MATHEMATICS

GRADE LEVEL CONTENT EXPECTATIONS v.12.05

MICHIGAN Department of Education

Office of School Improvement

www.michigan.gov/mde

JENNIFER M. GRANHOLM
GOVERNOR

MICHAEL P. FLANAGAN
SUPERINTENDENT OF
PUBLIC INSTRUCTION

March 2006

Dear Michigan Educators:

The Michigan Department of Education is pleased to announce the publication of *Version 12.05* of Michigan's Grade Level Content Expectations in English Language Arts and Mathematics. This edition reflects the feedback received from educators across the state. We can all take pride in this newly revised document. The revision process exemplifies Michigan educators' continued commitment to excellence and the collaboration between the field and the Office of School Improvement.

The Grade Level Content Expectations provide educators with clearly defined statements of what all students should know and be able to do as they progress from kindergarten through eighth grade. Serving as a guide, these expectations support educators as they create exciting and engaging classrooms where students attain the highest standards.

We encourage you to celebrate all that has been accomplished during the past year to support the implementation of the Grade Level Content Expectations within the state. We invite you to make the Michigan Department of Education's Office of School Improvement a partner within your professional learning community. The power of the expectations is in the conversations they will generate. Together, we can prepare our young people to have fulfilling and successful lives in the global community in which they will live.

Thank you for your continued efforts to make Michigan a place where our students have increasingly more opportunities to succeed.

Sincerely,

Mike Flanagan

STATE BOARD OF EDUCATION

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608 WEST ALLEGAN STREET • P.O. BOX 30008 • LANSING, MICHIGAN 48909
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Clarification of the Revision of the 6.04 Version to 12.05

An Overview

The 12.05 edition of Michigan's Grade Level Content Expectations was developed by members of the original advisory and editing team, and reflects the feedback received from educators across the state during the past year. This new version refines and clarifies the original expectations, while preserving their essence and original intent.

As a result of this revision process version 12.05 provides Michigan's educators with a more teacher-friendly resource. The process greatly improved the continuity from one grade to the next and better ensured coherence both in content and pedagogy.

Types of Changes Made

- Parallel text across the grades
- Continuity in wording
- Clarity in the intent of the expectations
- Accuracy in concepts and language
- Proper flow of concepts and skills across the grades—no repetitions or gaps
- Merging of like expectations
- Recoding of some expectations

As you examine each of the expectations in this document, you will find that the majority of content revisions are minor. Expectations that were recoded are notated in the *Across the Grades K-8 v.12.05* companion document and are also documented in the chart below.

The Office of School Improvement encourages local and intermediate school districts to continue the stellar work they have begun over the past year supporting the implementation of the Grade Level Expectations. The resources that have been generated and shared throughout the state are a wonderful example of Michigan educators' commitment and dedication to help students attain the concepts and skills necessary to meet these expectations and prepare students for promising futures.

Expectations that were recoded in Mathematics

CODE IN v.6.04	CODE IN v.12.05	CODE IN v.6.04	CODE IN v.12.05
Second Grade		**Sixth Grade**	
N.FL.02.17	N.MR.02.17	N.FL.06.13	N.MR.06.13
G.GS.02.03	M.TE.02.11	**Seventh Grade**	
Fourth Grade		N.ME.07.01/N.FL.07.02	N.MR.07.02
N.FL.04.14	N.MR.04.14	**Eighth Grade**	
N.MR.04.24	N.ME.04.24	N.MR.08.11	N.FL.08.11
N.FL.04.28	N.MR.04.28	D.AN.08.07	Removed
N.MR.04.37	Removed	In the ***Mathematics Across the Grades K-8 v.12.05*** companion document the revised expectations are in italics.	
Fifth Grade			
N.MR.05.05	N.FL.05.05		
N.FL.05.12	N.ME.05.12		
N.FL.05.13	N.MR.05.13		

GRADE LEVEL CONTENT EXPECTATIONS

K MATH

v.12.05

NUMBER & OPERATIONS

ALGEBRA

MEASUREMENT

GEOMETRY

DATA & PROBABILITY

Welcome to Michigan's K-8 Grade Level Content Expectations

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The Grade Level Content Expectations build from the Michigan Curriculum Framework and its Teaching and Assessment Standards. Reflecting best practices and current research, they provide a set of clear and rigorous expectations for all students and provide teachers with clearly defined statements of what students should know and be able to do as they progress through school.

