understandings

Students will be able to

- Identify symptotes from domain restrictions.
- Understand the limit concept.
- Use the definition of a limit to estimate limits.
- Determine a limit by looking at a graph.
- Determine whether limits of a functions exist.
- Use properties of limits and direct substitution to evaluate limits.
- Evaluate limits at infinity of rational functions.
- Use different techniques to evaluate limits of functions.
- Find one-sided limits.
- Distinguish between continuous and discontinuous functions
- Graph discontinuous functions both removable and non- removable by hand and using technology.
- Evaluate limits of difference quotients from calculus.
- Find the formula of the line tangent to a function through the limit process.

Essential Questions

- What is the relationship between the graph of a function and its limit?
- How are limits used to describe the end behavior of functions?
- Why do we define continuity using limits?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically
Identify Key Building Blocks
Make Connections (between and among key building blocks)
Short/Extended Constructed Response Items
Multiple-Choice Items (where multiple answer choices may be correct)
Drag and Drop Items
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- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC-ALG/?referrer=featured_content
- Statistics Education Web (STEW). http://www.amstat.org/education/STEW/
- The Data and Story Library (DASL). http://lib.stat.cmu.edu/DASL/

Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	B
Rational Functions and Asymptotes 8 days	SWBAT find the domain of rational functions. SWBAT find vertical and horizontal asymptotes of graphs of rational functions.	Graph rational functions, factor numerator and denominator to find equations of vertical asymptotes and open points, find equation of horizontal asymptote, if one exists, and discuss domain and range.	Group a daily, fi Homew textboo Introdu will be student underst Activity Student and wil having provide their jus
Introduction to Limits 6 days	SWBAT understand the limit concept. SWBAT use the definition of a limit to estimate limits. SWBAT determine a limit by looking at a graph. SWBAT determine whether limit of a function exist.	Activity: Investigate sums of series such as 1 + 1/2 + 1/3 + … or 1/1! + 1/2! + 1/3! ... Use the graphing calculator to analyze the limit of a function, as x approaches different values on the graph. Includes a situation where the limit for the function will fail to exist.	Group a daily, fi Homew textboo Introdu will be student underst Quiz or
Techniques for Evaluating Limits 7 days	SWBAT use different techniques to evaluate limits of functions.	Model when and why to use divide out or rationalization technique. Describe the process of using divide out and rationalization techniques to find the limit. Illustrate the concept of one-sided limits with tables and graphs.	Group a daily, fi Homew textboo Introdu will be student underst Mid un

Limits at Infinity 3 days	SWBAT evaluate limits at infinity of rational functions.	Students will study behavior of different parts of a function as x increases or decreases without bound.	Group a daily, fi Homev textboo Introdu will be student underst Quiz or
The tangent Line Problem 2 days	SWBAT evaluate limits of difference quotients from calculus. SWBAT find the formula of the line tangent to a function through the limit process.	Model definition of slope using limit process. Demonstrate few examples how to find slope of a tangent line that intersect graphs at a given point using limit process.	Group a daily, fi Homev textboo Introdu will be student underst Quiz or
Continuity 4 days	SWBAT distinguish between continuous and discontinuous functions. SWBAT graph discontinuous functions both removable and non- removable by hand and using technology.	Recognize that a rational function is continuous at every number, except any at which it is not defined. Demonstrate examples of rational functions by factor numerator and denominator to find removable and non removable discontinuities.	Group a daily, fi Homev textboo Introdu will be student underst Quiz or

Suggested Modifications for Special Education, ELL and Gifted Students

· Anchor charts to model strategies

· Review Algebra concepts to ensure students have the information needed to progress in understanding

· Pre-teach pertinent vocabulary

· Provide reference sheets that list formulas, step-by-step procedures, theorems, and modeling of strategies

· Word wall with visual representations of mathematical terms

· Teacher modeling of thinking processes involved in solving, graphing, and writing equations

· Introduce concepts embedded in real-life context to help students relate to the mathematics involved

· Record formulas, processes, and mathematical rules in reference notebooks

· Graphing calculator to assist with computations and graphing of trigonometric functions

· Utilize technology through interactive sites to represent nonlinear data

· Graphic organizers to help students interpret the meaning of terms in an expression or equation in context

· Translation dictionary

· Sentence stems to provide additional language support for ELL students.

· Introduce vocabulary before lessons, so that ELLs have access to and can build understand of the math language.

