DISCLAIMER

All lessons related to writing a program will include the following Software Development standards:

1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development

9.1 Explain the steps in the System Development Life Cycle (SDLC) (e.g., planning, analysis, design, development, testing, implementation, maintenance)

9.2 Interpret a problem statement and identify program requirements

9.3 Develop program requirements/specifications and a testing plan (e.g., user stories, automated testing, test procedures)

9.4 Determine input and output

9.5 Choose appropriate data structures

9.7 Apply pseudo code or graphical representations to plan the structure of a program or module (e.g., flowcharting, white boarding, UML)

10.1 Use a program editor to enter and modify code

10.5 Name identifiers and formatting code by applying recognized conventions

11.1 Identify errors in program modules

11.4 Categorize, identify, and correct errors in code, including syntax, semantic, logic, and runtime

16.2 Choose the appropriate data type for a given situation

16.4 Identify the correct syntax for initializing and modifying variables

18.1 Identify correct input/output statements in a program

These standards will be listed as (PROGRAM); please refer back to this page for a full description.

DISCLAIMER

3409Number and Quantity: The Real Number System (N-RN)

Extend the properties of exponents to rational exponents.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-RN.A.1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.* Connections: *11-12.RST.4; 11-12.RST.9; 11-12.WHST.2d*	A II	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 6.1 Explain the function of base number systems in mathematics as they relate to computer technology 9.5 Choose appropriate data structures 12.1 Identify and	To create programs that accept a base, a numerator and a denominator of an exponent, and return a decimal value. Test data will need to be created by working the problem longhand to test the program.	**Question 1** What is the correct simplification of $25^{1/2}$? **Solution:** 5 **Question 2** What is the correct simplification of $\left(4^{\frac{1}{3}}\right)^3$? **Solution:** 4

3409Number and Quantity: The Real Number System (N-RN) **Extend the properties of exponents to rational exponents.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.N-RN.A.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.	A II	*HS.MP.7.* Look for and make use of structure.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk	To rewrite expressions so that they may be more easily coded into a computer programming language	Rewrite the following expression so that it may be placed into computer code. $X^{\frac{3}{2}}$ **Solution:** $\sqrt[2]{X^3}$

3409Number and Quantity: The Real Number System (N-RN) **Extend the properties of exponents to rational exponents.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 6.1 Explain the function of base number systems in mathematics as they relate to computer technology 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct		

3409Number and Quantity: The Real Number System (N-RN) **Extend the properties of exponents to rational exponents.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		

Number and Quantity: The Real Number System (N-RN) **Use properties of rational and irrational numbers.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-RN.B.3. Explain why the sum or product of two rational numbers are rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is	A I	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others.	12.4 Identify correct and problematic uses of integers, floating-point numbers, and fixed-point numbers, and fixed-point numbers in arithmetic 16.2 Choose the	Declare variables for appropriate uses. For example: int, double, float	**Name all the number systems to which each value belongs:** **a. 2.37** **b. -9** **c. $3+\sqrt{2}$** **Answer:** **a. Rational, real** **b. Integer, rational, real** **c. Irrational, real** **Software example:** **double a = 2.37**

Number and Quantity: The Real Number System (N-RN) **Use properties of rational and irrational numbers.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
irrational. Connection: *9-10.WHST.1e*			appropriate data type for a given situation 16.4 Identify the correct syntax for initializing and modifying variables		**int b = -9** **double c = 3 + sqrt(2)**

Number and Quantity: Quantities ★ (N-Q)

Reason qualitatively and use units to solve problems.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. Connections: *SCHS-S1C4-02*; *SSHS-S5C5-01*	A I ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create programs which use the CPU timer and return usable time values. Test data will need to be created by working the problem longhand to test the program.	Convert 4,325,786 milliseconds into hours, minutes, and/or seconds. **Solution:** 1 hour, 12 minutes, 5.786 seconds

Number and Quantity: Quantities ★ (N-Q) **Reason qualitatively and use units to solve problems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.N-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling. Connection: *SSHS-S5C5-01*	A I A II ★	*HS.MP.4.* Model with mathematics. *HS.MP.6.* Attend to precision.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software	To understand the appropriate units to use when discussing such things as amount of memory, download speeds, etc.	Convert 45,623 kilobytes to megabytes. **Solution:** 44.5537

Number and Quantity: Quantities ★ (N-Q) **Reason qualitatively and use units to solve problems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.N-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when	A I	*HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	1.1 Describe methods and considerations for prioritizing and scheduling	To choose the data type with the correct degree of precision to store the data	Calculate the total cost of 18 gallons of gas priced at $4.2995 to the nearest cent. **Solution:** $77.39

Number and Quantity: Quantities ★ (N-Q) **Reason qualitatively and use units to solve problems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
reporting quantities.			software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate		

Number and Quantity: Quantities ★ (N-Q) **Reason qualitatively and use units to solve problems.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.2 Choose the appropriate data type for a given situation		

Number and Quantity: The Complex Number System (N-CN)

Perform arithmetic operations with complex numbers.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-CN.A.1. Know there is a complex number *i* such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.	A II	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.6.* Attend to precision.			**Math Example:** Simplify: $2 - 3i^2$ Solution: 5 **Code Example:** Why will the following line of code not compile? double x = sqrt(-4) Solution: The square root of -4 is an imaginary number, and cannot be assigned to a double.
HS.N-CN.A.2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. Connection: *11-12.RST.4*	A II	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.7.* Look for and make use of structure.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to	To create programs that will process complex numbers. Given the coefficients of the real and imaginary parts, the program will process the number correctly and return a complex number in the standard format. Test data will need to be created by working the	**Math Example:** Simplify the following expression. (2-2i)(2-3i) Solution: -2-10i

Number and Quantity: The Complex Number System (N-CN) **Perform arithmetic operations with complex numbers.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 18.3 Choose the correct method of outputting data, with formatting	problem longhand to test the program.	

Number and Quantity: The Complex Number System (N-CN) **Perform arithmetic operations with complex numbers.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			and escaping 20.4 Read the state of an object by invoking accessor methods 20.5 Change the state of an object by invoking a modifier method 20.6 Determine the requirements for constructing new objects by reading the documentation		

Number and Quantity: The Complex Number System (N-CN)

Use complex numbers in polynomial identities and equations.

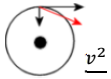
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-CN.C.7. Solve quadratic equations with real coefficients that have complex solutions.	A II		1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create programs that will process quadratic equations. Given the coefficients of the terms, the program will find the roots and determine if there are any real roots to be used in other functions. Test data will need to be created by working the problem longhand to test the program.	**Math Example:** Find all solutions of $3x^2 + 5 = 2x$ and express them in the form $a + bi$. **Solution:** $\frac{1}{3} - \frac{\sqrt{14}}{3}i, \quad \frac{1}{3} + \frac{\sqrt{14}}{3}i$ **Code Example:** int discriminant = (b*b) – (4*a*c); if discriminant < 0 then print "No real solutions";

Number and Quantity: The Complex Number System (N-CN) **Use complex numbers in polynomial identities and equations.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal) 14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR) 14.4 Select an appropriate decision structure for a given situation 14.1 Select correct syntax for decision statements (e.g.,		

Number and Quantity: The Complex Number System (N-CN) **Use complex numbers in polynomial identities and equations.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			if/else, if, switch case)		

Number and Quantity: Vector and Matrix Quantities (N-VM)

