FIRST® Tech Challenge Common Core Mathematics Standards Alignment & Instructional Exemplars

Rationale	Color Code
There is no evidence that the standard is addressed as part of a *FIRST*® program.	Red
This standard potentially could be addressed as part of a *FIRST*® program either by actions that the coach/mentor takes when working with the students or by conditions established by the program for that given year.	Yellow
The standard is clearly addressed by program activities.	Green

Standards for Mathematical Practice				*FIRST*® Alignment	Instructional Exemplar
Standards for Mathematical Practice	Make sense of problems and persevere in solving them.	MP1	Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.	Green	As part of the *FIRST*® Tech Challenge experience students will be expected to analyze the various challenges, develop solutions, test and refine their answers all while using mathematical formulas and data. These actions are at the heart of the mathematical practice of making sense of problems and persevering to determine solutions.
Standards for Mathematical Practice	Reason abstractly and quantitatively.	MP2	Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and	Green	Students in the *FIRST*® *Tech Challenge* program will solve a variety of problems allowing them to develop their ability to reason both quantitatively and abstractly as they work to solve problems associated with designing, building, and programming their robot.

Standards for Mathematical Practice	Construct viable arguments and critique the reasoning of others.	MP3	Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.		Building off the first practice, students in the *FIRST® Tech Challenge* program will interact with their peers and be expected to provide reasoned critique of solutions developed supported by evidence and viable arguments.
Standards for Mathematical Practice	Model with mathematics.	MP4	Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.		Students in the *FIRST® Tech Challenge* program will use mathematics and mathematical tools (e.g., charts, graphs, tables) to create different models that inform choices they make about robot design and programming and to track and predict competitor's performance, as well as identify potential alliance partnerships.
Standards for Mathematical Practice	Use appropriate tools strategically.	MP5	Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.		Students in the *FIRST® Tech Challenge* program will use a variety of age-appropriate mathematical tools (e.g., charts, graphs, tables, calculators) to solve mathematical problems encountered as they work to program their robot and optimize their strategy to address the various challenges.

Standards for Mathematical Practice	Attend to precision.	MP6	Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.		Students in the *FIRST®* *Tech Challenge* program in order to complete the challenges in the most efficient manner possible will have to develop their mathematical precision as they program their robot to interact with the different challenge structures as well as navigate the challenge board.
Standards for Mathematical Practice	Look for and make use of structure.	MP7	Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression x2 + 9x + 14, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see 5 - 3(x -y)2 as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.		Students in the *FIRST®* *Tech Challenge* program will learn to recognize and use patterns to solve problems and challenges. In particular, students will take advantage of the properties of different shapes when they build their robot, program its movements, and determine solutions for the different challenges.
Standards for Mathematical Practice	Look for and express regularity in repeated reasoning.	MP8	Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation (y - 2)/(x - 1) = 3. Noticing the regularity in the way terms cancel when expanding (x - 1)(x + 1), (x - 1)(x2 + x + 1), and (x - 1)(x3 + x2 +x + 1) might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.		Students in the *FIRST®* *Tech Challenge* program will be able to experience regularity in repeated reasoning as they program their robot to complete the different challenges in the game.

Domain	**Cluster**	**Standard**	**Indicator/Skill**	***FIRST®* Alignment**	**Instructional Exemplar**
The Real Number System	Extend the properties of exponents to rational exponents.	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.		Not Applicable

The Real Number System	Extend the properties of exponents to rational exponents.	HS.N-RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.		Not Applicable
The Real Number System	Use properties of rational and irrational numbers.	HS.N-RN.B.3	Explain why the sum or product of two rational numbers is 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 irrational.		Not Applicable
Quantities	Reason quantitatively and use units to solve problems.	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.		As students design, build, program, and operate their robot they will make use of different units to make sense and solve problems, as well as communicate information to others.
Quantities	Reason quantitatively and use units to solve problems.	HS.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.		As students design, build, program, and operate their robot they will need to appropriately define quantities and the units that measure them so they can be used in modeling.
Quantities	Reason quantitatively and use units to solve problems.	HS.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.		As students design, build, program, and operate their robot they will need to decide what the appropriate level of accuracy is as they make calculations and report results.
The Complex Number System	Perform arithmetic operations with complex numbers.	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.		Not Applicable
The Complex Number System	Perform arithmetic operations with complex numbers.	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.		Not Applicable
The Complex Number System	Perform arithmetic operations with complex numbers.	HS.N-CN.A.3	(+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.		Not Applicable
The Complex Number System	Represent complex numbers and their operations on the complex plane.	HS.N-CN.B.4	(+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.		Not Applicable
The Complex Number System	Represent complex numbers and their operations on the complex plane.	HS.N-CN.B.5	(+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, (–1 +√3 i)3 = 8 because (–1 + √3 i) has modulus 2 and argument 120°.		Not Applicable
The Complex Number System	Represent complex numbers and their operations on the complex plane.	HS.N-CN.B.6	(+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.		Not Applicable
The Complex Number System	Use complex numbers in polynomial identities and equations.	HS.N-CN.C.7	Solve quadratic equations with real coefficients that have complex solutions.		Not Applicable
The Complex Number System	Use complex numbers in polynomial identities and equations.	HS.N-CN.C.8	(+) Extend polynomial identities to the complex numbers. For example, rewrite x2 + 4 as (x + 2i)(x – 2i).		Not Applicable
The Complex Number System	Use complex numbers in polynomial identities and equations.	HS.N-CN.C.9	(+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.		Not Applicable
Vector and Matrix Quantities	Represent and model with vector quantities.	HS.N-VM.A.1	(+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).		As the students program their robot to operate autonomously, they will need to use vector quantities to determine robot motion.
Vector and Matrix Quantities	Represent and model with vector quantities.	HS.N-VM.A.2	(+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.		As the students work on their robot to operate autonomously, they will need to find the components of different vectors to accurately program the motion of the robot.
Vector and Matrix Quantities	Represent and model with vector quantities.	HS.N-VM.A.3	(+) Solve problems involving velocity and other quantities that can be represented by vectors.		As the students program their robot to operate autonomously, they will need to solve problems with involving velocity as a vector to accurately program the motion of the robot.

