INTRODUCTION TO ROBOTICS WITH AXLE

GRADES 6–8

This document lists the Massachusetts 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 Massachusetts Department of Elementary and Secondary Education (DESE).

41	16	9	66
MATH	STE	DLCS	TOTAL STANDARDS

MATHEMATICS

41 STANDARDS

Based on the Massachusetts state frameworks

GRADE	CODE	STANDARD
6	6.NS.A.1	Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem.
6	6.NS.C.8	Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.
6	6.EE.B.5	Understand solving an equation or inequality as a process of answering a question: Which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.
6	6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
6	6.EE.B.7	Solve real-world and mathematical problems by writing and solving equations of the form x + p = q and px = q for cases in which p, q, and x are all nonnegative rational numbers.
6	6.EE.C.9	Use variables to represent two quantities in a real-world problem 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.
6	6.G.A.1	Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.

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GRADE	CODE	STANDARD
6	6.G.A.2	Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas V = lwh and V = Bh to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.
6	6.G.A.4	Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface areas of these figures. Apply these techniques in the context of solving real-world and mathematical problems.
6	6.SP.A.1	Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers.
6	6.SP.A.2	Understand that a set of data collected to answer a statistical question has a distribution, which can be described by its center (median, mean, and/or mode), spread (range, interquartile range), and overall shape.
6	6.SP.B.5c	Summarize numerical data sets in relation to their context, such as by: Giving quantitative measures of center (median, and/or mean) and variability (range and/or interquartile range), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
7	7.EE.B.4a	Solve word problems leading to equations of the form px + q = r and p(x ÷ q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.
7	7.EE.B.4c	Extend analysis of patterns to include analyzing, extending, and determining an expression for simple arithmetic and geometric sequences (e.g., compounding, increasing area), using tables, graphs, words, and expressions.
7	7.RP.A.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.
7	7.RP.A.2b	Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
7	7.RP.A.2c	Represent proportional relationships by equations.
7	7.RP.A.2d	Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.
7	7.RP.A.3	Use proportional relationships to solve multi-step ratio, rate, and percent problems.
7	7.G.A.1	Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
7	7.G.B.4a	Know that a circle is a two-dimensional shape created by connecting all of the points equidistant from a fixed point called the center of the circle.
7	7.G.B.4b	Understand and describe the relationships among the radius, diameter, and circumference of a circle.
7	7.G.B.4c	Understand and describe the relationship among the radius, diameter, and area of a circle.

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GRADE	CODE	STANDARD
7	7.G.B.4d	Know the formulas for the area and circumference of a circle and use them to solve problems.
7	7.G.B.4e	Give an informal derivation of the relationship between the circumference and area of a circle.
7	7.G.B.6	Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.
7	7.NS.A.1c	Understand 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 real-world contexts.
7	7.NS.A.1d	Apply properties of operations as strategies to add and subtract rational numbers.
7	7.NS.A.2c	Apply properties of operations as strategies to multiply and divide rational numbers.
7	7.NS.A.3	Solve real-world and mathematical problems involving the four operations with integers and other rational numbers.
8	8.NS.A.1	Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion. For rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.
8	8.NS.A.2	Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2).
8	8.EE.B.5	Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.
8	8.EE.C.8a	Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
8	8.EE.C.8b	Solve systems of two linear equations in two variables algebraically (using substitution and elimination strategies), and estimate solutions by graphing the equations. Solve simple cases by inspection.
8	8.EE.C.8c	Solve real-world and mathematical problems leading to two linear equations in two variables.
8	8.F.A.3	Interpret the equation y = mx + b as defining a linear function whose graph is a straight line; give examples of functions that are not linear.
8	8.F.B.4	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
8	8.G.B.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
8	8.G.B.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

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GRADE	CODE	STANDARD
8	8.G.C.9	Know the formulas for the volumes of cones, cylinders, and spheres, and use them to solve real-world and mathematical problems.