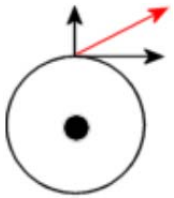
Represent and model with vector quantities.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-VM.A.3. Solve problems involving velocity and other quantities that can be represented by vectors. Connections: *11-12.RST.9; SCHS-S5C2-01*; *SCHS-S5C2-02*; *SCHS-S5C2-06*; *11-12.WHST.2d*	+	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	(PROGRAM) 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.1 Declare numeric, Boolean, character, and string variables 16.2 Choose the appropriate data type for a given situation	To create computer games using vectors to streamline the process.	**EXAMPLE:** In a computer game a spaceship must achieve orbit around a planet. The spaceship is traveling at 10 kilometers/sec tangent to the planet at a distance of 50 kilometers. The acceleration of gravity is 9.3 meters/sec^2 directed straight toward the center of the planet. Calculate the vector sum of the gravity vector plus the velocity vector of the ship to achieve the resulting vector and then indicate if orbit around the planet has been obtained. **Solution:**  $\frac{v^2}{r} > g$ **Orbit has not been achieved.** **Question 2** If orbit has not been established for the spaceship in the game, what changes would one need to make in the spaceship's approach to achieve orbit? **Solution:** Decrease velocity.

Number and Quantity: Vector and Matrix Quantities (N-VM) **Represent and model with vector quantities.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			17.4 Search and sort data in an array 17.6 Describe the efficiency of different sorting algorithms (e.g., bubble, insertion, merge) 17.7 Describe the efficiency of linear vs. binary searches [e.g., o(n) or o(log n)]		

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on vectors.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-VM.B.4. Add and subtract vectors.	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	(PROGRAM) 1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and	To create computer games using vectors to streamline the process. Test data will need to be created by working the problem longhand to test the program.	**Example:** A spaceship is flying across a solar system tangent to the star at an average speed of 17,000 miles per hour. There is a cross solar wind from the star at 1000 miles per hour. What is the magnitude and direction of the resultant? **Solution:**  **Magnitude 17029, angle 3.368 degrees above the tangent**

Number and Quantity: Vector and Matrix Quantities (N-VM) **Perform operations on vectors.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.1 Declare numeric, Boolean, character, and string variables 16.2 Choose the appropriate data type for a given situation 17.4 Search and sort data in an array 17.6 Describe the efficiency of different sorting algorithms (e.g., bubble, insertion, merge) 17.7 Describe the		

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on vectors.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			efficiency of linear vs. binary searches [e.g., o(n) or o(log n)]		
a. 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.	+		(PROGRAM) 17.1 Demonstrate basic uses of arrays, including initialization, storage, and retrieval of values	To create computer games using vectors to streamline the process. Test data will need to be created by working the problem longhand to test the program.	**Example:** Add $< -3, 4 > + < 2, -9 >$ Solution: $< -1, -5 >$
b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.	+		(PROGRAM) 17.1 Demonstrate basic uses of arrays, including initialization, storage, and retrieval of values	To create computer games using vectors to streamline the process. Test data will need to be created by working the problem longhand to test the program.	**Example:** A is a vector starting at (1, 1) and traveling northwest for $5\sqrt{2}$ units. B is a vector that starts at the terminus of A and travels southwest for a further $5\sqrt{2}$ units. C is a vector that begins at (1, 1) and terminates at the terminus of B. Find the direction and magnitude of C. Solution: C travels west for 10 units.
HS.N-VM.B.5. Multiply a vector by a scalar.	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model	1.1 Describe methods and considerations for prioritizing and	To create computer games using vectors to streamline the	**Question 1** If a spaceship traveling at a vector of $\langle 3, 4 \rangle$ triples in speed, what is the resulting vector?

Number and Quantity: Vector and Matrix Quantities (N-VM) **Perform operations on vectors.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
		with mathematics. *HS.MP.5.* Use appropriate tools strategically.	scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions	process. Test data will need to be created by working the problem longhand to test the program.	**Solution:** <9,12> **Question 2** What value should the scalar be to reverse the direction of the ship? **Solution:** -1

Number and Quantity: Vector and Matrix Quantities (N-VM) **Perform operations on vectors.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.1 Declare numeric, Boolean, character, and string variables 16.2 Choose the appropriate data type for a given situation 17.4 Search and sort data in an array 17.6 Describe the efficiency of different sorting algorithms (e.g., bubble, insertion, merge) 17.7 Describe the efficiency of linear vs. binary searches [e.g., o(n) or o(log n)]		

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-VM.C.6. Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. Connections: *9-10.RST.7*; *9-10.WHST.2f*; *11-12.RST.9*; *11-12.WHST.2e*; *ETHS-S6C2-03*	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create programs using arrays to hold and manipulate data. Test data will need to be validated by inputting the problem into a calculator.	**Math Example:** Display the system of equations in a matrix: $3x - 4y = -9$ $-2x + y = 0$ Solution: $\begin{bmatrix} 3 & -4 & -9 \\ -2 & 1 & 0 \end{bmatrix}$ **Coding Example:** Student 1 got scores of 91, 89, 78 and student 2 got scores of 87, 77, 92. Create a grade matrix that displays this data. Solution: $\begin{bmatrix} \mathbf{91} & \mathbf{89} & \mathbf{78} \\ \mathbf{87} & \mathbf{77} & \mathbf{92} \end{bmatrix}$

Number and Quantity: Vector and Matrix Quantities (N-VM) **Perform operations on matrices and use matrices in applications.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 17.1 Demonstrate basic uses of arrays, including initialization, storage, and retrieval of values 17.3 Identify techniques for declaring, initializing, and modifying user-defined data types 17.5 Create and use two-dimensional arrays 17.4 Search and sort data in an array 17.6 Describe the		

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			efficiency of different sorting algorithms (e.g., bubble, insertion, merge) 17.7 Describe the efficiency of linear vs. binary searches [e.g., o(n) or o(log n)]		
HS.N-VM.C.7. Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. Connections: *9-10.RST.3*; *ETHS-S6C2-03*	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures	To create programs using arrays to hold and manipulate data. Test data will need to be validated by inputting the problem into a calculator.	**Example:** Multiply: $-2\begin{bmatrix}-2 & 3\\ 0 & -9\end{bmatrix}$ Solution: $\begin{bmatrix}4 & -6\\ 0 & 18\end{bmatrix}$ **Example:** Student 1 got scores of 94, 88, 78 and student 2 got scores of 86, 76, and 92. If a teacher weights every student's score in every assignment by a factor of 1.5, what would the resulting matrix contain? **Solution:** $\begin{bmatrix}\mathbf{141} & \mathbf{132} & \mathbf{117}\\ \mathbf{129} & \mathbf{114} & \mathbf{138}\end{bmatrix}$

Number and Quantity: Vector and Matrix Quantities (N-VM) **Perform operations on matrices and use matrices in applications.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 17.1 Demonstrate basic uses of arrays, including initialization, storage, and retrieval of values 17.3 Identify techniques for declaring,		