Vector and Matrix Quantities	Perform operations on vectors.	HS.N-VM.B.4.A	(+) Add and subtract vectors. 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		As the students program their robot to operate autonomously, they will need to solve vector problems using a variety of methods to accurately program the motion of the robot.
Vector and Matrix Quantities	Perform operations on vectors.	HS.N-VM.B.4.B	(+) Add and subtract vectors. b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum		As the students program their robot to operate autonomously, they will need to determine the sum of the magnitude and direction of two vectors to accurately program the motion of the robot.
Vector and Matrix Quantities	Perform operations on vectors.	HS.N-VM.B.4.C	(+) Add and subtract vectors. c. Understand vector subtraction v – w as v + (–w), where –w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.		As the students program their robot to operate autonomously, they will need to solve vector subtraction problems using a variety of methods, including graphically, to accurately program the motion of the robot.
Vector and Matrix Quantities	Perform operations on vectors.	HS.N-VM.B.5.A	(+) Multiply a vector by a scalar. a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx, vy) = (cvx, cvy).		As the students program their robot to operate autonomously, they will need to multiply a vector by a scalar using a variety of methods, including graphically or component-wise, to accurately program the motion of the robot.
Vector and Matrix Quantities	Perform operations on vectors.	HS.N-VM.B.5.B	(+) Multiply a vector by a scalar. b. Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v≠ 0, the direction of cv is either along v (for c > 0) or against v (for c < 0).		As the students program their robot to operate autonomously, they will need to compute the magnitude of a scalar multiple using a variety of methods to accurately program the motion of the robot.
Vector and Matrix Quantities	Perform operations on matrices and use matrices in applications.	HS.N-VM.C.6	(+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.		As the students manipulate the data they collect to program the robot to function autonomously, they may use matrices.
Vector and Matrix Quantities	Perform operations on matrices and use matrices in applications.	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.		Depending upon how the students want to manipulate the data they collect to program the robot to function autonomously, they may multiply matrices by a scalar.
Vector and Matrix Quantities	Perform operations on matrices and use matrices in applications.	HS.N-VM.C.8	(+) Add, subtract, and multiply matrices of appropriate dimensions.		As students manipulate the data they collect to program the robot to function autonomously, they may add, subtract, and multiply matrices.
Vector and Matrix Quantities	Perform operations on matrices and use matrices in applications.	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 associative and distributive properties.		If students are working with matrices to manipulate the data their using to program the robot, they may have the opportunity to realize that matrix multiplication for square matrices is not a commutative operation.
Vector and Matrix Quantities	Perform operations on matrices and use matrices in applications.	HS.N-VM.C.10	(+) Understand that the zero and identity matrices play a role 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.		If students are working with matrices to manipulate the data their using to program the robot, they may have the opportunity to realize that the determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
Vector and Matrix Quantities	Perform operations on matrices and use matrices in applications.	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.		Since students will have to use vectors to describe the motion of the robot during its autonomous phase, they will work with matrices as transformations of vectors.
Vector and Matrix Quantities	Perform operations on matrices and use matrices in applications.	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.		In order to program the robot to autonomously function in the competition space, students will have to convert the physical space into 2x2 matrices.
Seeing Structure in Expressions	Interpret the structure of expressions	HS.A-SSE.A.1.A	Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients.		Depending upon how the coach/mentor approaches the use of equations to determine values to use in robot construction or programming, students may have the opportunity to examine and identify the terms, factors, and coefficients in a calculation.
Seeing Structure in Expressions	Interpret the structure of expressions	HS.A-SSE.A.1.B	Interpret expressions that represent a quantity in terms of its context. b. Interpret complicated expressions by 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.		Depending upon how the coach/mentor approaches the use of equations to determine values to use in robot construction or programming, students may have the opportunity to simplify complicated expressions by viewing one or more of their parts as a single entity.