Why Create a 12.05 Version of the Expectations?

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Assessment

The Grade Level Content Expectations document is intended to be a state assessment tool with the expectations written to convey expected performances by students. The Office of Assessment and Accountability was involved in the development of version 12.05 and has incorporated the changes in the construction of test and item specifications for the K-8 Michigan Education Assessment Program (MEAP) and MI-Access. This updated version will assist us in the creation of companion documents, content examples, and to guide program planners in focusing resources and energy.

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Curriculum

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Understanding the Organizational Structure

The expectations in this document are divided into strands with multiple domains within each, as shown below. The skills and content addressed in these expectations will in practice be woven together into a coherent, Mathematics curriculum. The domains in each mathematics strand are broader, more conceptual groupings. In several of the strands, the "domains" are similar to the "standards" in Principles and Standards for School Mathematics from the National Council of Teachers of Mathematics.

To allow for ease in referencing expectations, each expectation has been coded with a strand, domain, grade-level, and expectation number. For example, **M.UN.00.01** indicates:

> **M** - Measurement strand
>
> **UN** - Units & systems of measurement domain of the Measurement strand
>
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>
> **01** - First Expectation in the Grade-Level view of the Measurement strand

Strand 1 <u>N</u>umber & Operations	Strand 2 <u>A</u>lgebra	Strand 3 <u>M</u>easurement	Strand 4 <u>G</u>eometry	Strand 5 Data and <u>P</u>robability
Domains				
Meaning, notation, place value, and comparisons (ME) Number relationships and meaning of operations (MR) Fluency with operations and estimation (FL)	Patterns, relations, functions, and change (PA) Representation (RP) Formulas, expressions, equations, and inequalities (RP)	Units and systems of measurement (UN) Techniques and formulas for measurement (TE) Problem solving involving measurement (PS)	Geometric shape, properties, and mathematical arguments (GS) Location and spatial relationships (LO) Spatial reasoning and geometric modeling (SR) Transformation and symmetry (TR)	Data representation (RE) Data interpretation and analysis (AN) Probability (PR)

Preparing Students for Academic Success

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Through the collaborative efforts of Michigan educators and creation of professional learning communities, we can enable our young people to attain the highest standards, and thereby open doors for them to have fulfilling and successful lives.

NUMBER AND	**Count, write, and order numbers**
OPERATIONS	**N.ME.00.01** *Count objects in sets up to 30.**

N.ME.00.02 Use one-to-one correspondence to compare and order sets of objects to 30 using phrases such as "same number", "more than", or "less than"; use counting and matching.

N.ME.00.03 Compare and order numbers to 30 using phrases such as "more than" or "less than."

N.ME.00.04 *Read and write numbers to 30 and connect them to the quantities they represent.**

N.ME.00.05 Count orally to 100 by ones. Count to 30 by 2's, 5's and 10's using grouped objects as needed.

Compose and decompose numbers

N.ME.00.06 Understand the numbers 1 to 30 as having one, or two, or three groups of ten and some ones. Also count by tens with objects in ten-groups to 100.

N.MR.00.07 *Compose and decompose numbers from 2 to 10, e.g., 5 = 4 + 1 = 2 + 3, with attention to the additive structure of number systems, e.g., 6 is one more than 5, 7 is one more than 6.**

N.MR.00.08 Describe and make drawings to represent situations/stories involving putting together and taking apart for totals up to 10; use finger and object counting.

Add and subtract numbers

N.MR.00.09 Record mathematical thinking by writing simple addition and subtraction sentences, e.g., 7 + 2 = 9, 10 - 8 = 2.

Explore number patterns

N.MR.00.10 Create, describe, and extend simple number patterns.

MEASUREMENT   **Explore concepts of time**

M.UN.00.01 Know and use the common words for the parts of the day (morning, afternoon, evening, night) and relative time (yesterday, today, tomorrow, last week, next year).