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			initializing, and modifying user-defined data types 17.5 Create and use two-dimensional arrays		
HS.N-VM.C.8. Add, subtract, and multiply matrices of appropriate dimensions. Connections: *9-10.RST.3*; *ETHS-S6C2-03*	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic	To create programs using arrays to hold and manipulate data. Test data will need to be validated by inputting the problem into a calculator.	**Examples:** Find 3*A* + *B* - C given Matrices *A*, *B,* and *C* below. Matrix *A* $\begin{bmatrix} 5 & 30 & 10 \\ 21 & -5 & 0 \\ 9 & 15 & 4 \end{bmatrix}$ Matrix *B* $\begin{bmatrix} 43 & 10 & 33 \\ -2 & -16 & 2 \\ 44 & 8 & -5 \end{bmatrix}$ Matrix *C* $\begin{bmatrix} 7 & -3 & -1 \\ 12 & 14 & 88 \\ 18 & 52 & 44 \end{bmatrix}$ **Solution:** $\begin{bmatrix} \mathbf{51} & \mathbf{103} & \mathbf{64} \\ \mathbf{49} & \mathbf{-45} & \mathbf{-86} \\ \mathbf{53} & \mathbf{1} & \mathbf{-37} \end{bmatrix}$ **Question 2** Find $B \bullet C$ given Matrices *A*, *B,* and *C* below. Matrix *A* $\begin{bmatrix} 5 & 30 & 10 \\ 21 & -5 & 0 \\ 9 & 15 & 4 \end{bmatrix}$ Matrix *B* $\begin{bmatrix} 43 & 10 & 33 \\ -2 & -16 & 2 \\ 44 & 8 & -5 \end{bmatrix}$ Matrix *C* $\begin{bmatrix} 7 & -3 & -1 \\ 12 & 14 & 88 \\ 18 & 52 & 44 \end{bmatrix}$ **Solution:**

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 15.1 Identify various types of iteration structure (e.g., while, for, for-each, recursion) 15.2 Identify how loops are controlled (variable conditions and exits)		$\begin{bmatrix} 1015 & 1727 & 2289 \\ -170 & -114 & -1318 \\ 314 & -280 & 440 \end{bmatrix}$ **Examples:** Write a program that does each of the problems above.

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			15.3 Select the correct syntax for nested loops 15.4 Compute the values of variables involved with nested loops 17.1 Demonstrate basic uses of arrays, including initialization, storage, and retrieval of values 17.3 Identify techniques for declaring, initializing, and modifying user-defined data types 17.5 Create and use two-dimensional arrays		
HS.N-VM.C.9. Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.6.* Attend to precision.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile,	To create programs using arrays to hold and manipulate data. Test data will need to be validated by inputting the problem into a	**Math Example:** Given $A=\begin{bmatrix}3 & -5\\ 2 & 7\end{bmatrix}$ *and* $B=\begin{bmatrix}-5 & 2\\ 7 & 3\end{bmatrix}$ *and* $C=\begin{bmatrix}9 & -4\\ 6 & 2\end{bmatrix}$, determine if the following statements are true: • $AB = BA$ • $(AB)C = A(BC)$ **Solution:**

Number and Quantity: Vector and Matrix Quantities (N-VM) **Perform operations on matrices and use matrices in applications.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
associative and distributive properties. Connections: *ETHS-S6C2-03*; *9-10.WHST.1e*			GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules	calculator.	Both statements are true. **Coding Example:** Write a program that determines the truth value of each statement above.

Number and Quantity: Vector and Matrix Quantities (N-VM) **Perform operations on matrices and use matrices in applications.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal) 14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR) 14.4 Select an appropriate decision structure for a given situation 14.1 Select correct syntax for decision statements (e.g., if/else, if, switch case) 15.1 Identify various types of iteration structure (e.g., while, for, for-each, recursion) 15.2 Identify how		

Number and Quantity: Vector and Matrix Quantities (N-VM) **Perform operations on matrices and use matrices in applications.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			loops are controlled (variable conditions and exits) 15.3 Select the correct syntax for nested loops 15.4 Compute the values of variables involved with nested loops 17.1 Demonstrate basic uses of arrays, including initialization, storage, and retrieval of values 17.3 Identify techniques for declaring, initializing, and modifying user-defined data types 17.5 Create and use two-dimensional arrays		
HS.N-VM.C.10. Understand that the zero and identity matrices play a role	+	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.6.* Attend	(PROGRAM) 17.1 Demonstrate basic uses of arrays, including	To create programs using arrays to hold and manipulate data.	**Math Example:** Find the determinant of the following matrix: $\begin{bmatrix} 3 & 8 \\ 5 & 4 \end{bmatrix}$

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.		to precision.	initialization, storage, and retrieval of values 17.5 Create and use two-dimensional arrays	Test data will need to be validated by inputting the problem into a calculator.	Solution: -28 **Question 2** If possible, find the inverse of the matrix above. Solution: $\begin{bmatrix} -\frac{1}{7} & \frac{2}{7} \\ \frac{5}{28} & -\frac{3}{28} \end{bmatrix}$ **Coding Example:** Find the determinant of the following matrix: $\begin{bmatrix} -9 & 7 & 0 & 11 \\ 3 & -2 & -5 & -6 \\ 0 & 13 & 14 & 2 \\ -2 & 4 & -1 & 9 \end{bmatrix}$ **Question 2** If possible, find the inverse of the matrix above. Round all numbers to the nearest hundredth. $\begin{bmatrix} -.14 & .03 & .02 & .19 \\ .05 & .17 & .06 & .04 \\ -.04 & -.15 & .01 & -.06 \\ -.06 & -.09 & -.02 & .13 \end{bmatrix}$

Number and Quantity: Vector and Matrix Quantities (N-VM)

Perform operations on matrices and use matrices in applications.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.N-VM.C.11. Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. Connections: *ETHS-S6C1-03*; *11-12.WHST.1a*	+	*HS.MP.4*. Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	(PROGRAM) 17.1 Demonstrate basic uses of arrays, including initialization, storage, and retrieval of values 17.5 Create and use two-dimensional arrays	To create programs using arrays to hold and manipulate data. Test data will need to be validated by inputting the problem into a calculator.	**Math Example:** Find Ay where $y = \begin{bmatrix}2\\1\\3\end{bmatrix}$ and $A = \begin{bmatrix}1 & 2 & 3\\4 & 5 & 6\\7 & 8 & 9\end{bmatrix}$. Solution: $\begin{bmatrix}13\\31\\49\end{bmatrix}$ **Coding Example:** Have students create a square matrix that has *n* columns. Then create a vector with *n* elements. Ask them to multiply the matrix by the vector, and then check their answers using a matrix multiplication calculator.
HS.N-VM.C.12. Work with 2×2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area. Connection: *ETHS-S6C1-03*	+	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.		To create programs using arrays to hold and manipulate data. Test data will need to be validated by inputting the problem into a calculator.	

Algebra: Seeing Structure in Expressions (A-SSE)

Interpret the structure of expressions.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-SSE.A.1. Interpret expressions that represent a quantity in terms of its context.	A I ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.7.* Look for and make use of structure.	9.1 Explain the steps in the System Development Life Cycle (SDLC) (e.g., planning, analysis, design, development, testing, implementation, maintenance) 9.2 Interpret a problem statement and identify program requirements 9.3 Develop program requirements/ specifications and a testing plan (e.g., user stories, automated testing, test procedures) 9.4 Determine input and output 9.5 Choose appropriate data structures		**Math Example:** The height of a model rocket above the ground is modeled by the equation $h(t) = -16t^2 + 320t + 16$, where *t* represents the time in seconds since the rocket was launched, and *h* represents the height of the rocket above the ground in feet. Interpret the ordered pair (3, 832) in the context of the situation. Solution: 3 seconds after launch, the rocket is 832 feet above the ground. **Coding Example:** Write a function to determine how much paint is needed for a wall of a barn that is 80 feet long and 25 feet tall, if each gallon of paint covers 480 ft^2. Solution: 5 gallons
a. Interpret complicated expressions by	A I ★		12.1 Identify and correctly use		**Math Example:** Let $f(x) = 2x - 5$ and $g(4) = 12$. Find $f(g(4))$.

