

# High School Standards Draft 6.0

## Core Standard Structure

March 2009

## **Introduction:**

This document is the final draft of the Oregon Core Mathematics Content Standards for High School that will be presented to the State Board of Education in April 2009. The draft is based on several principles adopted by the content and assessment panel:

- Consider the mathematics all Oregon students should learn.
- Identify those topics that build on the core foundations of mathematics initiated in the 2007 K-8 Mathematics Content Standards.
- Emphasize the importance of the National Council of Teachers of Mathematics (NCTM) Process Standards and Oregon Essential Skills embedded in a Core Standard Structure.
- Reflect the recommendations of the National Mathematics Advisory Panel.
- Strive for coherence, clarity, and measurability.

This document outlines important mathematics ideas, concepts, skills, and procedures that form the foundation for understanding and learning the subject of mathematics. It provides a framework to bring focus to teaching, learning, and assessing mathematics.

## **Role of Technology:**

The math panel unanimously supported the use of technology as an aid to increase student learning and ultimately prepare students for an increasingly technology-focused work and life environment. However, the panel also agreed that much of mathematics should be developed first without the aid of technology. Therefore, teachers need to be knowledgeable about how technology can support students in learning mathematics without compromising mathematical fluency – number sense, procedural knowledge, and declarative knowledge. We trust that educators will make appropriate choices regarding the use of technology.

## **Process Standards and Essential Skills:**

The math panel recognized the importance of the NCTM Process Standards<sup>1</sup> which must be integrated in a high school mathematics curriculum to ensure that students are equipped with the knowledge and skills necessary to solve problems they will likely face in a variety of contexts. In the table below, these Process Standards – Problem Solving, Reasoning and Proof, Communication, Connections, and Representation – are defined and aligned to the Oregon Essential Skills as follows:

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<sup>1</sup> Principles and Standards for School Mathematics, NCTM, 2000

Process Standards	NCTM Process Standard Definition	Oregon Essential Skills Addressed
<b>Problem Solving</b>	<p>Build new mathematical knowledge through problem solving.</p> <p>Solve problems that arise in mathematics and in other contexts.</p> <p>Apply and adapt a variety of appropriate strategies to solve problems.</p> <p>Monitor and reflect on the process of mathematical problem solving.</p>	<p>Interpret a situation and apply workable mathematical concepts and strategies using appropriate technologies where applicable.</p>
<b>Reasoning and Proof</b>	<p>Recognize reasoning and proof as fundamental aspects of mathematics.</p> <p>Make and investigate mathematical conjectures.</p> <p>Develop and evaluate mathematical arguments and proofs.</p> <p>Select and use various types of reasoning and methods of proof.</p>	<p>Communicate and defend the verified process and solution using pictures, symbols, models, narrative, or other methods.</p>
<b>Communication</b>	<p>Organize and consolidate mathematical thinking through communication.</p> <p>Communicate mathematical thinking coherently and clearly to peers, teachers, and others.</p> <p>Analyze and evaluate the mathematical thinking and strategies of others.</p> <p>Use the language of mathematics to express mathematical ideas precisely.</p>	<p>Communicate and defend the verified process and solution using pictures, symbols, models, narrative, or other methods.</p>
<b>Connections</b>	<p>Recognize and use connections among mathematical ideas.</p> <p>Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.</p> <p>Recognize and apply mathematics in contexts outside of mathematics.</p>	<p>Interpret a situation and apply workable mathematical concepts and strategies using appropriate technologies where applicable.</p>

Process Standards	NCTM Process Standard Definition	Embedded Essential Skills of the Oregon Diploma
<b>Representation</b>	<p>Create and use representations to organize, record, and communicate mathematical ideas.</p> <p>Select, apply, and translate among mathematical representations to solve problems.</p> <p>Use representations to model and interpret physical, social, and mathematical phenomena.</p>	Produce evidence such as graphs, data, or mathematical models to obtain and verify a solution.