M.TE.00.02 Identify tools that measure time (clocks measure hours and minutes; calendars measure days, weeks, and months).

M.UN.00.03 Identify daily landmark times to the nearest hour (lunchtime is 12 o'clock; bedtime is 8 o'clock).

Explore other measurement attributes

M.UN.00.04 Compare two or more objects by length, weight and capacity, e.g., which is shorter, longer, taller?

M.PS.00.05 Compare length and weight of objects by comparing to reference objects, and use terms such as shorter, longer, taller, lighter, heavier.

GEOMETRY   **Create, explore, and describe shapes**

G.GS.00.01 Relate familiar three-dimensional objects inside and outside the classroom to their geometric name, e.g., ball/sphere, box/cube, soup can/cylinder, ice cream cone/cone, refrigerator/prism.

G.GS.00.02 Identify, sort, and classify objects by attribute and identify objects that do not belong in a particular group.

Explore geometric patterns

G.GS.00.03 Create, describe, and extend simple geometric patterns.

* revised expectations in italics

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GRADE LEVEL CONTENT EXPECTATIONS

1
MATH
v.12.05

NUMBER & OPERATIONS

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Welcome to Michigan's K-8 Grade Level Content Expectations

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NUMBER AND	**Count, write, and order numbers**
OPERATIONS	**N.ME.01.01** Count to 110 by 1's, 2's, 5's, and 10's, starting from any number in the sequence; count to 500 by 100's and 10's; use ordinals to identify position in a sequence, e.g., 1st, 2nd, 3rd.

Count, write, and order numbers

N.ME.01.01 Count to 110 by 1's, 2's, 5's, and 10's, starting from any number in the sequence; count to 500 by 100's and 10's; use ordinals to identify position in a sequence, e.g., 1st, 2nd, 3rd.

N.ME.01.02 Read and write numbers to 110 and relate them to the quantities they represent.

N.ME.01.03 Order numbers to 110; compare using phrases such as "same as", "more than", "greater than", "fewer than"; use = symbol. Arrange small sets of numbers in increasing or decreasing order, e.g., write the following from smallest to largest: 21, 16, 35, 8.

N.ME.01.04 Identify one more than, one less than, 10 more than, and 10 less than for any number up to 100.

N.ME.01.05 Understand that a number to the right of another number on the number line is bigger and that a number to the left is smaller.

N.ME.01.06 Count backward by 1's starting from any number between 1 and 100.

Explore place value

N.ME.01.07 *Compose and decompose numbers through 30, including using bundles of tens and units, e.g., recognize 24 as 2 tens and 4 ones, 10 and 10 and 4, 20 and 4, and 24 ones.**

Add and subtract whole numbers

N.ME.01.08 List number facts (partners inside of numbers) for 2 through 10, e.g., $8 = 7 + 1 = 6 + 2 = 5 + 3 = 4 + 4$; $10 = 8 + 2 = 2 + 8$.

N.MR.01.09 Compare two or more sets in terms of the difference in number of elements.

N.MR.01.10 *Model addition and subtraction for numbers through 30 for a given contextual situation using objects or pictures; explain in words; record using numbers and symbols; solve.**

N.MR.01.11 Understand the inverse relationship between addition and subtraction, e.g., subtraction "undoes" addition: if $3 + 5 = 8$, we know that $8 - 3 = 5$ and $8 - 5 = 3$; recognize that some problems involving combining, "taking away," or comparing can be solved by either operation.

N.FL.01.12 Know all the addition facts up to $10 + 10$, and solve the related subtraction problems fluently.

N.MR.01.13 Apply knowledge of fact families to solve simple open sentences for addition and subtraction, such as: $\square + 2 = 7$ and $10 - \square = 6$.

N.FL.01.14 Add three one-digit numbers.

N.FL.01.15 Calculate mentally sums and differences involving: a two-digit number and a one-digit number without regrouping; a two-digit number and a multiple of 10.

N.FL.01.16 *Compute sums and differences through 30 using number facts and strategies, but no formal algorithm.**

MEASUREMENT · **Estimate and measure length**

M.UN.01.01 Measure the lengths of objects in non-standard units, e.g., pencil lengths, shoe lengths, to the nearest whole unit.