Seeing Structure in Expressions	Interpret the structure of expressions	HS.A-SSE.A.2	Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 – y^4$ as $(x^2)^2 – (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 – y^2)(x^2 + y^2)$.		Depending upon how the coach/mentor approaches the use of equations tc determine values to use in robot construction or programming, students may have the opportunity to rewrite equations into equivalent forms that are easier to solve.
Seeing Structure in Expressions	Write expressions in equivalent forms to solve problems	HS.A-SSE.B.3.A	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines.		Depending upon the challenges encountered in the competition or design features of their robot, students may have the opportunity to factor a quadratic expression to reveal the zeros of the function.
Seeing Structure in Expressions	Write expressions in equivalent forms to solve problems	HS.A-SSE.B.3.B	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. . b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.		Depending upon how the coach/mentor approaches the use of equations to determine values to use in robot programming, students may have the opportunity to complete the square in a quadratic expression to reveal the maximum or minimum value of the function.
Seeing Structure in Expressions	Write expressions in equivalent forms to solve problems	HS.A-SSE.B.3.C	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.		Depending upon the calculations and formulas used to guide robot construction and programming, students may have the opportunity to use the properties of exponents to transform expressions for exponential functions.
Seeing Structure in Expressions	Write expressions in equivalent forms to solve problems	HS.A-SSE.B.4	Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.		Students may need to derive the formula for the sum of a finite geometric series (e.g., battery life) to determine values used in robot construction and programming.
Arithmetic with Polynomials and Rational Expressions	Perform arithmetic operations on polynomials	HS.A-APR.A.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.		Depending upon the calculations and formulas used to guide robot construction and programming, students may have the opportunity to realize that polynomials are like integers in that they can be added, subtracted, multiplied, and divided.
Arithmetic with Polynomials and Rational Expressions	Understand the relationship between zeros and factors of polynomials	HS.A-APR.B.2	Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x).		Depending upon the calculations and formulas used to guide robot construction and programming, students may have the opportunity to apply the Remainder Theorem.
Arithmetic with Polynomials and Rational Expressions	Understand the relationship between zeros and factors of polynomials	HS.A-APR.B.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.		Depending upon the calculations and formulas used to guide robot construction and programming, students may have the opportunity to construct a rough graph of the function defined by the polynomial.
Arithmetic with Polynomials and Rational Expressions	Use polynomial identities to solve problems	HS.A-APR.C.4	Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.		Students will need to prove polynomial identities and use them to describe numerical relationships in order to determine the appropriate values to program into the robot in order to interact with challenges during the autonomous phase of the competition.
Arithmetic with Polynomials and Rational Expressions	Use polynomial identities to solve problems	HS.A-APR.C.5	(+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.1		Depending upon the exact factors that students are trying to establish the numerical relationship between, they may apply the Binomial Theorem to determines values used to program the robot to interact with challenges during the autonomous phase of the competition.
Arithmetic with Polynomials and Rational Expressions	Rewrite rational expressions	HS.A-APR.D.6	Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.		Students will need to rewrite simple rational expressions and use them to describe numerical relationships in order to determine the appropriate values to for robot construction or programming.

Arithmetic with Polynomials and Rational Expressions	Rewrite rational expressions	HS.A-APR.D.7	(+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.		Students may have the opportunity to realize that rational expressions are like rational numbers in that they can be added, subtracted, multiplied, and divided, as they solve expressions to determine values used in robot contraction and programming.
Creating Equations	Create equations that describe numbers or relationships	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.		As students work to determine values to use in robot construction and programming, they will create equations and inequalities in one variable and use them to solve problems.
Creating Equations	Create equations that describe numbers or relationships	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.		As students work to determine values to use in robot construction and programming, they will create equations in two or more variables to represent relationships between quantities and use them to solve problems.
Creating Equations	Create equations that describe numbers or relationships	HS.A-CED.A.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.		As students work to determine values to use in robot construction and programming, they will interpret solutions as viable or nonviable options based on a real-world context.
Creating Equations	Create equations that describe numbers or relationships	HS.A-CED.A	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.		As students work to determine values to use in robot construction and programming, they will rearrange formulas to highlight a quantity of interest.
Reasoning with Equations and Inequalities	Understand solving equations as a process of reasoning and explain the reasoning	HS.A-REI.A.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.		Depending upon the expectations that the coach/mentor sets for the students' work, they may have to construct a viable argument to justify a solution method while working to determine values to use in robot construction and programming.
Reasoning with Equations and Inequalities	Understand solving equations as a process of reasoning and explain the reasoning	HS.A-REI.A.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.		As students work to determine values to use in robot construction and programming, they will solve simple rational and radical equations in one variable.
Reasoning with Equations and Inequalities	Solve equations and inequalities in one variable	HS.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.		As students work to determine values to use in robot construction and programming, they will solve linear equations and inequalities in one variable.
Reasoning with Equations and Inequalities	Solve equations and inequalities in one variable	HS.A-REI.B.4.A	Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.		As students work to determine values to use in robot construction and programming, they may use the method of completing the square to transform any quadratic equation.
Reasoning with Equations and Inequalities	Solve equations and inequalities in one variable	HS.A-REI.B.4.B	Solve quadratic equations in one variable b. 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 ± bi for real numbers a and b.		As students work to determine values to use in robot construction and programming, they will solve quadratic equations by a variety of methods.
Reasoning with Equations and Inequalities	Solve systems of equations	HS.A-REI.C.5	Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.		Depending upon the expectations that the coach/mentor sets for the students' work, they may prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. while working to determine values to use in robot construction and programming.
Reasoning with Equations and Inequalities	Solve systems of equations	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.		Depending upon the values students are working to determine for robot construction and programming, they may solve systems of linear equations.