**In addition to the process standards, high school students in Oregon will also be expected to:**

Additional Expectations	Oregon Definition	Embedded Essential Skills of the Oregon Diploma
<b>Reflect on one's solution</b>	<p>Interpret a solution within the context of a problem</p> <p>Check the reasonableness of solutions</p> <p>Justify or validate a solution</p> <p>Generalize a solution</p>	<p>Communicate and defend the verified process and solution using pictures, symbols, models, narrative, or other methods.</p> <p>Produce evidence such as graphs, data, or mathematical models to obtain and verify a solution.</p>

# High School - Algebra

It is essential that the high school mathematics content standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations. Students will also be expected to reflect on their solution(s). Every student should understand and use all mathematical concepts and skills from previous grade levels as they apply to these standards.

**H.A.1 Algebra and Numeracy: Develop a deep understanding of real numbers and algebraic symbols by fluently creating, manipulating, computing with, and determining equivalent expressions, both numeric and symbolic.**

- H.A.1.1 Compare, order, and locate real numbers on a number line.
- H.A.1.2 Evaluate, compute with, and determine equivalent numeric and algebraic expressions with real numbers and variables that may also include absolute value, integer exponents, square roots, pi, and/or scientific notation.
- H.A.1.3 Express square roots in equivalent radical form and their decimal approximations when appropriate.
- H.A.1.4 Apply algebraic properties to validate the equivalence of two expressions.
- H.A.1.5 Factor quadratic expressions limited to factoring common monomial terms, perfect-square trinomials, differences of squares, and quadratics of the form  $x^2 + bx + c$  that factor over the integers.

**H.A.2 Algebra: Use linear equations and functions to represent relationships and solve linear equations, linear inequalities, systems of linear equations, and systems of linear inequalities.**

- H.A.2.1 Identify, construct, extend, and analyze linear patterns and functional relationships that are expressed contextually, numerically, algebraically, graphically, in tables, or using geometric figures.
- H.A.2.2 Given a rule, a context, two points, a table of values, a graph, or a linear equation in either slope intercept or standard form, identify the slope, determine the x and/or y intercept(s), and interpret the meaning of each.
- H.A.2.3 Determine the equation of a line given any of the following information: two points on the line, its slope and one point on the line, or its graph. Also, determine an equation of a new line parallel or perpendicular to a given line, through a given point.
- H.A.2.4 Fluently convert among representations of linear relationships given in the form of a graph of a line, a table of values, or an equation of a line in slope-intercept and standard form.

- H.A.2.5 Given a linear function, interpret and analyze the relationship between the independent and dependent variables. Solve for  $x$  given  $f(x)$  or solve for  $f(x)$  given  $x$ .
- H.A.2.6 Analyze how changing the parameters transforms the graph of  $f(x) = mx + b$ .
- H.A.2.7 Write, use, and solve linear equations and inequalities using graphical and symbolic methods. Represent solutions on a coordinate graph or number line.
- H.A.2.8 Solve systems of two linear equations graphically and algebraically, and solve systems of two linear inequalities graphically.

**H.A.3 Algebra: Use quadratic and exponential equations and functions to represent relationships.**

- H.A.3.1 Given a quadratic or exponential function, identify or determine a table or graph.
- H.A.3.2 Given a table or graph that represents a quadratic or exponential function, extend the pattern to make predictions.
- H.A.3.3 Compare the characteristics of and distinguish among linear, quadratic, and exponential functions that are expressed in a table of values, a sequence, a context, algebraically, and/or graphically, and interpret the domain and range of each as it applies to a given context.
- H.A.3.4 Given a quadratic or exponential function, interpret and analyze the relationship between the independent and dependent variables, and evaluate the function for specific values of the domain.
- H.A.3.5 Given a quadratic of the form  $y = x^2 + bx + c$  (or  $f(x) = x^2 + bx + c$ ) with integer roots, determine and interpret the roots, vertex, and the equation for the axis of symmetry graphically and algebraically.