Algebra: Seeing Structure in Expressions (A-SSE)
Interpret the structure of expressions.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.*			arithmetic operations, applying the order of operations (precedence) with respect to programming 12.2 Interpret and construct mathematical formulas		Solution: 19 Coding Example: Write a function to solve the problem above. Possible Solution: int n = 12; int k = 2*n – 5; print k;

Algebra: Arithmetic with Polynomials and Rational Expressions (A-APR) **Understand the relationship between zeros and factors of polynomials.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***

Algebra: Creating Equations ★ (A-CED)

Create equations that describe numbers or relationships.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-CED.A.1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*	A I A II ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create programs that use linear and quadratic functions to obtain needed results from input data. Test data will need to be created by working the problem longhand to test the program.	Write an equation that converts 673 degrees Fahrenheit to Celsius. One equation is $F = \frac{9}{5}C + 32$ **Solution:** 356.111 $C = \frac{5}{9}(F - 32)$

Algebra: Creating Equations ★ (A-CED) **Create equations that describe numbers or relationships.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.A-CED.A.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	A I ★	*HS.MP.2*. Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software	To create computer games using equations for placement and movement of objects on the screen. Test data will need to be created by working the problem longhand to test the program.	The path of a ship is given by the equation Y=3X-2, and another ship is Y=-X-6. Where do they intersect? **Solution:** (-1, -5)

Algebra: Creating Equations ★ (A-CED) **Create equations that describe numbers or relationships.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.A-CED.A.4. Rearrange formulas to highlight a quantity of interest,	A I ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model	1.1 Describe methods and considerations for prioritizing and	To create programs that use formulas to obtain needed	Rearrange the following formula ($C = \pi d$) to calculate the diameter of a circle given its circumference. **Solution:**

Algebra: Creating Equations ★ (A-CED) **Create equations that describe numbers or relationships.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*		with mathematics. *HS.MP.5*. Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions	results from input data. Test data will need to be created by working the problem longhand to test the program. Sometimes the formulae must be manipulated to obtain the desired results.	$d = C / \pi$

Algebra: Creating Equations ★ (A-CED) **Create equations that describe numbers or relationships.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.1 Declare numeric, Boolean, character, and string variables 16.2 Choose the appropriate data type for a given situation 16.3 Identify the correct syntax for constants in a program 16.4 Identify the correct syntax for initializing and modifying variables		

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)

Solve equations and inequalities in one variable.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-REI.A.2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	A II	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others. HS.*MP.7.* Look for and make use of structure.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create computer games using equations for placement and movement of objects on the screen. Test data will need to be created by working the problem longhand to test the program.	In a right triangle the hypotenuse is 25 and a leg is 20. What is the length of the remaining leg? **Solution:** 15

Algebra: Reasoning with Equations and Inequalities ★ (A-REI) **Solve equations and inequalities in one variable.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.1 Declare numeric, Boolean, character, and string variables 16.2 Choose the appropriate data type for a given situation 16.3 Identify the correct syntax for constants in a program 16.4 Identify the correct syntax for initializing and modifying variables		

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)

Solve equations and inequalities in one variable.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-REI.B.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	A I	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.1 Declare numeric, Boolean, character, and string variables 16.2 Choose the appropriate data type for a given situation 16.3 Identify the correct syntax	To create programs using equations to obtain results from input data. Test data will need to be created by working the problem longhand to test the program. Equations will need to be manipulated to obtain the desired result.	If L = 2W, what does P equal? **Solution:** P = 6W

Algebra: Reasoning with Equations and Inequalities ★ (A-REI) **Solve equations and inequalities in one variable.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			for constants in a program 16.4 Identify the correct syntax for initializing and modifying variables		
HS.A-REI.B.4. Solve quadratic equations in one variable.	A I A II	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.			
a. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.	A I A II		(PROGRAM) 12.1 Identify and correctly use arithmetic operation, applying the order of operations (precedence) with respect to programming. 12.2 Interpret and construct mathematical formulas 12.3 Use basic algorithms	Solve quadratic equations	Math example: $X^2 + 3x - 4 = 0$ Solution: x = -4, 1 Software Example: Implement the quadratic formula in a program given the equation.

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)

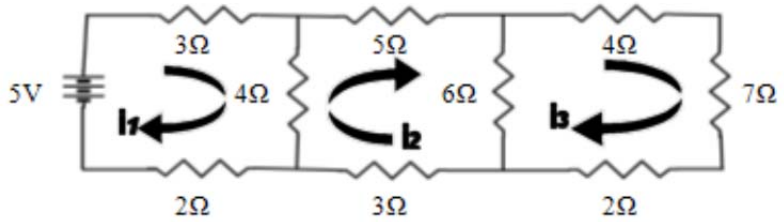
Solve systems of equations.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-REI.C.6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. Connection: *ETHS-S6C2-03*	A I A II	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas	To create computer games using systems of equations for placement, interaction, and movement of objects on the screen. Test data will need to be created by working the problem longhand to test the program.	One ship fires a missile along the path Y = 3X – 2, and the other ship is traveling along the path Y = –X – 6. Where does the missile hit the other ship? **Solution:** (-1, -5)

Algebra: Reasoning with Equations and Inequalities ★ (A-REI) **Solve systems of equations.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.1 Declare numeric, Boolean, character, and string variables 16.2 Choose the appropriate data type for a given situation 16.3 Identify the correct syntax for constants in a program 16.4 Identify the correct syntax for initializing and modifying variables		

Algebra: Reasoning with Equations and Inequalities ★ (A-REI)

Solve systems of equations.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.A-REI.C.8. Represent a system of linear equations as a single matrix equation in a vector variable.	+		1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas	To create programs which engineers might use. Test data will need to be created by working the problem longhand to test the program.	Using Kirchhoff's Laws, solve a three loop circuit for all internal currents using determinants. The following matrix is generated from the values in a circuit. $\begin{bmatrix} 9 & -4 & 0 \\ -4 & 18 & 6 \\ 0 & -6 & 20 \end{bmatrix}$ The following solution matrix is also obtained. $\begin{bmatrix} -5 \\ 0 \\ 0 \end{bmatrix}$  **Solution:** i_1=-0.61, i_2=-0.123, i_3=0.037

Algebra: Reasoning with Equations and Inequalities ★ (A-REI) **Solve systems of equations.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 15.4 Compute the values of variables involved with nested loops 17.1 Demonstrate basic uses of arrays, including initialization, storage, and retrieval of values 17.3 Identify techniques for declaring, initializing, and modifying user-defined data types 17.5 Create and use two-dimensional arrays		

Functions: Interpreting Functions (F-IF)

Interpret functions that arise in applications in terms of context.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.F-IF.A.2. Use function notations, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. Connection: *9-10.RST.4*	A1	*HS.MP.2.* Reason abstractly and quantitatively	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.4 Determine input and output 9.5 Choose appropriate data structures 11.3 Perform integration testing including tests within a program to protect execution from bad input or other runtime	To create functions which return values. Test data will need to be created by working the problem longhand to test the program.	If $f(x) = x^2 + 7x - 2$, find $f(3)$. **Solution:** 28

Functions: Interpreting Functions (F-IF) **Interpret functions that arise in applications in terms of context.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.F-IF.A.3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the*	A I A II	*HS.MP.8.* Look for and express regularity in repeated reasoning.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile,	To create functions which call themselves one or more times before they return values. Test data will need to be created by	Define the solution of 5! by using n! = n times (n-1)! recursively. **Solution:** 120

Functions: Interpreting Functions (F-IF)

Interpret functions that arise in applications in terms of context.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
Fibonacci sequence is defined recursively by f (0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.			GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules	working the problem longhand to test the program.	