· Support ELL students by modeling, creating visuals, describing with words, symbols, or numbers. Chart key vocabulary and examples with students. Leave these anchor-charts up so you and the students can refer back to them.

· Supports such as sentence stems, think-pair-shares, intentional groupings for cooperative learning activities, and guided math groups so ELLs can be successful.

· The ability to synthesize concepts and make real world and cross- curricular connections through examples for gifted students

· Elevated contextual complexity for gifted students

· Sometimes independent activities, sometimes direct instruction for gifted students

· Inquiry based or open ended assignments and projects for gifted students

· Using supplementary materials in addition to the normal range of resources for gifted students

· Choices for students for gifted students

· Tiered/Multi-level activities with flexible groups (may change daily or weekly) for gifted students

Suggested Technological Innovations/Use

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

Cross Curricular/21st Century Connections

Science Connection:

Name of Task: Rabbits Population NJSLS: HS-LS1-2;

HS-LS1-4 The population of rabbits over a 2 year period in a certain county is given below

1- Draw a scatter plot of the data

2- Find a logistic regression model for the data. Find the limit of that model as time approaches infinity

3- What can you conclude about the limit of the rabbit population growth in the county?

4- Provide a reasonable explanation for the population growth limit.

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.

Unit 09 Logarithmic Functions

Content Area: **Mathematics**
Course(s): **Pre Calculus Honors**
Time Period: **4th Marking Period**
Length: **8-10 Days**
Status: **Not Published**

Summary of the Unit

This unit will focus on the study of exponential and logarithmic functions. Exponential functions describe relationships that have a variable rate of change. Students are introduced to the natural base, e. Logarithmic functions are the inverses of exponential functions. Students will learn to analyze both types of functions using analytical, numerical and graphical approaces.

MA.F-BF.B.5	Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.
MA.F-IF.C.7e	Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

Enduring Understandings

Students will be able to

- Recognize, evaluate, and graph exponential and logarithmic functions.
- Use exponential and logarithmic functions to model and solve real life problems.

Essential Questions

How do we model quantities that change at a constant rate over time?

What is a logarithm? How do mathematicians use them?

What is the relationship between exponential and logarithmic functions?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically
Identify Key Building Blocks
Make Connections (between and among key building blocks)
Short/Extended Constructed Response Items
Multiple-Choice Items (where multiple answer choices may be correct)
Drag and Drop Items
Use of Equation Editor Quizzes
Journal Entries/Reflections/Quick-Writes
Accountable talk
Projects Portfolio
Observation
Graphic Organizers/Concept Mapping

Presentations
Role Playing
Teacher-Student and Student-Student Conferencing Homework

Resources

- Cengage Learning: Precalculus with Limits - A Graphing Approach, Sixth Edition
- https://www.ixl.com/standards/new-jersey/math/high-school
- http://www.mathwords.com/index_adv_alg_precal.htm
- http://www.hershey.k12.pa.us/Page/3608
- https://sites.google.com/a/evergreenps.org/ms-griffin-s-math-classes/updates
- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC-ALG/?referrer=featured_content
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Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Be
Logarithmic Functions 5 days	SWBAT review graphing logarithmic functions, functions involving *e*, and evaluating logarithms.	Provide review problems on graphing logarithmic functions, functions involving *e*, and evaluating logarithms.	Group assigne Homew textboo Introdu will be student underst
Solve logarithmic equations 6 days	SWBAT solve logarithmic equations	Provide notes and examples on how to solve logarithmic equations, in one of the two following cases: 1) in problems where you have (or can obtain by using log properties) "log" with the same base on BOTH sides, or 2) in problems where you have (or can obtain by using log properties) one "log" on one side, but not on the other. Use the graphing calculator to “check” solutions.	Group daily, f Homew textboo

		As time permits, include word problems.	Introdu will be student underst Quiz/A

Suggested Modifications for Special Education, ELL and Gifted Students

· Anchor charts to model strategies

· Review Algebra concepts to ensure students have the information needed to progress in understanding

· Pre-teach pertinent vocabulary

· Provide reference sheets that list formulas, step-by-step procedures, theorems, and modeling of strategies

· Word wall with visual representations of mathematical terms

· Teacher modeling of thinking processes involved in solving, graphing, and writing equations

· Introduce concepts embedded in real-life context to help students relate to the mathematics involved

· Record formulas, processes, and mathematical rules in reference notebooks

· Graphing calculator to assist with computations and graphing of trigonometric functions

· Utilize technology through interactive sites to represent nonlinear data

· Graphic organizers to help students interpret the meaning of terms in an expression or equation in context

· Translation dictionary

· Sentence stems to provide additional language support for ELL students.