# High School – Geometry

It is essential that the high school mathematics content standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations. Students will also be expected to reflect on their solution(s). Every student should understand and use all mathematical concepts and skills from previous grade levels as they apply to these standards.

## **H.G.1 Geometry: Apply properties of two-dimensional figures.**

- H.G.1.1 Identify, apply, and analyze angle relationships between two or more lines and a transversal to determine if lines are parallel, perpendicular, or neither.
- H.G.1.2 Apply theorems, properties, and definitions to determine, identify, and justify congruency or similarity of triangles and to classify quadrilaterals.
- H.G.1.3 Apply theorems of corresponding parts of congruent and similar figures to determine missing sides and angles of polygons.
- H.G.1.4 Determine the missing dimensions, angles, or area of regular polygons, quadrilaterals, triangles, circles, composite shapes, and shaded regions.
- H.G.1.5 Determine if three given lengths form a triangle. If the given lengths form a triangle, classify it as acute, right, or obtuse.
- H.G.1.6 Use trigonometric ratios (sine, cosine and tangent) and the Pythagorean Theorem to solve for unknown lengths in right triangles.
- H.G.1.7 Apply theorems and properties of chords, tangents, and angles; and theorems and formulas of arcs and sectors to circles.

## **H.G.2 Geometry: Apply properties of three-dimensional solids.**

- H.G.2.1 Identify, classify, model, sketch, and label representations of three-dimensional objects from nets and from different perspectives.
- H.G.2.2 Identify and apply formulas for surface area and volume of spheres; right solids, including rectangular prisms and pyramids; cones; and cylinders; and compositions thereof. Solve related problems.
- H.G.2.3 Identify and apply formulas to solve for the missing dimensions of spheres and right solids, including rectangular prisms and pyramids, cones, and cylinders, both numerically and symbolically.

**H.G.3 Geometry: Transform and analyze figures.**

- H.G.3.1 Recognize and identify line and rotational symmetry of two-dimensional figures.
- H.G.3.2 Identify and perform single and composite transformations of geometric figures in a plane, including translations, origin-centered dilations, and reflections across either axis or  $y = \pm x$ , and rotations about the origin in multiples of  $90^\circ$ .
- H.G.3.3 Apply a scale factor to determine similar two- and three-dimensional figures, and compare and compute their respective areas and volumes.
- H.G.3.4 Apply slope, distance, and midpoint formulas to solve problems in a coordinate plane.

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# High School – Statistics

It is essential that the high school mathematics content standards be addressed in contexts that promote problem solving, reasoning, communication, making connections, and designing and analyzing representations. Students will also be expected to reflect on their solution(s). Every student should understand and use all mathematical concepts and skills from previous grade levels as they apply to these standards.

## **H.PS.1** Data Analysis: **Analyze and interpret empirical data.**

- H.PS.1.1 Determine appropriate survey methods, analyze the strengths and limitations of a particular survey, observational study, experiment, or simulation, and the display of its data.
- H.PS.1.2 Evaluate data-based reports by considering the source of the data, the design of the study, and the way the data was analyzed and displayed.
- H.PS.1.3 Compare and draw conclusions about two or more data sets using graphical displays or central tendencies and range.
- H.PS.1.4 Use or construct a scatter plot for a given data set, determine whether there is a(n) linear, quadratic, exponential, or no trend. If linear, determine if there is a positive or negative correlation among the data; and, if appropriate, sketch a line of best fit, and use it to make predictions.
- H.PS.1.5 Construct, analyze, and interpret tables, scatter plots, frequency distributions, and histograms of data sets.

## **H.PS.2** Probability: **Apply basic principles of probability.**

- H.PS.2.1 Identify, analyze, and use both experimental and theoretical probability to estimate and calculate the probability of simple events.
- H.PS.2.2 Determine the sample space of a probability experiment.
- H.PS.2.3 Compute and interpret probabilities for independent, dependent, complementary, and compound events using various methods (e.g., diagrams, tables, area models, and counting techniques).