Functions: Interpreting Functions (F-IF) **Interpret functions that arise in applications in terms of context.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal) 14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR) 14.4 Select an appropriate decision structure for a given situation 15.1 Identify various types of iteration structure (e.g., while, for, for-each, recursion)		
HS.F-IF.B.4. For a function that models a relationship between two quantities, interpret	A I A II ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with	1.2 Describe methods and techniques of problem-solving and	To create programs that solves real world problems and might be used by	An object is launched at 20 meters per second from a 60 meter tall platform. The equation which governs the height of the object is $H(t) = -5t^2+20t+60$, where H(t) is in meters. Determine the time at which the object hits the ground. **Solution:**

Functions: Interpreting Functions (F-IF)

Interpret functions that arise in applications in terms of context.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* Connections: *ETHS-S6C2.03*; *9-10.RST.7*; *11-12.RST.7*		mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.1 Declare numeric, Boolean,	engineers. Test data will need to be created by working the problem longhand to test the program.	6 seconds

Functions: Interpreting Functions (F-IF) **Interpret functions that arise in applications in terms of context.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			character, and string variables 18.4 Employ graphics methods to create images at specified locations		
HS.F-IF.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* Connection: *9-10.WHST.2f*	A I ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.6.* Attend to precision.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 11.2 Identify boundary cases and generate	To create functions that return values and to understand the limits on those functions. Test data will need to be created by working the problem longhand to test the program.	What is the domain of the square root function? **Solution:** $[0, \infty)$

Functions: Interpreting Functions (F-IF) **Interpret functions that arise in applications in terms of context.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			appropriate test data 11.3 Perform integration testing including tests within a program to protect execution from bad input or other runtime 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from		

Functions: Interpreting Functions (F-IF) **Interpret functions that arise in applications in terms of context.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			modules 21.1 Identify run-time errors 21.2 Describe error-handling strategies 21.3 Handle unexpected return values 21.4 Handle (catch) run-time errors and take appropriate action 21.5 Throw standard exception classes 21.6 Develop and throw custom exception classes		

Functions: Building Functions (F-BF)

Build a function that models a relationship between two quantities.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.F-BF.A.1. Write a function that describes a relationship between two quantities. Connections: *ETHS-S6C1-03*; *ETHS-S6C2-03*	A I A II + ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create functions which use other functions within their calling parameters. Test data will need to be created by working the problem longhand to test the program.	**Question 1** Find the volume of a sphere given that the pressure is 5 atmospheres and that the sphere contains 2 moles of gas at a temperature 28 degrees Fahrenheit, if $PV = nRT, R = 0.082,$ and $T_K = \frac{5}{9}(T_y - 241)$. **Solution:** -3.8813 **Question 2** The function that describes the relationship between the volume and temperature of a gas is: $V(t) = \frac{nrt}{P}$, and the function that describes the relationship between the temperature in Fahrenheit and temperature in Kelvin is: $t(f) = \frac{5}{9(f-241)}$. What is the composite function $(t(f))$? **Solution:** $V(t(f)) = \frac{nr\left(\frac{5}{9}(f-241)\right)}{P}$

Functions: Building Functions (F-BF)

Build a function that models a relationship between two quantities.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.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.	A II ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.8.* Look for and express regularity in repeated reasoning.	*1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban)* *1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software*	To create functions that generate values recursively. Test data will need to be created by working the problem longhand to test the program.	Generate the first 8 terms given f(0) = 0, f(x) = (x-1) +1. **Solution:** 1, 2, 3, 4, 5, 6, 7, 8

Functions: Building Functions (F-BF) **Build a function that models a relationship between two quantities.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			development *9.5 Choose appropriate data structures* *12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to* *12.2 Interpret and construct mathematical formulas* *13.1 Use standard library functions* *13.4 Demonstrate the use of parameters to pass data into program modules* *13.5 Demonstrate the use of return values from modules* *15.1 Identify various types of iteration structure (e.g., while, for, for-each, recursion)*		

Geometry: Congruence (G-CO)

Experiment with transformations in the plane.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-CO.A.1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. Connection: *9-10.RST.4*	G	*HS.MP.6*. Attend to precision.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to	To create functions which generate graphical objects from the API, and to understand how the API functions connect to their mathematical definitions. Test data will need to be created by working the problem longhand to test the program.	**Project 1** Construct a circle using the definition of all points that are a distance of 3 centimeters from a set point (3, 4). $(x-3)^2 + (g-4)^2 = 3^2$. **Project 2** Use a repetition code block to draw a fence with parallel posts along a picture of a house.

Geometry: Congruence (G-CO) **Experiment with transformations in the plane.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			pass data into program modules 13.5 Demonstrate the use of return values from modules 15.1 Identify various types of iteration structure (e.g., while, for, for-each, recursion) 15.2 Identify how loops are controlled (variable conditions and exits) 15.4 Compute the values of variables involved with nested loops 20.3 Instantiate objects from existing classes		
HS.G-CO.A.2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give	G	*HS.MP.5.* Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and	To use a graphics library and write mutator methods that transform the object by resizing the specific parts and maintain aspect ratios	**Project** Create a stickman figure that increases proportionally in size or shifts or translates so that the stickman appears to be moving toward the viewer.

Geometry: Congruence (G-CO) **Experiment with transformations in the plane.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch). Connection: *ETHS-S6C1-03*			troubleshooting applicable to software development 9.5 Choose appropriate data structures 11.2 Identify boundary cases and generate appropriate test data 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.G-CO.A.3. Given a rectangle,	G	*HS.MP.3* Construct viable	1.1 Describe methods and considerations	To write transform	**Project**

Geometry: Congruence (G-CO)

Experiment with transformations in the plane.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
parallelogram, trapezoid, or regular polygons, describe the rotations and reflections that carry it onto itself. Connections: *ETHS-S6C1-03*; *9-10.WHST.2c*		arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically.	for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) ~~1.3~~ 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 11.2 Identify boundary cases and generate appropriate test data 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard	methods to mutate graphic objects on a Cartesian coordinate plane	Create software that shows the reflection of a graphic on the water that it stands on; i.e. draw programmatically a picture of a sailboat with a trapezoidal base and have the software draw the reflection underneath the boat.

Geometry: Congruence (G-CO) **Experiment with transformations in the plane.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 16.2 Choose the appropriate data type for a given situation 17.3 Identify techniques for declaring, initializing, and modifying user-defined data types		
HS.G-CO.A.4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. Connections: *ETHS-S6C1-03*; *9-10.WHST.4*	G	*HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.2 Interpret a problem statement	To write transform methods to mutate graphic objects on a Cartesian coordinate plane	**Project** Students will use the graphics capability of a programming language to generate animation of a square rotating, (i.e. a block falling down a hill, a windmill with rectangular blades).