M.UN.01.02 Compare measured lengths using the words shorter, shortest, longer, longest, taller, tallest, etc.

*revised expectations in italics

MEASUREMENT	**Tell time**

M.UN.01.03 Tell time on a twelve-hour clock face to the hour and half-hour.

Work with money

M.UN.01.04 Identify the different denominations of coins and bills.

M.UN.01.05 Match one coin or bill of one denomination to an equivalent set of coins/bills of other denominations, e.g., 1 quarter = 2 dimes and 1 nickel.

M.UN.01.06 Tell the amount of money: in cents up to $1, in dollars up to $100. Use the symbols $ and ¢.

M.PS.01.07 Add and subtract money in dollars only or in cents only.

Solve problems

M.PS.01.08 Solve one-step word problems using addition and subtraction of length, money and time, including "how much more/less", without mixing units.

GEOMETRY	**Create and describe shapes**

G.GS.01.01 Create common two-dimensional and three-dimensional shapes, and describe their physical and geometric attributes, such as color and shape.

G.LO.01.02 Describe relative position of objects on a plane and in space, using words such as above, below, behind, in front of.

Create and describe patterns involving geometric objects

G.SR.01.03 Create and describe patterns, such as repeating patterns and growing patterns using number, shape, and size.

G.SR.01.04 Distinguish between repeating and growing patterns.

G.SR.01.05 Predict the next element in a simple repeating pattern.

G.SR.01.06 Describe ways to get to the next element in simple repeating patterns.

DATA AND	**Use pictographs**
PROBABILITY	

D.RE.01.01 Collect and organize data to use in pictographs.

D.RE.01.02 Read and interpret pictographs.

D.RE.01.03 Make pictographs of given data using both horizontal and vertical forms of graphs; scale should be in units of one and include symbolic representations, e.g., ☺ represents one child.

GRADE LEVEL CONTENT EXPECTATIONS

2 MATH

v.12.05

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NUMBER AND	**Count, write, and order whole numbers**
OPERATIONS	

N.ME.02.01 Count to 1000 by 1's, 10's and 100's starting from any number in the sequence.

N.ME.02.02 Read and write numbers to 1000 in numerals and words, and relate them to the quantities they represent.

N.ME.02.03 Compare and order numbers to 1000; use the symbols > and <.

N.ME.02.04 *Count orally by 3's and 4's starting with 0, and by 2's, 5's, and 10's starting from any whole number.**

Understand place value

N.ME.02.05 *Express numbers through 999 using place value, e.g., 137 is 1 hundred, 3 tens, and 7 ones; use concrete materials.**

Add and subtract whole numbers

N.FL.02.06 Decompose 100 into addition pairs, e.g., 99 + 1, 98 + 2…

N.MR.02.07 Find the distance between numbers on the number line, e.g., how far is 79 from 26?

N.MR.02.08 Find missing values in open sentences, e.g., 42 + □ = 57; use relationship between addition and subtraction.

N.MR.02.09 *Given a contextual situation that involves addition and subtraction using numbers through 99: model using objects or pictures; explain in words; record using numbers and symbols; solve.**

N.FL.02.10 *Add fluently two numbers through 99, using strategies including formal algorithms; subtract fluently two numbers through 99.**

N.FL.02.11 *Estimate the sum of two numbers with three digits.**

N.FL.02.12 Calculate mentally sums and differences involving: three-digit numbers and ones; three-digit numbers and tens; three-digit numbers and hundreds.

Understand meaning of multiplication and division

N.MR.02.13 Understand multiplication as the result of counting the total number of objects in a set of equal groups, e.g., 3 × 5 gives the number of objects in 3 groups of 5 objects, or 3 × 5 = 5 + 5 + 5 = 15.

N.MR.02.14 Represent multiplication using area and array models.

N.MR.02.15 Understand division (÷) as another way of expressing multiplication, using fact families within the 5 × 5 multiplication table; emphasize that division "undoes" multiplication, e.g., 2 × 3 = 6 can be rewritten as 6 ÷ 2 = 3 or 6 ÷ 3 = 2.