Reasoning with Equations and Inequalities	Solve systems of equations	HS.A-REI.C.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = –3x and the circle $x^2 + y^2 = 3$.		Depending upon the values students are working to determine for robot construction and programming, they may solve a simple system consisting of a linear equation and a quadratic equation in two variables.
Reasoning with Equations and Inequalities	Solve systems of equations	HS.A-REI.C.8	(+) Represent a system of linear equations as a single matrix equation in a vector variable.		Depending upon the values students are working to determine for robot construction and programming, they may represent a system of linear equations as a single matrix equation.
Reasoning with Equations and Inequalities	Solve systems of equations	HS.A-REI.C.9	(+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).		Depending upon the values students are working to determine for robot construction and programming, they may find the inverse of a matrix if it exists and use it to solve systems of linear equations
Reasoning with Equations and Inequalities	Represent and solve equations and inequalities graphically	HS.A-REI.D.10	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).		As students work to determine values to use in robot construction and programming, they will understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.
Reasoning with Equations and Inequalities	Represent and solve equations and inequalities graphically	HS.A-REI.D.11	Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.		Depending upon the values students are working to determine for robot construction and programming, they may explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x).
Reasoning with Equations and Inequalities	Represent and solve equations and inequalities graphically	HS.A-REI.D.12	Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.		Depending upon the values students are working to determine for robot construction and programming, they may graph the solutions to a linear inequality in two variables as a half plane.
Interpreting Functions	Understand the concept of a function and use function notation	HS.F-IF.A.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).		As students work to determine values to use in robot construction and programming, they will understand a function assigns to each element of the domain exactly one element of the range.
Interpreting Functions	Understand the concept of a function and use function notation	HS.F-IF.A.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.		As students work to determine values to use in robot construction and programming, they will use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
Interpreting Functions	Understand the concept of a function and use function notation	HS.F-IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.		Depending upon the values students are working to determine for robot construction and programming, they may recognize that sequences are functions, sometimes defined recursively.
Interpreting Functions	Interpret functions that arise in applications in terms of the context	HS.F-IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.		As students work to determine values to use in robot construction and programming, they will use functions to model relationships between two quantities.
Interpreting Functions	Interpret functions that arise in applications in terms of the context	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.		As students work to determine values to use in robot construction and programming, they will relate the domain of a function to its graph.

Interpreting Functions	Interpret functions that arise in applications in terms of the context	HS.F-IF.B.6	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.		As students work to determine values to use in robot construction and programming (e.g. robot speed), they will calculate and interpret the average rate of change of a function.
Interpreting Functions	Analyze functions using different representations	HS.F-IF.C.7.A	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima.		As students work to determine values to use in robot construction and programming, they will graph linear and quadratic functions and show intercepts, maxima, and minima.
Interpreting Functions	Analyze functions using different representations	HS.F-IF.C.7.B	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.		Not Applicable
Interpreting Functions	Analyze functions using different representations	HS.F-IF.C.7.C	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.		Not Applicable
Interpreting Functions	Analyze functions using different representations	HS.F-IF.C.7.D	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.		Depending upon the values students are working to determine for robot construction and programming, they may graph rational functions.
Interpreting Functions	Analyze functions using different representations	HS.F-IF.C.7.E	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.		Not Applicable
Interpreting Functions	Analyze functions using different representations	HS.F-IF.C.8.A	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.		Depending upon the values students are working to determine for robot construction and programming, they may use the process of factoring and completing the square.

Interpreting Functions	Analyze functions using different representations	HS.F-IF.C.8.B	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.		As students work to determine values to use in robot construction and programming, they will use the properties of exponents to interpret expressions for exponential functions.
Interpreting Functions	Analyze functions using different representations	HS.F-IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.		Depending upon the values students are working to determine for robot construction and programming, they may compare properties of two functions each represented in a different way.
Building Functions	Build a function that models a relationship between two quantities	HS.F-BF.A.1.A	Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context.		As students work to determine values to use in robot construction and programming, they will determine an explicit expression, a recursive process, or steps for calculation from a context.
Building Functions	Build a function that models a relationship between two quantities	HS.F-BF.A.1.B	Write a function that describes a relationship between two quantities. . b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.		As students work to determine values to use in robot construction and programming, they will combine standard function types using arithmetic operations.
Building Functions	Build a function that models a relationship between two quantities	HS.F-BF.A.1.C	Write a function that describes a relationship between two quantities. c. (+) Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.		As students work to determine values to use in robot construction and programming, they will compose functions as is necessary.
Building Functions	Build a function that models a relationship between two quantities	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.		As students work to determine values to use in robot construction and programming, they will write arithmetic and geometric sequences both recursively and with an explicit formula
Building Functions	Build new functions from existing functions	HS.F-BF.B.3	Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(ox), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.		Not Applicable
Building Functions	Build new functions from existing functions	HS.F-BF.B.4.A	Find inverse functions. a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x–1)$ for $x \neq 1$.		Not Applicable
Building Functions	Build new functions from existing functions	HS.F-BF.B.4.B	Find inverse functions. b. (+) Verify by composition that one function is the inverse of another.		Not Applicable