Geometry: Congruence (G-CO) **Experiment with transformations in the plane.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			and identify program requirements 9.5 Choose appropriate data structures 10.2 Differentiate between interpreted and compiled code (e.g., steps necessary to run executable code) 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 14.2 Compare values		

Geometry: Congruence (G-CO)

Experiment with transformations in the plane.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			using relational operators (e.g., =, >, <, >=, <=, not equal) 15.3 Select the correct syntax for nested loops		
HS.G-CO.A.5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. Connections: *ETHS-S6C1-03*; *9-10.WHST.3*	G	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create functions that will rotate, reflect, and/or translate a graphical object. Test data will need to be created by working the problem longhand to test the program.	**Project** Take one shape and transform it into another shape by using rotation, reflection, and/or translation. **Question** A trapezoid with vertices at (0, 0), (3, 4), (7, 4), and (10, 0) is rotated counter-clockwise around the origin 90 degrees and is moved up 10 and to the right 5. What are the new coordinates of the vertices? **Solution:** (5, 10), (1, 13), (1,17), (5,20)

Geometry: Congruence (G-CO) **Experiment with transformations in the plane.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 20.3 Instantiate objects from existing classes		

Geometry: Congruence (G-CO)

Understand congruence in terms of rigid motions.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-CO.B.6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. Connections: *ETHS-S1C2-01*; *9-10.WHST.1e*	G	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	14.1 Select correct syntax for decision statements (e.g., if/else, if, switch case) 14.2 Compare values using relational operators(e.g. =,>,<, >=, <=, not equal) 14.4 Select an appropriate decision structure for a given situation	Prove triangle congruency: Side/angle/side etc.	Math example: Put math example here. Software Example: Write a program that compares two triangles for congruency using conditional statements.
HS.G-CO.B.7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are	G	*HS.MP.3.* Construct viable arguments and critique the reasoning of others.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and	To define congruency in programming code by comparing side lengths and corresponding angles	To prove that Triangle 1 is congruent to Triangle 2, using only rigid transformations, what transformation would one use to map Triangle 1 onto Triangle 2? Triangle 1: (2,-1) (3,4) (5,-2) Triangle 2: (6,-3) (7,2) (9,-4) **Solution:** A translation of 4 right and 2 down

Geometry: Congruence (G-CO) **Understand congruence in terms of rigid motions.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
congruent. Connection: *9-10.WHST.1e*			techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from		

Geometry: Congruence (G-CO) **Understand congruence in terms of rigid motions.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			modules 20.3 Instantiate objects from existing classes 20.7 Create a user-defined class 20.8 Create a subclass of an existing class 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal) 14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR) 14.4 Select an appropriate decision structure for a given situation 14.1 Select correct syntax for decision statements (e.g., if/else, if, switch case)		

Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT)

Define trigonometric ratios and solve problems involving right triangles.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-SRT.C.6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. Connection: *ETHS-S6C1-03*	G		1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create computer games in which players may specify angle and distance of travel for placement and movement of objects on the screen. Test data will need to be created by working the problem longhand to test the program.	An object located at (8, 5) travels at an angle of 28 degrees above the horizontal for a distance of 27 units. Find the coordinates of the new location of this object using the trigonometric ratios. **Solution:** (23.840, 17.675)

Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Define trigonometric ratios and solve problems involving right triangles.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 18.4 Employ graphics methods to create images at specified locations 20.3 Instantiate objects from existing classes 20.5 Change the state of an object by invoking a modifier method		
HS.G-SRT.C.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. Connections: *ETHS-S6C2-03*;	G ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.4.* Model with mathematics.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value,	To create software to determine the angle of depression on approach to an airport runway given the	A plane is on approach to the airport and is currently horizontally 1,000 feet away. Its current altitude is 50 feet. What angle of depression is needed to land the plane? **Solution:** 2.86 degrees

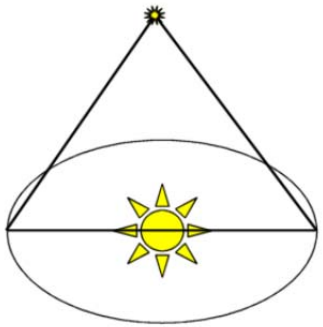
Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Define trigonometric ratios and solve problems involving right triangles.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
9-10.RST.7		*HS.MP.5.* Use appropriate tools strategically.	waterfall, agile, GTD, Kanban) ~~1.3~~ 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass	horizontal distance from the runway and the altitude of the airplane. Use sine, cosine, and tangent relationships.	

Geometry: Similarity, Right Triangles, and Trigonometry (G-SRT) **Define trigonometric ratios and solve problems involving right triangles.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			data into program modules 13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal) 14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR)		

Geometry: Circles (G-SRT) **Apply trigonometry to general triangles.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-SRT.D.11. Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in	+	HS.MP.1. Make sense of problems and persevere in solving them. HS.MP.4. Model with mathematics.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks	To create computer games in which players can calculate the distance to an object knowing the angles to the	An astronomer takes the angle of a distant star with the plane of the sun to be 89.5 degrees. Exactly 6 months later he again takes the same measurement and finds it to be 89.8 degrees. Since the diameter of the earth's orbit is 186 million miles, what is the distance from the earth at each point to the star?

Geometry: Circles (G-SRT)

Apply trigonometry to general triangles.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
right and non-right triangles (e.g., surveying problems, resultant forces). Connections: *11-12.WHST.2c*; *11-12.WHST.2e*			(e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass	object and distance between sighting points. Test data will need to be created by working the problem longhand to test the program.	 **Solution:** 150 and 152 billion miles

Geometry: Circles (G-SRT) **Apply trigonometry to general triangles.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			data into program modules 13.5 Demonstrate the use of return values from modules 18.4 Employ graphics methods to create images at specified locations 20.3 Instantiate objects from existing classes 20.5 Change the state of an object by invoking a modifier method		

Geometry: Circles (G-C)

Understand and apply theorems about circles.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-C.A.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	G	*HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.5*. Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To use a programming language to program a game to draw a circumscribed circle inside a triangle	**Project** Construct circumscribed circles of a triangle.

Geometry: Circles (G-C) **Understand and apply theorems about circles.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		

Geometry: Circles (G-C)

Find arc lengths and areas of sectors of circles.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-C.B.5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Connections: *ETHS-S1C2-01*; *11-12.RST.4*	G	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To create 2D side-scrolling games that show a car driving	**Project** Students draw lines that are tangent to the wheels on a vehicle that lies on the road.

Geometry: Circles (G-C) **Find arc lengths and areas of sectors of circles.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		

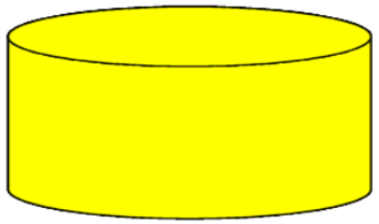
Geometry: Expressing Geometric Properties with Equations (G-GPE) **Use coordinates to prove simple geometric theorems algebraically.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-GPE.B.6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio. Connections: *ETHS-S1C2-01*; *9-10.RST.3*	G	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.8*. Look for and express regularity in repeated reasoning.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To use a programming language to find the midpoints of each side of a triangle. Students will draw a smaller triangle by drawing lines between those midpoints.	Given the line segment created by the points (-2, 4) & (4,-2), which points would be placed to create a 2:1 ratio? **Solution:** (0, 2)

Geometry: Expressing Geometric Properties with Equations (G-GPE) **Use coordinates to prove simple geometric theorems algebraically.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.G-GPE.B.7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. Connections: *ETHS-S1C2-01*; *9-10.RST.3*; *11-12.RST.3*	G ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development	To create programs that solve real world problems by deriving the coordinates of the figure from screen coordinates. Test data will need to be created by working the problem longhand to test the program.	Given the coordinates of (0, 0), (5, 10), (10, 0), find the area that a figure composed of line segments between the three points encloses. **Solution:** 50

Geometry: Expressing Geometric Properties with Equations (G-GPE) **Use coordinates to prove simple geometric theorems algebraically.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 18.4 Employ graphics methods to create images at specified locations		

Geometry: Geometric Measurement and Dimension ★ (G-MG)

Apply geometric concepts in modeling situations.