· Introduce vocabulary before lessons, so that ELLs have access to and can build understand of the math language.

· Support ELL students by modeling, creating visuals, describing with words, symbols, or numbers. Chart key vocabulary and examples with students. Leave these anchor-charts up so you and the students can refer back to them.

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Suggested Technological Innovations/Use

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

Cross Curricular/21st Century Connections

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.

Unit 10 Sequences and Series

Content Area: **Mathematics**
Course(s): **Pre Calculus Honors**
Time Period: **1st Marking Period**
Length: **10 -12 Days**
Status: **Not Published**

Summary of the Unit

In this unit, students will study sequences and series, which are used for approximating functions.

MA.F-BF.A.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

Essential Questions

- How do mathematicians model arithmetic and geometric sequences and series? What purpose do these models serve?
- What are different methods which can be used when determining the sum of a sequence? What is the nth term of a sequence and how is it useful in making predictions?
- How are patterns used to find the sum of arithmetic sequences?
- Is it possible for an infinite series to have a finite sum?
- What is the role of the interval of convergence in a geometric series?
- How are sequences and series used to model real life problems?

Summative Assessment and/or Summative Criteria

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

Resources

- Cengage Learning: Precalculus with Limits - A Graphing Approach, Sixth Edition
- https://www.ixl.com/standards/new-jersey/math/high-school

- http://www.mathwords.com/index_adv_alg_precal.htm
- http://www.hershey.k12.pa.us/Page/3608
- https://sites.google.com/a/evergreenps.org/ms-griffin-s-math-classes/updates
- https://sites.google.com/site/dgrahamcalculus/trigpre-calculus/trig-pre-calculus-worksheets
- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
- https://www.ck12.org/algebra/Applications-of-Function-Models/lesson/Applications-of-Function-Models-BSC-ALG/?referrer=featured_content
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Unit Plan

Topic/Selection Timeframe	General Objectives	Instructional Activities	Be
Sequences and Series 12 days	SWBAT model arithmetic and geometric sequences and series? and determine what purpose do these models serve? SWBAT to determine the sum of a sequence using different methods. SWBAT find the nth term of a sequence and how is it useful in making predictions? SWBAT to determine how are patterns used to find the sum of arithmetic sequences? SWBAT determine if it is possible for an infinite series to have a finite sum? SWBAT to determine the role of the interval of convergence in a geometric series? SWBAT to determine how are sequences and series used to model real life problems?	Use the formula to find the sum of a finite arithmetic and geometric series, given a problem written in summation notation form. Derive the Sum of an Infinite Geometric Series formula, and discuss when a sum does not exist.	Group daily, f Homew textboo Introdu will be studen unders Quiz/A

Suggested Modifications for Special Education, ELL and Gifted Students

· Anchor charts to model strategies

· Review Algebra concepts to ensure students have the information needed to progress in understanding

· Pre-teach pertinent vocabulary

· Provide reference sheets that list formulas, step-by-step procedures, theorems, and modeling of strategies

· Word wall with visual representations of mathematical terms

· Teacher modeling of thinking processes involved in solving, graphing, and writing equations

· Introduce concepts embedded in real-life context to help students relate to the mathematics involved

· Record formulas, processes, and mathematical rules in reference notebooks

· Graphing calculator to assist with computations and graphing of trigonometric functions

· Utilize technology through interactive sites to represent nonlinear data

· Graphic organizers to help students interpret the meaning of terms in an expression or equation in context

· Translation dictionary

· Sentence stems to provide additional language support for ELL students.

· Introduce vocabulary before lessons, so that ELLs have access to and can build understand of the math language.

· Support ELL students by modeling, creating visuals, describing with words, symbols, or numbers. Chart key vocabulary and examples with students. Leave these anchor-charts up so you and the students can refer back to them.

· Supports such as sentence stems, think-pair-shares, intentional groupings for cooperative learning activities, and guided math groups so ELLs can be successful.

· The ability to synthesize concepts and make real world and cross- curricular connections through examples for gifted students

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Suggested Technological Innovations/Use

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to

create and communicate knowledge.

Cross Curricular/21st Century Connections

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.