Building Functions	Build new functions from existing functions	HS.F-BF.B.4.C	Find inverse functions. c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse	Not Applicable
Building Functions	Build new functions from existing functions	HS.F-BF.B.4.D	Find inverse functions. d. (+) Produce an invertible function from a non-invertible function by restricting the domain.	Not Applicable
Building Functions	Build new functions from existing functions	HS.F-BF.B.5	(+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.	Depending upon the values students are working to determine for robot construction and programming, they may understand the inverse relationship between exponents and logarithms and use this relationship to solve problems.
Linear, Quadratic, and Exponential Models	Construct and compare linear, quadratic, and exponential models and solve problems	HS.F-LE.A.1.A	Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.	Depending upon the values students are working to determine for robot construction and programming, they may prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
Linear, Quadratic, and Exponential Models	Construct and compare linear, quadratic, and exponential models and solve problems	HS.F-LE.A.1.B	Distinguish between situations that can be modeled with linear functions and with exponential functions. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another	As students work to determine values to use in robot construction and programming, they will recognize situations in which one quantity changes a a constant rate per unit interval relative to another.
Linear, Quadratic, and Exponential Models	Construct and compare linear, quadratic, and exponential models and solve problems	HS.F-LE.A.1.C	Distinguish between situations that can be modeled with linear functions and with exponential functions. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another	As students work to determine values to use in robot construction and programming, they will recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
Linear, Quadratic, and Exponential Models	Construct and compare linear, quadratic, and exponential models and solve problems	HS.F-LE.A.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).	As students work to determine values to use in robot construction and programming, they will construct linear and exponential functions.
Linear, Quadratic, and Exponential Models	Construct and compare linear, quadratic, and exponential models and solve problems	HS.F-LE.A.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.	Depending upon the values students are working to determine for robot construction and programming, they may observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratic ally
Linear, Quadratic, and Exponential Models	Construct and compare linear, quadratic, and exponential models and solve problems	HS.F-LE.A.4	For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.	Depending upon the values students are working to determine for robot construction and programming, they may express as a logarithm the solution to $ab^{ct} = d$.
Linear, Quadratic, and Exponential Models	Interpret expressions for functions in terms of the situation they model	HS.F-LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.	As students work to determine values to use in robot construction and programming, they will interpret the parameters in a linear or exponential function in terms of a context.
Trigonometric Functions	Extend the domain of trigonometric functions using the unit circle	HS.A-TF.A.1	Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	As students work to determine values to use in robot construction and programming, they will understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
Trigonometric Functions	Extend the domain of trigonometric functions using the unit circle	HS.A-TF.A.2	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.	Depending upon the values students are working to determine for robot construction and programming, they may explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers.
Trigonometric Functions	Extend the domain of trigonometric functions using the unit circle	HS.A-TF.A.3	(+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π–x, π+x, and 2π–x in terms of their values for x, where x is any real number.	Depending upon the values students are working to determine for robot construction and programming, they may use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6.
Trigonometric Functions	Extend the domain of trigonometric functions using the unit circle	HS.A-TF.A.4	(+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.	Depending upon the values students are working to determine for robot construction and programming, they may use the unit circle to explain symmetry and periodicity of trigonometric functions.

Trigonometric Functions	Model periodic phenomena with trigonometric functions	HS.A-TF.B.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.		Depending upon the values students are working to determine for robot construction, programming or interacting with challenges, they may choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline
Trigonometric Functions	Model periodic phenomena with trigonometric functions	HS.A-TF.B.6	(+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.		Depending upon the values students are working to determine for robot construction and programming, they may restrict trigonometric functions to one domain allowing inverses to be constructed
Trigonometric Functions	Model periodic phenomena with trigonometric functions	HS.A-TF.B.7	(+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context		Depending upon the values students are working to determine for robot construction and programming, they may use inverse functions to solve trigonometric equations.
Trigonometric Functions	Prove and apply trigonometric identities	HS.A-TF.C.8	Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.		Depending upon the values students are working to determine for robot construction and programming, they may prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to solve problems.
Trigonometric Functions	Prove and apply trigonometric identities	HS.A-TF.C.9	(+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.		Depending upon the values students are working to determine for robot construction and programming, they may prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.
Congruence	Experiment with transformations in the plane	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.		As students work to program their robot to function autonomously, they will make use of specific geometric definitions. If teams use CAD design and/or 3D printing, they will need to know characteristics of many geometric figures.
Congruence	Experiment with transformations in the plane	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 other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).		As students work to design, construct, and program their robot to function autonomously, they will make use of transformations in a plane to identify locations or placement of parts. If teams use CAD design and/or 3D printing, they will need to apply properties of transformations.
Congruence	Experiment with transformations in the plane	HS.G-CO.A.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.		As students work to design, construct, and program their robot to function autonomously, they will make use of reflections and rotations of various shapes to outline the look of the robot, placement of parts, and approaches to navigation. If teams use CAD design and/or 3D printing, they will need to apply properties of transformations.
Congruence	Experiment with transformations in the plane	HS.G-CO.A.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.		As students work to design, construct, and program their robot to function autonomously, they will make use of reflections and rotations of various shapes to outline the look of the robot, placement of parts, and approaches to navigation. If teams use CAD design and/or 3D printing, they will need to apply properties of transformations.
Congruence	Experiment with transformations in the plane	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.		As students work to design, construct, and program their robot to function autonomously, they will make use of reflections and rotations of various shapes to outline the look of the robot, placement of parts, and approaches to navigation. If teams use CAD design and/or 3D printing, they will need to apply properties of transformations.
Congruence	Understand congruence in terms of rigid motions	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.		As students work to design, construct, and program their robot to function autonomously, they will make use of reflections and rotations of various shapes to outline the look of the robot, placement of parts, and approaches to navigation. If teams use CAD design and/or 3D printing, they will need to understand congruence in terms of rigid motion.
Congruence	Understand congruence in terms of rigid motions	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 congruent.		Depending upon the expectations of the coach/mentor, students may have the opportunity when working with triangles to use the concept of congruence to prove that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. If teams use CAD design and/or 3D printing, they will need to apply properties of transformations.
Congruence	Understand congruence in terms of rigid motions	HS.G-CO.B.8	Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.		Depending upon the expectations of the coach/mentor, students may have the opportunity when working with triangles to explain how the criteria for triangle congruence follow from the definition of congruence in terms of rigid motions.