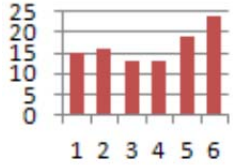
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.G-MG.A.2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). Connection: *ETHS-S1C2-01*	G ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the	To create programs which solve real world 3D modeling problems by using the properties of real objects in unique situations. Test data will need to be created by working the problem longhand to test the program.	A cylindrical water craft, having the diameter of its base 6 feet and its height 4 feet, floats with its top edge 1 foot out of the water on earth where the water density is 64.2 pounds/cubic foot. When this same craft is placed in a fluid-filled lake on another planet it floats with its top edge 2 feet out of the liquid. Assuming all other factors are the same, what must the density of the liquid be on this other planet?  **Solution:** 96.3

Geometry: Geometric Measurement and Dimension ★ (G-MG) **Apply geometric concepts in modeling situations.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			use of return values from modules 18.4 Employ graphics methods to create images at specified locations		
HS.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). Connection: *ETHS-S1C2-01*	G ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard	To create programs which solve real world 3D modeling problems by using the properties of real objects in unique situations. Test data will need to be created by working the problem longhand to test the program.	Given 35 feet of fence and the need to enclose the maximum area, what geometric figure would enclose the most area? **Solution:** Circle

Geometry: Geometric Measurement and Dimension ★ (G-MG) **Apply geometric concepts in modeling situations.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 18.4 Employ graphics methods to create images at specified locations		

Statistics and Probability: Interpreting Categorical and Quantitative Data★ (S-ID)

Summarize, represent, and interpret data on a single count or measurement variable.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.S-ID.A.1. Represent data with plots on the real number line (dot plots, histograms, and box plots). Connections: *SCHS-S1C1-04*; *SCHS-S1C2-03*; *SCHS-S1C2-05*; *SCHS-S1C4-02*; *SCHS-S2C1-04*; *ETHS-S6C2-03*; *SSHS-S1C1-04*; *9-10.RST.7*	A I ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 11.2 Identify boundary cases and generate appropriate test data 12.1 Identify and correctly use arithmetic operations, applying the order	To develop algorithms to compute the mean, median, and mode of data	A die from a game is rolled 100 times. Display the following data in a histogram form. 1 15 2 16 3 13 4 13 5 19 6 24 **Solution:** 

Statistics and Probability: Interpreting Categorical and Quantitative Data★ (S-ID) **Summarize, represent, and interpret data on a single count or measurement variable.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal) 14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR)		
HS.S-ID.A.2. Use statistics appropriate to the	A I ★	*HS.MP.2*. Reason abstractly and quantitatively.	1.1 Describe methods and considerations for	Students develop algorithms to compute the	**Question 1** Using the following data, what are the mean, median, mode, and standard

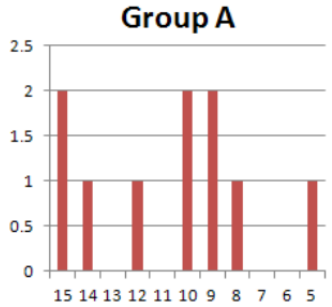
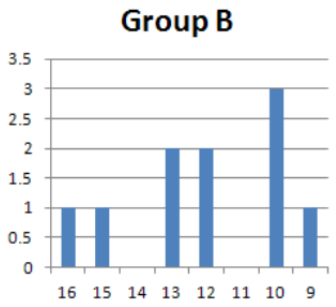
Statistics and Probability: Interpreting Categorical and Quantitative Data★ (S-ID)
Summarize, represent, and interpret data on a single count or measurement variable.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. Connections: *SCHS-S1C3-06*; *ETHS-S6C2-03*; *SSHS-S1C1-01*		*HS.MP.3*. Construct viable arguments and critique the reasoning of others. *HS.MP.4.* Model with mathematics. HS.MP.5. Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.2 Interpret a problem statement and identify program requirements 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to	mean, median, and mode of data.	deviation of those students? Student one scored 100. Student two scored 98. Student three scored 75. Student four scored 80. Student five scored 96. **Solution:** Mean=89.8 Median=96 Mode=N/A Standard Deviation: 10.24 **Question 2** Using the following scores, what can be said about the two groups? (table below)

											Mean	Median	Range	SD
Group A	15	15	14	12	10	10	9	9	8	5	10.7	10	10	3.267687
Group B	16	15	13	13	12	12	10	10	10	9	12	12	7	2.309401

Statistics and Probability: Interpreting Categorical and Quantitative Data★ (S-ID)

Summarize, represent, and interpret data on a single count or measurement variable.

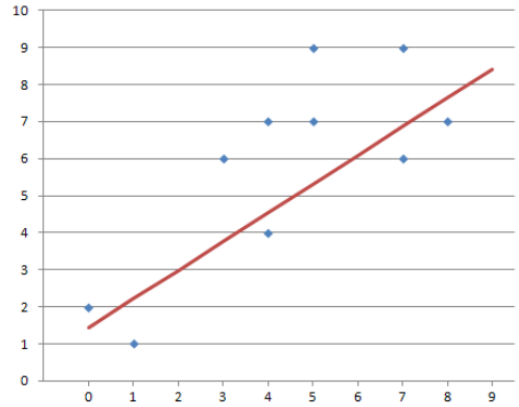
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal) 14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR)		 As B and  **Solution:** a group, has higher more closely packed scores.

Statistics and Probability: Interpreting Categorical and Quantitative Data ★ (S-ID)

Interpret linear models.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.S-ID.C.7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. Connections: *SCHS-S5C2-01*; *ETHS-S1C2-01*; *ETHS-S6C2-03*; *9-10.RST.4*; *9-10.RST.7*; *9-10.WHST.2f*	A I ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.7 Apply pseudo code or graphical representations to plan the structure of a program or module (e.g., 9.4 Determine input and output 9.5 Choose appropriate data structures 9.6 Differentiate between bottom-up and top-down design 9.3 Develop program requirements/specifications and a testing plan (e.g., user stories, automated testing, test 10.1 Use a program editor to enter and modify code 10.2 Differentiate between interpreted and compiled	To use y=mx+b relationships in functions to extrapolate data	Using the following data, generate a linear model that defines the height of the candle at a given time. Time (min.) / Height (in.) 2 / 10 3 / 8 4 / 6 5 / 4 **Solution:** y=-2x+12

Statistics and Probability: Interpreting Categorical and Quantitative Data ★(S-ID)
Interpret linear models.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			code (e.g., steps necessary to run executable code) 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		
HS.S-ID.C.8. Compute (using technology) and interpret the correlation coefficient of a linear fit. Connections: *ETHS-S1C2-01*; *ETHS-S6C2-03*; *11-12.RST.5*; *11-12.WHST.2e*	A I ★	*HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.8.* Look for and express regularity in repeated reasoning.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate	To use a correlation coefficient to measure the relationship between an independent variable and its dependent one	The data plotted in blue below has a correlation coefficient of 0.775264. What does the coefficient reveal about the correlation data? 

Statistics and Probability: Interpreting Categorical and Quantitative Data ★(S-ID) **Interpret linear models.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 15.3 Select the correct syntax for nested loops		**Solution:** The x-axis values correlate well with the y-axis values.

