# Michigan • Mathematics

**DOCUMENTS REVIEWED**

*Mathematics Grade Level Content Expectations v.12.05.* March 2006.
Accessed from: http://www.michigan.gov/documents/MathGLCE_140486_7.pdf

*Algebra I (v.09.09) and II (v.11.07), Geometry (v.11.07), and Pre-Calculus.*
Accessed from: http://www.michigan.gov/mde/0,1607,7-140-38924_41644_42668---,00.html

## Overview

Michigan's standards are well organized and clearly written. They cover much of the essential content with both depth and rigor, particularly in high school. Elementary school has many excellent features, but some of the basics for whole-number arithmetic are missing.

**GRADE**

**A-**

| | |
|---|---|
| Clarity and Specificity: | 3/3 |
| Content and Rigor: | 6/7 |
| **Total State Score:** | **9/10** |

*(Common Core Grade: A-)*

## General Organization

The K-8 standards are organized into five content strands such as Algebra and Geometry. The strands are divided into three or four domains, which are further organized by topics, then into grade-level expectations. Not all domains or strands appear in each grade. For example, the Algebra strand does not appear until sixth grade.

The high school standards are organized by course. Within each course the standards are organized similarly to K-8 but with different strands, domains, and topics.

## Clarity and Specificity

The standards are well organized and easy to read and understand. They are stated clearly and succinctly, for example:

Add and subtract money in dollars and cents (grade 3)

Locate tenths and hundredths on a number line (grade 4)

Express fractions and decimals as percentages and vice versa (grade 5)

Convert ratio quantities between different systems of units, such as feet per second to miles per hour (grade 7)

While the succinctness of the standards results in many per grade—fifty-five in fourth grade alone—breaking the standards down into these discrete small bites generally serves to add to specificity rather than detract from clarity.

In high school, particularly in the generally rigorous Algebra I, some standards are either too vague or too general to give proper guidance, for example:

Identify and interpret the key features of a function from its graph or its formula(s) (high school)

Write the general symbolic forms that characterize each family of functions (high school)

Identify the family of function best suited for modeling a given real-world situation (high school)

It is not clear what students are expected to know or what kinds of problems they should be able to solve.

Though not all standards are clear, Michigan's grade-level expectations are generally well organized and easy to read and interpret. They provide solid guidance to users about the content and skills students must master and therefore merit three points out of three for Clarity and Specificity (see *Common Grading Metric,* Appendix A).

## Content and Rigor

*Content Priorities*

The majority of the standards in elementary grades are focused on arithmetic. This appropriately prioritizes arithmetic, which should be the foundation of elementary- and middle-school mathematics.

*Content Strengths*

Michigan's standards include most of the essential content. Many of the K-8 standards, in particular, give excellent guidance on the mathematical content that students must master. The number line appears early and is included throughout. The development of fractions is notably strong. In fourth grade, two topics are "Understand Fractions" and "Add and Subtract Fractions." In fifth grade, the often neglected topic of common denominators appears explicitly under the topic "Add and Subtract Fractions Using Common Denominators." Also, the concept of fractions as division is made explicit with:

> Understand a fraction as a statement of division (grade 5)

The invert and multiply formula for the division of fractions is done better than in most textbooks:

> Understand division of fractions as the inverse of multiplication, e.g., if $4/5 \div 2/3 = \square$, then $2/3 \cdot \square = 4/5$, so $\square = 4/5 \cdot 3/2$ $=12/10$ (grade 6)

The development of area is also strong, including, for example, the following standards:

> Know the definition of area and perimeter and calculate the perimeter of a square and rectangle given whole-number side lengths (grade 3)

> Use square units in calculating area by covering the region and counting the number of square units (grade 3)

> Know and understand the formulas for perimeter and area of a square and a rectangle; calculate the perimeters and areas of these shapes and combinations of these shapes using the formulas (grade 4)

The standards for high school are often well stated and rigorous, including most STEM-ready standards.

Linear equations are well covered. In this Algebra I example, linear equations' various forms and the ability to convert between them are made explicit:

> Write the symbolic forms of linear functions (standard, point-slope, and slope-intercept) given appropriate information and convert between forms (high school)

The geometry standards are excellent. Not only do they include proofs, they set up the foundation for geometry with:

> Recognize Euclidean geometry as an axiom system. Know the key axioms and understand the meaning of and distinguish between undefined terms, axioms, definitions, and theorems (high school)

In addition, important facets of quadratic equations are stated clearly:

> Convert quadratic functions from standard to vertex form by completing the square (high school)
> Express quadratic functions in vertex form to identify their maxima or minima and in factored form to identify their zeros (high school)

*Content Weaknesses*

Michigan does not develop the foundation for whole-number arithmetic sufficiently. The standards do not adequately specify that students have automaticity, or quick recall, of basic number facts. These are the basic building blocks for future mathematics; students who are still struggling with basic facts are not prepared to move on to the next level of mathematics.

Moreover, students are expected to know, not necessarily instantly recall, only the facts for addition. The others they can solve for or find. Students should not be struggling with basic number facts as they continue on to more difficult mathematics.

The standards do call for fluency with basic whole-number operations, but they do not adequately include standard methods and procedures. For example, the following second-grade standard mentions strategies and algorithms, but does not specify what algorithms are to be used:

> Add fluently two numbers through 99, using strategies including formal algorithms; subtract fluently two numbers through 99 (grade 2)

High school covers much mathematics with both depth and rigor. In elementary school, arithmetic is appropriately prioritized, and fluency is required, but the standards do not support the standard algorithms. This minor problem results in a Content and Rigor score of six points out of seven (see *Common Grading Metric*, Appendix A).

### The Bottom Line

With some minor differences, Common Core and Michigan both cover the essential content for a rigorous K-12 mathematics program. That said, Michigan's standards are exceptionally clear and well presented. Standards are briefly stated and sometimes clarified with the use of examples, making them easier to read and follow than Common Core. In addition, the high school content is organized so that standards addressing specific topics, such as quadratic functions, are grouped together in a mathematically coherent way. The organization of the Common Core is more difficult to navigate, in part because standards dealing with related topics sometimes appear separately rather than together.

The chief weakness in Michigan's standards stems from their lack of specific content expectations in the development of arithmetic. Common Core provides admirable focus and explicitly requires standard methods and procedures, and the inclusion of those essential details would enhance Michigan's standards.