Congruence	Prove geometric theorems	HS.G-CO.C.9	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.		Not Applicable
Congruence	Prove geometric theorems	HS.G-CO.C.10	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.		Not Applicable
Congruence	Prove geometric theorems	HS.G-CO.C.11	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.		Not Applicable
Congruence	Make geometric constructions	HS.G-CO.D.12	Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.		As students work to design, construct, and program their robot to function autonomously, they will make formal geometric constructions with a variety of tools and methods. If teams use CAD design and/or 3D printing, they will need to construct different geometric figures.
Congruence	Make geometric constructions	HS.G-CO.D.13	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.		Depending upon the how the students are fabricating robot parts or programming for autonomous navigation, they may construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle
Similarity, Right Triangles, and Trigonometry	Understand similarity in terms of similarity transformations	HS.G-SRT.A.1.A	Verify experimentally the properties of dilations given by a center and a scale factor: a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.		Depending upon the how the students are fabricating robot parts or programming for autonomous navigation, they may verify experimentally the properties of dilations given by a center and a scale factor.
Similarity, Right Triangles, and Trigonometry	Understand similarity in terms of similarity transformations	HS.G-SRT.A1.B	Verify experimentally the properties of dilations given by a center and a scale factor: b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.		Depending upon the how the students are fabricating robot parts or programming for autonomous navigation, they may verify experimentally the properties of dilations given by a center and a scale factor.
Similarity, Right Triangles, and Trigonometry	Understand similarity in terms of similarity transformations	HS.G-SRT.A.2	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.		As students work to design, construct, and program their robot to function autonomously, they will compare the similarity of two figures based on the definition as well as a transformation.
Similarity, Right Triangles, and Trigonometry	Understand similarity in terms of similarity transformations	HS.G-SRT.A.3	Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.		Not Applicable
Similarity, Right Triangles, and Trigonometry	Prove theorems involving similarity	HS.G-SRT.B.4	Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.		Not Applicable
Similarity, Right Triangles, and Trigonometry	Prove theorems involving similarity	HS.G-SRT.B.5	Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.		As students work to design, construct, and program their robot to function autonomously, they will use congruence and similarity criteria of triangles to establish the relationship between two shapes.
Similarity, Right Triangles, and Trigonometry	Define trigonometric ratios and solve problems involving right triangles	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.		As students work to design, construct, and program their robot to function autonomously, they will use the fact that side ratios in right triangles are properties of the angles in the triangle to solve problems.
Similarity, Right Triangles, and Trigonometry	Define trigonometric ratios and solve problems involving right triangles	HS.G-SRT.C.7	Explain and use the relationship between the sine and cosine of complementary angles.		As students work to design, construct, and program their robot to function autonomously, they will use the relationship between the sine and cosine of complementary angles to solve problems.

Similarity, Right Triangles, and Trigonometry	Define trigonometric ratios and solve problems involving right triangles	HS.G-SRT.C.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.		As students work to design, construct, and program their robot to function autonomously, they will use trigonometric ratios and the Pythagorean Theorem to solve problems.
Similarity, Right Triangles, and Trigonometry	Apply trigonometry to general triangles	HS.G-SRT.D.9	(+) Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.		Not Applicable
Similarity, Right Triangles, and Trigonometry	Apply trigonometry to general triangles	HS.G-SRT.D.10	(+) Prove the Laws of Sines and Cosines and use them to solve problems.		Depending upon the expectations of the coach/mentor, students may use the Laws of Sines and Cosines to solve problems.
Similarity, Right Triangles, and Trigonometry	Apply trigonometry to general triangles	HS.G-SRT.D.11	(+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).		As students work to design, construct, and program their robot to function autonomously, they will apply the Law of Sines and the Law of Cosines to solve problems.
Circles	Understand and apply theorems about circles	HS.G-C.A.1	Prove that all circles are similar.		Not Applicable
Circles	Understand and apply theorems about circles	HS.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.		Depending upon the expectations of the coach/mentor, students may identify and describe relationships among inscribed angles, radii, and chords and use these facts to solve problems.
Circles	Understand and apply theorems about circles	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.		Depending upon the expectations of the coach/mentor, students may construct the inscribed and circumscribed circles of a triangle and quadrilateral.
Circles	Understand and apply theorems about circles	HS.G-C.A.4	(+) Construct a tangent line from a point outside a given circle to the circle.		Depending upon the expectations of the coach/mentor, students may construct a tangent line and use it to solve problems
Circles	Find arc lengths and areas of sectors of circles	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.		Depending upon the expectations of the coach/mentor, students may derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius and use it to solve problems.
Expressing Geometric Properties with Equations	Translate between the geometric description and the equation for a conic section	HS.G-GPE.A.1	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.		Depending upon the expectations of the coach/mentor, students may derive the equation of a circle of given center and radius using the Pythagorean Theorem.
Expressing Geometric Properties with Equations	Translate between the geometric description and the equation for a conic section	HS.G-GPE.A.2	Derive the equation of a parabola given a focus and directrix.		Depending upon the expectations of the coach/mentor, students may derive the equation of a parabola with a given focus and directrix.
Expressing Geometric Properties with Equations	Translate between the geometric description and the equation for a conic section	HS.G-GPE.A.3	(+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.		Depending upon the expectations of the coach/mentor, students may derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
Expressing Geometric Properties with Equations	Use coordinates to prove simple geometric theorems algebraically	HS.G-GPE.B.4	Use coordinates to prove simple geometric theorems algebraically. For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).		As students work to design, construct, and program their robot to function autonomously, they may use coordinates to prove simple geometric theorems algebraically.
Expressing Geometric Properties with Equations	Use coordinates to prove simple geometric theorems algebraically	HS.G-GPE.B.5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).		As students work to design, construct, and program their robot to function autonomously, they will prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems
Expressing Geometric Properties with Equations	Use coordinates to prove simple geometric theorems algebraically	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.		As students work to design, construct, and program their robot to function autonomously, they will find the point on a directed line segment between two given points that partitions the segment in a given ratio.
Expressing Geometric Properties with Equations	Use coordinates to prove simple geometric theorems algebraically	HS.G-GPE.B.7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.		As students work to design, construct, and program their robot to function autonomously, they will use coordinates to compute perimeters of polygons and areas of triangles and rectangles and solve problems.
Geometric Measurement and Dimension	Explain volume formulas and use them to solve problems	HS.G-GMD.A.1	Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.		Depending upon the expectations of the coach/mentor, students may give an informal argument for the formulas associated with a circle.