Statistics and Probability: Making Inferences and Justifying Conclusions ★ (S-IC)

Understand and evaluate random processes underlying statistical experiments.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.S-IC.A.2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin will fall heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?* Connections: *ETHS-S6C2-03*; *9-10.WHST.2d*; *9-10.WHST.2f*	A II ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3*. Construct viable arguments and critique the reasoning of others. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision. *HS.MP.7*. Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	10.1 Use a program editor to enter and modify code 10.2 Differentiate between interpreted and compiled code (e.g., steps necessary to run executable code) 10.4 Apply industry standards in documentation (e.g., self-documenting code; function-level, program-level, and 10.5 Name identifiers and formatting code by applying recognized conventions 10.6 Find and use program and language documentation 13.1 Use standard library functions 12.2 Interpret and construct mathematical formulas	To create a program that will use decimal math and remainder theorems to generate random numbers. In addition, students must calculate histograms to measure results.	A person drew numbers written on small sheets of paper from a container. The number was replaced after it was recorded, and the container was stirred and shaken to redistribute all of the numbers inside. After drawing numbers 1000 times, the person noticed that not all numbers were drawn an equal number of times. What can be concluded from this data? **Solution:** Nothing can be concluded.

Statistics and Probability: Conditional Probability and the Rules of Probability ★ (S-CP)

Understand independence and conditional probability and use them to interpret data.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.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"). Connection: *11-12.WHST.2e*	A II ★	*HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.4.* Model with mathematics. *HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To use Boolean algebra to describe events as unions (OR) and intersections (AND) of other events.	**Question 1** Which colored area represents people who are both programmers and web page designers but not graphic artists? **Solution:** Magenta **Question 2** In deciding which color represents people who are both programmers and web page designers, which method does one use? **Solution:** Intersections 

Statistics and Probability: Conditional Probability and the Rules of Probability ★ (S-CP) **Understand independence and conditional probability and use them to interpret data.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal) 14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR) 14.4 Select an appropriate decision structure for a given situation 14.1 Select correct syntax for decision statements (e.g.,		

Statistics and Probability: Conditional Probability and the Rules of Probability ★ (S-CP) **Understand independence and conditional probability and use them to interpret data.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			if/else, if, switch case) 14.5 Select the correct nesting for decision structures		
HS.S-CP.A.4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities*. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected*	A II ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations,	To model two sets of data to determine relationships	**Project** Design and develop a random number generator that will generate frequency tables and determine that the events are independent of each other.

Statistics and Probability: Conditional Probability and the Rules of Probability ★ (S-CP) **Understand independence and conditional probability and use them to interpret data.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results. Connections: *ETHS-S6C2-03*; *11-12.RST.4*; *11-12.RST.9*; *11-12.WHST.1e*		structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal)		

Statistics and Probability: Using Probability to Make Decisions ★ (S-MD)

Use probability to evaluate outcomes of decisions.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
HS.S-MD.B.6. Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). Connections: *ETHS-S1C2-01*; *ETHS-S6C2-03*; *11-12.RST.3*; *11-12.RST.9*; *11-12.WHST.1b*; *11-12.WHST.1e*	+ ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.7.* Look for and make use of structure.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct	To use integer math and truncation of decimals to generate random numbers	**Project** Design and develop software that will allow teachers to enter in student names. When the button is pressed, the software will randomly choose a student to answer the question. The software will make sure that all students are called upon and will not call the same student twice before all other students have been selected.

Statistics and Probability: Using Probability to Make Decisions ⋆ (S-MD) **Use probability to evaluate outcomes of decisions.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			mathematical formulas 13.1 Use standard library functions 11.2 13.5 Demonstrate the use of return values from modules		

Contemporary Mathematics: Discrete Mathematics ★ (CM-DM)

Understand and apply vertex-edge graph topics.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
AZ.HS.CM-DM.A.1. Study the following topics related to vertex-edge graphs: Euler circuits, Hamilton circuits, the Travelling Salesperson Problem (TSP), minimum weight spanning trees, shortest paths, vertex coloring, and adjacency matrices. Connections: *ETHS-S6C2-03*; *11-12.RST.4*; *11-12.RST.5*; *11-12.RST.9*; *11-12.WHST.1b*; *11-12.WHST.1e*	+ ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2.* Reason abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	1.1 Describe methods and considerations for prioritizing and scheduling software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 11.2 Identify boundary cases and generate appropriate test data 11.3 Perform integration testing including tests within a program to protect	To use computer software in solving discrete mathematics problems such as Spanning Tree problems	**Project** Implement a Java program to generate a Eulurian Trail from one vertex to another one using the following computer algorithm: 1. Make sure the graph is connected and all vertices have an even degree. 2. Start at any vertex. 3. Travel through an edge if a. it is not a bridge for the untraveled part, or b. there is no other alternative. 4. Label the edges in the order which they were traveled Leave no untraveled edges.

Contemporary Mathematics: Discrete Mathematics ★ (CM-DM) **Understand and apply vertex-edge graph topics.**					
Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			execution from bad input or other runtime 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules 14.2 Compare values using relational operators (e.g., =, >, <, >=, <=, not equal)		

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			14.3 Evaluate Boolean expressions (e.g., AND, OR, NOT, NOR, XOR) 14.4 Select an appropriate decision structure for a given situation 14.1 Select correct syntax for decision statements (e.g., if/else, if, switch case) 15.1 Identify various types of iteration structure (e.g., while, for, for-each, recursion) 15.2 Identify how loops are controlled (variable conditions and exits)		
AZ.HS.CM-DM.A.2. Understand, analyze, and apply vertex-edge graphs to model and solve	+ ★	*HS.MP.1.* Make sense of problems and persevere in solving them. *HS.MP.2*. Reason	1.1 Describe methods and considerations for prioritizing and scheduling	To create algorithms to solve for the shortest path through a graph	**Project** Implement Dijkstra's Shortest Path algorithm in Java to find the shortest distance from the source to each vertex in the graph.

Contemporary Mathematics: Discrete Mathematics ★ (CM-DM)

Understand and apply vertex-edge graph topics.

Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
problems related to paths, circuits, networks, and relationships among a finite number of elements, in real-world and abstract settings. Connections: *ETHS-S6C2-03*; *11-12.RST.9*; *11-12.WHST.1b*; *11-12.WHST.1e*;		abstractly and quantitatively. *HS.MP.3.* Construct viable arguments and critique the reasoning of others. *HS.MP.4.* Model with mathematics. *HS.MP.5.* Use appropriate tools strategically. *HS.MP.6.* Attend to precision. *HS.MP.7.* Look for and make use of structure. *HS.MP.8.* Look for and express regularity in repeated reasoning.	software development tasks (e.g., risk value, waterfall, agile, GTD, Kanban) 1.2 Describe methods and techniques of problem-solving and troubleshooting applicable to software development 9.5 Choose appropriate data structures 11.1 Identify errors in program modules 11.2 Identify boundary cases and generate appropriate test data 11.3 Perform integration testing including tests within a program to protect execution from bad input or other		Utilize a map data structure to store a list of shortest distances from the source node to all other nodes.

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Standards *Students are expected to:*	***TRAD***	***Mathematical Practices***	***CTE Standard / Measurement Criterion***	***Application of Mathematics Standard***	***Explanations and Examples***
			runtime 11.4 Categorize, identify, and correct errors in code, including syntax, semantic, logic, and runtime. 12.1 Identify and correctly use arithmetic operations, applying the order of operations (precedence) with respect to 12.2 Interpret and construct mathematical formulas 13.1 Use standard library functions 13.4 Demonstrate the use of parameters to pass data into program modules 13.5 Demonstrate the use of return values from modules		