SCIENCE, TECHNOLOGY & ENGINEERING

16 STANDARDS

Based on the Massachusetts state frameworks

GRADE	CODE	STANDARD
6	6.MS-PS1-7(MA)	Use a particulate model of matter to explain that density is the amount of matter (mass) in a given volume. Apply proportional reasoning to describe, calculate, and compare relative densities of different materials.
6	6.MS-PS4-1	Use diagrams of a simple wave to explain that (a) a wave has a repeating pattern with a specific amplitude, frequency, and wavelength, and (b) the amplitude of a wave is related to the energy of the wave.
6	6.MS-PS4-2	Use diagrams and other models to show that both light rays and mechanical waves are reflected, absorbed, or transmitted through various materials.
6	6.MS-PS4-3	Present qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses representing 0s and 1s) can be used to encode and transmit information.
6	6.MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.
6	6.MS-ETS2-1(MA)	Analyze and compare properties of metals, plastics, wood, and ceramics, including flexibility, ductility, hardness, thermal conductivity, electrical conductivity, and melting point.
6	6.MS-ETS2-2(MA)	Given a design task, select appropriate materials based on specific properties needed in the construction of a solution.
6	6.MS-ETS2-3(MA)	Choose and safely use appropriate measuring tools, hand tools, fasteners, and common hand-held power tools used to construct a prototype.
7	7.MS-PS3-1	Construct and interpret data and graphs to describe the relationships among kinetic energy, mass, and speed of an object.
7	7.MS-ETS3-1(MA)	Explain the function of a communication system and the role of its components, including a source, encoder, transmitter, receiver, decoder, and storage.
7	7.MS-ETS3-3(MA)	Research and communicate information about how transportation systems are designed to move people and goods using a variety of vehicles and devices. Identify and describe subsystems of a transportation vehicle, including structural, propulsion, guidance, suspension, and control subsystems.
7	7.MS-ETS3-5(MA)	Use the concept of systems engineering to model inputs, processes, outputs, and feedback among components of a transportation, structural, or communication system.
8	8.MS-PS1-4	Develop a model that describes and predicts changes in particle motion, relative spatial arrangement, temperature, and state of a pure substance when thermal energy is added or removed.

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GRADE	CODE	STANDARD
8	8.MS-PS2-1	Develop a model that demonstrates Newton's third law involving the motion of two colliding objects.
8	8.MS-PS2-2	Provide evidence that the change in an object's speed depends on the sum of the forces on the object (the net force) and the mass of the object.
8	8.MS-ETS2-5(MA)	Present information that illustrates how a product can be created using basic processes in manufacturing systems, including forming, separating, conditioning, assembling, finishing, quality control, and safety. Compare the advantages and disadvantages of human vs. computer control of these processes.

DIGITAL LITERACY & COMPUTER SCIENCE

9 STANDARDS

Based on the Massachusetts state frameworks

GRADE	CODE	STANDARD
6–8	6-8.CAS.c.1	Describe current events and emerging technologies in computing and the effects they may have on education, the workplace, individuals, communities, and global society.
6–8	6-8.CS.a.4	Identify and describe the use of sensors, actuators, and control systems in an embedded system (e.g., a robot, an e-textile, installation art, smart room).
6–8	6-8.CS.c.2	Model the components of a network, including devices, routers, switches, cables, wires, and transponders.
6–8	6-8.CT.b.1	Design solutions that use repetition and conditionals.
6–8	6-8.CT.b.3	Individually and collaboratively, decompose a problem and create a sub-solution for each of its parts (e.g., video game, robot obstacle course, making dinner).
6–8	6-8.CT.b.4	Recognize that more than one algorithm can solve a given problem.
6–8	6-8.CT.d.3	Create a program, individually and collaboratively, that implements an algorithm to achieve a given goal.
6–8	6-8.CT.d.4	Implement problem solutions using a programming language, including all of the following: looping behavior, conditional statements, expressions, variables, and functions.
6–8	6-8.CT.d.5	Trace programs step-by-step in order to predict their behavior.

SOURCES & NOTES

- The official mathematics, science and computer science standards for Massachusetts, as published by the Massachusetts Department of Elementary and Secondary Education (DESE).
- 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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