Geometric Measurement and Dimension	Explain volume formulas and use them to solve problems	HS.G-GMD.A.2	(+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.		Depending upon the expectations of the coach/mentor, students may give an informal argument for Cavalieri's principle.
Geometric Measurement and Dimension	Explain volume formulas and use them to solve problems	HS.G-GMD.A.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.		Depending upon the design of their robot and the challenges encountered in the competition, students may have to use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
Geometric Measurement and Dimension	Visualize relationships between two-dimensional and three-dimensional objects	HS.G-GMD.B.4	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.		Depending upon the design of their robot and the challenges encountered in the competition, students may have to use conversions of two-dimensional objects to solve problems.
Modeling with Geometry	Apply geometric concepts in modeling situations	HS.G-MG.A.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).		Depending upon the design of their robot and the challenges encountered in the competition, students may use geometric shapes, their measures, and their properties to describe objects.
Modeling with Geometry	Apply geometric concepts in modeling situations	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).		Depending upon the design of their robot and the challenges encountered in the competition, students may apply concepts of density based on area and volume in modeling situations
Modeling with Geometry	Apply geometric concepts in modeling situations	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).		As students work to design, construct, and program their robot to function autonomously, they will apply geometric methods to design problems.
Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on a single count or measurement variable	HS.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).		As students work to design, construct, program their robot to function autonomously, and select a partner team, they will represent data with plots on the real number line
Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on a single count or measurement variable	HS.S-ID.A,2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.		As students work to program their robot to function autonomously and select a partner team, they will use statistics appropriate to the shape of the data distribution
Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on a single count or measurement variable	HS.S-ID.A.3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).		As students work to program their robot to function autonomously and select a partner team, they will interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data point.
Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on a single count or measurement variable	HS.S-ID.A.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.		As students work to program their robot to function autonomously and possibly select an alliance team, they will interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points .Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages
Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on two categorical and quantitative variables	HS.S-ID.B.5	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.		As students work to program their robot to function autonomously and possibly select an alliance team, they will summarize categorical data for two categories in two-way frequency tables and interpret relative frequencies.
Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on two categorical and quantitative variables	HS.S-ID.B.6.A	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related . a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.		As students work to program their robot to function autonomously and possibly select an alliance team, they will fit a function to the data; use functions fitted to data to solve problems
Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on two categorical and quantitative variables	HS.S-ID.B.6.B	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. b. Informally assess the fit of a function by plotting and analyzing residuals.		As students work to program their robot to function autonomously and possibly select an alliance team, they will informally assess the fit of a function by plotting and analyzing residuals.
Interpreting Categorical and Quantitative Data	Summarize, represent, and interpret data on two categorical and quantitative variables	HS.S-ID.B.6.C	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. c. Fit a linear function for a scatter plot that suggests a linear association.		As students work to program their robot to function autonomously and possibly select an alliance team, they will informally assess the fit a linear function for a scatter plot that suggests a linear association.
Interpreting Categorical and Quantitative Data	Interpret linear models	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.		As students work to program their robot to function autonomously and possibly select an alliance team, they will interpret the slope (rate of change and the intercept (constant term) of a linear model in the context of the data

Interpreting Categorical and Quantitative Data	Interpret linear models	HS.S-ID.C.8	Compute (using technology) and interpret the correlation coefficient of a linear fit.	As students work to program their robot to function autonomously and possibly select an alliance team, they will compute and interpret the correlation coefficient of a linear fit.
Interpreting Categorical and Quantitative Data	Interpret linear models	HS.S-ID.C.9	Distinguish between correlation and causation.	As students work to program their robot to function autonomously and possibly select an alliance team, they will distinguish between correlation and causation.
Making Inferences and Justifying Conclusions	Understand and evaluate random processes underlying statistical experiments	HS.S-IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.	As students work to program their robot to function autonomously and possibly select an alliance team, they will understand statistics as a process for making inferences about population parameters based on a random sample.
Making Inferences and Justifying Conclusions	Understand and evaluate random processes underlying statistical experiments	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 falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?	As students work to program their robot to function autonomously and possibly select an alliance team, they will decide if a specified model is consistent with results from a given data-generating process.
Making Inferences and Justifying Conclusions	Make inferences and justify conclusions from sample surveys, experiments, and observational studies	HS.S-IC.B.3	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.	Depending upon coach/mentor expectations as students work to program their robot to function autonomously and possibly select an alliance team, they may recognize the purposes of and differences among sample surveys, experiments, and observational studies.
Making Inferences and Justifying Conclusions	Make inferences and justify conclusions from sample surveys, experiments, and observational studies	HS.S-IC.B.4	Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.	Depending upon how a team chooses to plan for fundraising or outreach activities, students may use data from a sample survey to estimate a population mean or proportion and develop a margin of error.
Making Inferences and Justifying Conclusions	Make inferences and justify conclusions from sample surveys, experiments, and observational studies	HS.S-IC.B.5	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.	Depending upon how students go about testing their robot design, programming, and user operation, they may use data from a randomized experiment to compare different treatments.
Making Inferences and Justifying Conclusions	Make inferences and justify conclusions from sample surveys, experiments, and observational studies	HS.S-IC.B.6	Evaluate reports based on data.	As students work to program their robot to function autonomously, test their robot design, test their robot operation and possibly select an alliance team, they will evaluate reports based on data.
Conditional Probability and the Rules of Probability	Understand independence and conditional probability and use them to interpret data	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”).	Depending upon the nature of the challenges in the competition, and as students work to program their robot to function autonomously and set-up their game strategy, they may work with events as subsets of a sample (e.g., how many red rings are added to the highest peg as opposed to blue rings?)
Conditional Probability and the Rules of Probability	Understand independence and conditional probability and use them to interpret data	HS.S-CP.A.2	Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.	Depending upon the nature of the challenges in the competition, and as students work to program their robot to function autonomously and set-up their game strategy, they may need to determine whether two events are independent (e.g., How many red balls are added to the basket?, How many blue rings are added to the highest peg?)
Conditional Probability and the Rules of Probability	Understand independence and conditional probability and use them to interpret data	HS.S-CP.A.3	Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.	Depending upon the nature of the challenges in the competition, and as students work to program their robot to function autonomously and set-up their game strategy, they may need to use conditional probability to determine of two events are independent (e.g., How many red balls are added to the basket?, How many blue rings are added to the highest peg?)
Conditional Probability and the Rules of Probability	Understand independence and conditional probability and use them to interpret data	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 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.	Depending upon the nature of the challenges in the competition, and as students work to program their robot to function autonomously and set-up their game strategy, they may need to construct and interpret two-way frequency tables of data.

