INTRODUCTION TO ROBOTICS WITH AXLE

GRADES 6–8

This document lists the Minnesota learning standards addressed by Introduction to Robotics with Axle, True Robotics' grades 6–8 robotics curriculum. Standards are grouped by subject and grade level, with codes and wording as published by the Minnesota Department of Education.

36	10	1	47
MATH	SCIENCE	CS	TOTAL STANDARDS

MATHEMATICS

36 STANDARDS

Based on the Minnesota state standards

GRADE	CODE	STANDARD
6	6.1.1.1	Recognize a statistical question as one that anticipates variability in the data, compares differences between groups and collects categorical or numerical data related to the question, and accounts for it in the answer.
6	6.1.1.3	Identify, determine and interpret measures of center (mean and median) and measures of variability (range, interquartile range, mean-absolute deviation) to answer a statistically investigative question, summarizing the distribution of data using the measures of center and variability.
6	6.2.3.1	Calculate the measurements of the surface area of rectangular and triangular prisms using appropriate units. Justify the formulas used. Justification may involve decomposition, nets or other models.
6	6.2.3.2	Calculate the measurement of the volume of prisms (including triangular and nonrectangular prisms) using appropriate units. Justify the formulas used. Justification may involve decomposition or other models.
6	6.2.3.5	Find the area of special quadrilaterals and polygons by composing into rectangles or decomposing into triangles and other shapes. Apply these techniques in contextual mathematical situations.
6	6.2.4.3	Draw polygons in the coordinate plane given coordinates for the vertices. Use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in contextual situations.
6	6.3.5.2	Locate positive and negative rational numbers on a number line. Plot ordered pairs of positive and negative rational numbers on a coordinate grid.
6	6.3.5.8	Multiply and divide fractions and mixed numbers using visual models to represent the situation leading towards generalizable algorithms.

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GRADE	CODE	STANDARD
6	6.3.5.9	Solve mathematical situations requiring arithmetic, including multiplication and division, with decimals, fractions and mixed numbers, explaining the solution pathway. Interpret quotients in the context of the situation.
6	6.3.6.3	Represent mathematical situations using expressions, equations and inequalities involving variables and positive rational numbers.
6	6.3.6.4	Solve one-step equations, including equations of the form x + p = q and px = q for cases in which p, q and x are all positive rational numbers. Use number sense, properties of arithmetic and the idea of maintaining equality on both sides of the equation. Interpret a solution in the original context and assess the reasonableness of results.
6	6.3.7.1	Use variables to represent two quantities in a situation that change in relationship to one another. Write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables and relate these to the equation.
7	7.1.1.4	Understand that a set of data collected to answer a statistical question has a distribution that can be described by its center, variability and overall shape. Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. Justify the choice of measures of center and variability, the shape of the data distribution and the context in which the data were gathered.
7	7.2.3.1	Demonstrate an understanding of the proportional relationship between the diameter and circumference of a circle and that the unit rate (constant of proportionality) is π.
7	7.2.3.2	Calculate the circumference and area of circles to solve situations in various contexts.
7	7.2.3.4	Calculate the surface area and volume of cylinders. Justify the formulas used.
7	7.2.4.4	Use proportional reasoning and ratios to solve situations involving scale drawings and conversions of measurement units.
7	7.3.5.1	Know that every rational number can be written as the ratio of two integers and as a terminating or repeating decimal. Recognize that π is not rational but that it can be approximated by rational numbers such as 22/7 and 3.14.
7	7.3.5.4	Recognize subtraction of rational numbers as adding the additive inverse, p – q = p + (–q). Show that the distance between two rational numbers on the number line is the absolute value of their difference and apply this principle in contexts.
7	7.3.5.6	Solve mathematical situations involving adding, subtracting, multiplying and dividing positive and negative rational numbers that are integers, fractions and terminating decimals. Use efficient and generalizable procedures. Raise positive rational numbers to whole-number exponents.
7	7.3.5.7	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.
7	7.3.6.1	Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.
7	7.3.6.2	Represent and solve contextual situations resulting in two-step equations and inequalities involving variables and positive/negative rational numbers. Graph the solution set of the inequality and interpret the solution in context.