Enduring Understandings

Students will be able to:

- Variety of ways to represent a sequence of terms.
- Find sum of infinite series.
- Use sequences and series to model and solve real-life problems.
- Recognize, write, and find the nth terms of arithmetic and geometric sequences.
- Find nth partial sums of arithmetic and geometric sequences.
- Use arithmetic and geometric sequences to model and solve real-life problems.

Unit 11 Probability

Content Area: **Mathematics**
Course(s): **Pre Calculus Honors**
Time Period: **4th Marking Period**
Length: **7-9 Days**
Status: **Not Published**

Summary of the Unit

In this unit, students will study probability, a field used for analyzing data and decision making. Students will learn how to find conditional probabilities, permutations and combinations.

MA.S-CP.B.6	Find the conditional probability of □ given □ as the fraction of □'s outcomes that also belong to □, and interpret the answer in terms of the model.
MA.S-CP.B.7	Apply the Addition Rule, □(□ □□ □) = □(□) + □(□) – □(□ □□□ □), and interpret the answer in terms of the model.
MA.S-CP.B.8	Apply the general Multiplication Rule in a uniform probability model, □(□ □□□ □) = [□(□)] × [□(□|□)] = [□(□)] × [□(□|□)], and interpret the answer in terms of the model.
MA.S-CP.B.9	Use permutations and combinations to compute probabilities of compound events and solve problems.
MA.S-CP.A.1	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
MA.S-CP.A.2	Understand that two events □ and □ are independent if the probability of □ and □ occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
MA.S-CP.A.3	Understand the conditional probability of □ given □ as □(□ □□□ □)/□(□), and interpret independence of □ and □ as saying that the conditional probability of □ given □ is the same as the probability of □, and the conditional probability of □ given □ is the same as the probability of □.
MA.S-CP.A.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.

Enduring Understandings

Students will be able to:

- Use the Fundamental Counting Principle to solve counting problems.
- Use Permutation and Combination to solve counting problems.
- Use Probability to solve a variety of problems.

Essential Questions

- How do you count the number of ways in which an event can occur?
- When do I use a permutation vs. a combination?
- How do you find probability that a series of events will occur?

- How is probability related to real world events?
- How can experimental and theoretical probabilities be used to make predictions or draw conclusions?

Summative Assessment and/or Summative Criteria

Describe Learning Vertically
Identify Key Building Blocks
Make Connections (between and among key building blocks)
Short/Extended Constructed Response Items
Multiple-Choice Items (where multiple answer choices may be correct)
Drag and Drop Items
Use of Equation Editor Quizzes
Journal Entries/Reflections/Quick-Writes
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- https://www.ixl.com/math/precalculus
- https://www.illustrativemathematics.org/
- http://map.mathshell.org/materials/lessons.php?gradeid=24
- http://www.achieve.org/ccss-cte-classroom-tasks
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Unit Plan

Topic/Selection	General Objectives	Instructional Activities	B

Timeframe			
The Counting Principle 2 days	SWBAT use the Fundamental Counting Principle to solve counting problems.	Introduce the Fundamental Counting Principle, and provide practice problems using it (both independent and dependent events).	Group daily,
Premutaion and Combination 3 days	SWBAT use Permutation and Combination to solve counting problems.	Introduce the permutation and combination formula, and show how to use it in the graphing calculator. Show the formula for permutation with repetition, and provide practice problems to use it. Provide practice problems with simple events, and multiple events.	Group daily,
Probability 4 days	SWBAT use Probability to solve a variety of problems.	Provide notes that: If 2 events are independent, then the probability of both events happening is the product of the two independent probabilities. Practice problems together, and extend the above to more than two independent events. Define simple event, compound event, mutually exclusive, and inclusive. Provide notes that: If two events are mutually exclusive, then the probability of either the first or the second event occurs is the sum of their probabilities. Provide notes on conditional probability. Model problems before providing practice problems.	Group daily,

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Suggested Technological Innovations/Use

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Cross Curricular/21st Century Connections

Social Studies Connection:

Name of Task: Security System at Quail Creek NJSLS: 9.1.12.A.4 Ten homes in the Quail Creek area were identified by a surveyor; you were told that 4 of the homes have security system.

1- If you are to pick 3 homes randomly:

a. What is the probability that all 3 homes have security system? b. What is the probability that only 1 has a security system?

2- If 40% of the homes constructed in the Quail creek area include a security system.

Three homes are selected at random:

a. What is the probability all three of the selected homes have a security system?

b. What is the probability none of the selected homes have a security system?

c. What is the probability that at least one has a security system?

3- Create probability distribution tables for part 1 and part 2

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CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.