Conditional Probability and the Rules of Probability	Understand independence and conditional probability and use them to interpret data	HS.S-CP.A.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.		Depending upon the expectations of the coach/mentor, students may analyze conditional probability as it occurs in the real-world outside of the dynamics of the competition.
Conditional Probability and the Rules of Probability	Use the rules of probability to compute probabilities of compound events in a uniform probability model	HS.S-CP.B.6	Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.		Depending upon the nature of the challenges in the competition, as students work to program their robot to function autonomously and set-up their game strategy, they may need to find the conditional probability of A given B as the fraction of B's outcomes that also belong to A.
Conditional Probability and the Rules of Probability	Use the rules of probability to compute probabilities of compound events in a uniform probability model	HS.S-CP.B.7	Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.		Depending upon the nature of the challenges in the competition, as students work to program their robot to function autonomously and set-up their game strategy, they may need to apply the Addition Rule to solve problems.
Conditional Probability and the Rules of Probability	Use the rules of probability to compute probabilities of compound events in a uniform probability model	HS.S-CP.B.8	(+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.		Depending upon the nature of the challenges in the competition, as students work to program their robot to function autonomously and set-up their game strategy, they may need to apply the Multiplication Rule to solve problems.
Conditional Probability and the Rules of Probability	Use the rules of probability to compute probabilities of compound events in a uniform probability model	HS.S-CP.B.9	(+) Use permutations and combinations to compute probabilities of compound events and solve problems.		As students work to program their robot to function autonomously, test their robot design, test their robot operation and possibly select an alliance team, they will use permutations and combinations to compute probabilities of compound events and solve problems.
Using Probability to Make Decisions	Calculate expected values and use them to solve problems	HS.S-MD.A.1	(+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.		Depending upon how the students are going about establishing their game strategy, they may decide to estimate the likelihood of an event occurring by assigning random values to occurrences. For example, the students may want to determine their likelihood of earning 20 points, so they estimate that they have a 0.5 chance of earning 10 points on Task A, a 0.2 chance of earning 5 points at task B, and a 0.4 chance of earning 8 points on Task C.
Using Probability to Make Decisions	Calculate expected values and use them to solve problems	HS.S-MD.A.2	(+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.		As students work to program their robot to function autonomously, test their robot design, test their robot operation, and possibly select an alliance team they will calculate an expected value that is the mean of the probability distribution.
Using Probability to Make Decisions	Calculate expected values and use them to solve problems	HS.S-MD.A.3	(+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.		Depending upon how the students are going about establishing their game strategy, they may decide to estimate the likelihood of an event occurring by using the likelihood of the occurrences. For example, the students may want to determine their likelihood of earning 20 points, through a calculation were they have a 0.5 chance of earning 10 points on Task A, a 0.2 chance of earning 5 points at task B, and a 0.4 chance of earning 8 points on Task C.
Using Probability to Make Decisions	Calculate expected values and use them to solve problems	HS.S-MD.A.4	(+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?		Depending upon how the students are establishing their game strategy, they may use expected values. For example, using the data from robot trials, students can calculate the expected number of times their robot will successfully complete a task.
Using Probability to Make Decisions	Use probability to evaluate outcomes of decisions	HS.S-MD.B.5.A	(+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. a. Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.		Throughout the *FIRST*® Robotics Challenge, students will use probabilities to analyze their robot's autonomous functioning, their game strategy and select a partner team.

Using Probability to Make Decisions	Use probability to evaluate outcomes of decisions	HS.S-MD.B.5.B	(+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. b. Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.		Throughout the *FIRST®* Robotics Challenge, students will use probabilities to analyze their robot's autonomous functioning, their game strategy and select a partner team.
Using Probability to Make Decisions	Use probability to evaluate outcomes of decisions	HS.S-MD.B.6	(+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).		Depending upon coach/mentor expectations, probabilities may be used to determine student order or opportunities to participate in specific tasks (e.g., driving the robot, speaking for the team).
Using Probability to Make Decisions	Use probability to evaluate outcomes of decisions	HS.S-MD.B.7	(+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).		Throughout the *FIRST®* Robotics Challenge, students will use probabilities to analyze their robot's autonomous functioning, test their robot operation and select a partner team.