

**NCTM Curriculum Standards  
for Secondary Mathematics**

High School

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## **Standard 1: Mathematics as Problem Solving**

In grades 6 – 12, the mathematics should include the refinement and extension of methods of mathematical problem solving so that all students can –

- use, with increasing confidence, problem-solving approaches to investigate and understand mathematical content;
- apply integrated mathematical problem-solving strategies to solve problems from within and outside mathematics;
- recognize and formulate problems from situations within and outside mathematics;
- apply the process of mathematical modeling to real-world problem situations.

## **Standard 2: Mathematics as Communication**

In grades 6 – 12, the mathematics curriculum should include the continued development of language and symbolism to communicate mathematical ideas so that all students can --

- reflect upon and clarify their thinking about mathematical ideas and relationships;
- formulate mathematical definitions and express generalizations discovered through investigations;
- express mathematical ideas orally and in writing;
- read written presentations of mathematics with understanding;
- ask clarifying and extending questions related to mathematics they have read or heard about;
- appreciate the economy, power, and elegance of mathematical notation and its role in the development of mathematical ideas.

## **Standard 3: Mathematics as Reasoning**

In grades 6 – 12, the mathematics curriculum should include numerous and varied experiences that reinforce and extend logical reasoning skills so that all students can –

- make and test conjectures;
  - formulate counterexamples;
  - follow logical arguments;
  - judge the validity of arguments;
  - construct simple valid arguments;
- and so that, in addition, college-intending students can –
- construct proofs for mathematical assertions, including indirect proofs and proofs by mathematical induction.

#### **Standard 4: Mathematical Connections**

In grades 6 – 12, the mathematics curriculum should include the investigation of the connections and interplay among various mathematical topics and their application so that all students can –

- recognize equivalent representations of the same concept;
- relate procedures in one representation to procedures in an equivalent representation;
- use and value the connections among mathematical topics;
- use and value the connections between mathematics and other disciplines.

#### **Standard 5: Algebra**

In grades 6 – 12, the mathematics curriculum should include the continued study of algebraic concepts and methods so that all students can –

- represent situations that involve variable quantities with expressions, equations, inequalities and matrices;
  - use tables and graphs as tools to interpret expressions, equations, and inequalities;
  - operate on expressions and matrices, and solve equations and inequalities;
  - appreciate the power of mathematical abstraction and symbolism;
- and so that, in addition, college-intending students can –
- use matrices to solve linear systems;
  - demonstrate technical facility with algebraic transformations, including techniques based on the theory of equations.

#### **Standard 6: Functions**

In grades 6 – 12, the mathematics curriculum should include the continued study of functions so that all students can –

- model real-world phenomena with a variety of functions;
  - represent and analyze relationships using tables, verbal rules, equations, and graphs;
  - translate among tabular, symbolic, and graphical representation of functions;
  - recognize that a variety of problem situations can be modeled by the same type of function;
  - analyze the effects of parameter changes on the graphs of functions;
- and so that , in addition, college-intending students can –
- understand operations on, and the general properties and behavior of, classes of functions.

### **Standard 7: Geometry from a Synthetic Perspective**

In grades 6–12, the mathematics curriculum should include the continued study of the geometry of two and three dimensions so that all students can –

- interpret and draw three-dimensional objects;
- represent problem situations with geometric models and apply properties of figures;
- classify figures in terms of congruence and similarity and apply these relationships;
- deduce properties of, and relationships between, figures from given assumptions; and so that, in addition, college-intending students can –
- develop an understanding of an axiomatic system through investigating and comparing various geometries.

### **Standard 8: Geometry from an Algebraic Perspective**

In grades 6 – 12, the mathematics curriculum should include the study of the geometry of two and three dimensions from an algebraic point of view so that all students can –

- translate between synthetic and coordinate representations;
- deduce properties of figures using transformations and using coordinates;
- identify congruent and similar figures using transformations;
- analyze properties in Euclidean transformations and relate translations to vectors; and so that, in addition, college-intending students can –
- deduce properties of figures using vectors;
- apply transformations, coordinates, and vectors in problem-solving

### **Standard 9: Trigonometry**

In grades 6 – 12, the mathematics curriculum should include the study of trigonometry so that all students can –

- apply trigonometry to problem situations involving triangles;
- explore periodic real-world phenomena using the sine and cosine functions; and so that, in addition, college-intending students can –
- understand the connection between trigonometric and circular functions;
- use circular functions to model periodic real-world phenomena;
- apply general graphing techniques to trigonometric identities;
- understand the connections between trigonometric functions and polar coordinates, complex numbers and series.

### **Standard 10: Statistics**

In grades 6 – 12, the mathematics curriculum should include the continued study of data analysis and statistics so that all students can –

- construct and draw inferences from charts, tables, and graphs that summarize data from real-world situations;
- use curve fitting to predict from data;
- understand and apply measures of central tendency, variability, and correlation;
- understand sampling and recognize its role in statistical claims;
- design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the outcomes;
- analyze the effects of data transformations on measures of central tendency and variability;

and so that, in addition, college-intending students can –

- transform data to aid in data interpretation and prediction;
- test hypothesis using appropriate statistics.

### **Standard 11: Probability**

In grades 6 – 12, the mathematics curriculum should include the continued study of probability so that all students can –

- use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty;
- use simulations to estimate probabilities;
- understand the concept of a random variable;
- create and interpret discrete probability distributions;
- describe, in general terms, the normal curve and use its properties to answer questions about sets of data that are assumed to be normally distributed;

and so that, in addition, college-intending students can—

- apply the concept of a random variable to generate and interpret probability distributions including binomial uniform, normal, and chi square.

### **Standard 12: Discrete Mathematics**

In grades 6 – 12, the mathematics curriculum should include topics from discrete mathematics so that all students can –

- represent problem situations using discrete structures such as finite graphs, matrices sequences, and recurrence relations;
- represent and analyze finite graphs using matrices;
- develop and analyze algorithms;
- solve enumeration and finite probability problems;

and so that, in addition, college-intending students can—

- represent and solve problems using linear programming and difference equations;
- investigate problem situations that arise in connection with computer validation and the application of algorithms.

### **Standard 13: Conceptual Underpinnings of Calculus**

In grades 6 – 12, the mathematics curriculum should include the informal exploration of calculus concepts from both a graphical and a numerical perspective so that all students can—

- determine maximum and minimum points of a graph and interpret the results in problem situations;
- investigate limiting processes by examining infinite sequences and series and areas under curves;  
and so that, in addition, college-intending students can –
- understand the conceptual foundations of limit, the area under a curve, the rate of change, and the slope of a tangent line, and their applications in other disciplines;
- analyze the graphs of polynomial, rational, radical, and transcendental functions.

### **Standard 14: Mathematical Structure**

In grades 6 – 12, the mathematics curriculum should include the study of mathematical structure so that all students can –

- compare and contrast the real number system and its various subsystems with regard to their structural characteristics;
- understand the logic of algebraic procedures;
- appreciate that seemingly different mathematical systems may be essentially the same;  
and so that, in addition, college-intending students can –
- develop the complex number system and demonstrate facility with its operations;
- prove elementary theorems within various mathematical structures, such as groups and fields;
- develop an understanding of the nature and purpose of axiomatic systems.