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GRADE	CODE	STANDARD
7	7.3.6.4	Solve multi-step situations involving proportional relationships in numerous contexts using models, such as tables of equivalent ratios involving scaling up and down, tape diagrams, double number lines or equations.
7	7.3.6.5	Solve multi-step financial literacy situations including simple interest, tax, markups and markdowns, tips and commissions, fees, percent increase and decrease and percent error. Distinguish between sales tax and income tax for earned wages. Situations include finding the whole, the part and the percent.
7	7.3.7.1	Represent proportional relationships with tables, verbal descriptions, symbols, equations and graphs. Translate from one representation to another. Determine the unit rate (constant of proportionality or rate of change) given any of these representations.
7	7.3.7.3	Determine whether two quantities are in a proportional relationship by testing for equivalent ratios in a table or graphing on a coordinate plane and by observing whether the graph is a straight line through the origin. Use graphing technology to examine the relationship between the unit rate and the line for a given situation.
8	8.2.3.2	Apply the Pythagorean Theorem to solve multi-step contextual situations by determining unknown side lengths in right triangles in both two- and three-dimensional shapes.
8	8.2.3.3	Determine the distance between two points on a horizontal or vertical line in a coordinate system. Use the Pythagorean Theorem to find the distance between any two points in a coordinate system.
8	8.3.5.1	Classify real numbers as rational or irrational. Know that when a square root of a positive integer is not an integer, then it is irrational.
8	8.3.5.2	Use rational approximations of irrational numbers to compare the size of irrational numbers and locate them approximately on a number line. Estimate the value of expressions involving irrational numbers.
8	8.3.6.9	Represent relationships in various contextual situations using systems of linear equations. Solve systems of linear equations in two variables, symbolically and graphically, understanding that the solution corresponds to the point of intersection of their graphs.
8	8.3.7.1	Compare graphical properties of proportional and non-proportional linear relationships, including slope.
8	8.3.7.4	Represent linear functions with tables, verbal descriptions, symbols, equations and graphs. Translate from one representation to another.
8	8.3.7.6	Identify graphical properties of linear functions in the form f(x) = mx + b, including slope, y-intercept and x-intercept. Know that the graph is a straight line, the slope (m) equals the rate of change, the y-intercept (b) is the value of the function at x = 0 and the x-intercept is the value of the function at f(x) = 0.
8	8.3.7.9	Represent arithmetic and geometric sequences using equations, tables, graphs and verbal descriptions and use them to solve situations.

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SCIENCE

10 STANDARDS

Based on the Minnesota state standards

GRADE	CODE	STANDARD
7	7L.3.1.1.3	Develop and use a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
7	7L.4.1.1.1	Support or refute an explanation by arguing from evidence for how the body is a system of interacting subsystems composed of groups of cells.
7	7L.4.1.2.1	Construct an argument supported by empirical evidence that changes in physical or biological components of an ecosystem affect populations.
8	8P.1.2.1.1	Plan and conduct an investigation of changes in pure substances when thermal energy is added or removed and relate those changes to particle motion.
8	8P.1.2.1.2	Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
8	8P.2.1.1.2	Construct and interpret graphical displays of data to describe the relationship of kinetic energy to the mass and speed of an object.
8	8P.2.2.1.1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
8	8P.3.1.1.4	Develop and use a model to qualitatively describe that waves are reflected, absorbed, or transmitted through various materials.
8	8P.3.2.2.2	Design a solution to a problem involving the motion of two colliding objects using Newton's 3rd Law.
8	8P.4.2.1.2	Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

COMPUTER SCIENCE

1 STANDARD

Based on the Minnesota state standards

GRADE	CODE	STANDARD
8	8P.2.2.1.2	Create a computer program to illustrate the transfer of energy within a system where energy changes form.

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SOURCES & NOTES

- The official mathematics, science and computer science standards for Minnesota, as published by the Minnesota Department of Education.
- Codes and standard wording are reproduced from the official standards documents. Clarification statements, examples and assessment boundaries are omitted.
- Grade shows the grade level at which True Robotics lessons address each standard. A range (for example K–2) marks a standard written for a grade band.
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- A lesson-level crosswalk is available on request at info@truerobotics.org.

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