N.MR.02.16 *Given a situation involving groups of equal size or of sharing equally, represent with objects, words, and symbols; solve.**

N.MR.02.17 *Develop strategies for fluently multiplying numbers up to 5 x 5.**

Work with unit fractions

N.ME.02.18 Recognize, name, and represent commonly used unit fractions with denominators 12 or less; model $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ by folding strips.

N.ME.02.19 Recognize, name, and write commonly used fractions: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$.

N.ME.02.20 Place 0 and halves, e.g., $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, on the number line; relate to a ruler.

N.ME.02.21 For unit fractions from $\frac{1}{12}$ to $\frac{1}{2}$ understand the inverse relationship between the size of a unit fraction and the size of the denominator; compare unit fractions from $\frac{1}{12}$ to $\frac{1}{2}$.

N.ME.02.22 Recognize that fractions such as $\frac{2}{2}$, $\frac{3}{3}$, and $\frac{4}{4}$ are equal to the whole (one).

*revised expectations in italics

MEASUREMENT	**Measure, add, and subtract length**

M.UN.02.01 Measure lengths in meters, centimeters, inches, feet, and yards approximating to the nearest whole unit and using abbreviations: cm, m, in, ft, yd.

M.PS.02.02 Compare lengths; add and subtract lengths (no conversion of units).

Understand the concept of area

M.UN.02.03 Measure area using non-standard units to the nearest whole unit.

M.TE.02.04 Find the area of a rectangle with whole number side lengths by covering with unit squares and counting, or by using a grid of unit squares; write the area as a product.

Tell time and solve time problems

M.UN.02.05 Using both A.M. and P.M., tell and write time from the clock face in 5 minute intervals and from digital clocks to the minute; include reading time: 9:15 as nine-fifteen and 9:50 as nine-fifty. Interpret time both as minutes after the hour and minutes before the next hour, e.g., 8:50 as eight-fifty and ten to nine. Show times by drawing hands on clock face.

M.UN.02.06 Use the concept of duration of time, e.g., determine what time it will be half an hour from 10:15.

Record, add and subtract money

M.UN.02.07 Read and write amounts of money using decimal notations, e.g., $1.15.

M.PS.02.08 Add and subtract money in mixed units, e.g., $2.50 + 60 cents and $5.75 - $3, but not $2.50 + $3.10.

Read thermometers

M.UN.02.09 Read temperature using the scale on a thermometer in degrees Fahrenheit.

Solve measurement problems

M.PS.02.10 Solve simple word problems involving length and money.

M.TE.02.11 *Determine perimeters of rectangles and triangles by adding lengths of sides, recognizing the meaning of perimeter.**

GEOMETRY	**Identify and describe shapes**

G.GS.02.01 Identify, describe, and compare familiar two-dimensional and three-dimensional shapes, such as triangles, rectangles, squares, circles, semi-circles, spheres, and rectangular prisms.

G.GS.02.02 Explore and predict the results of putting together and taking apart two-dimensional and three-dimensional shapes.

G.GS.02.04 Distinguish between curves and straight lines and between curved surfaces and flat surfaces.

G.SR.02.05 Classify familiar plane and solid objects, e.g., square, rectangle, rhombus, cube, pyramid, prism, cone, cylinder, and sphere, by common attributes such as shape, size, color, roundness, or number of corners and explain which attributes are being used for classification.

G.TR.02.06 Recognize that shapes that have been slid, turned, or flipped are the same shape, e.g., a square rotated 45° is still a square.

revised expectations in italics

Use coordinate systems

G.LO.02.07 Find and name locations using simple coordinate systems such as maps and first quandrant grids.

DATA AND PROBABILITY

Create, interpret, and solve problems involving pictographs

D.RE.02.01 Make pictographs using a scale representation, using scales where symbols equal more than one.

D.RE.02.02 Read and interpret pictographs with scales, using scale factors of 2 and 3.

D.RE.02.03 Solve problems using information in pictographs; include scales such as each ■ represents 2 apples; avoid ■ cases.

GRADE LEVEL CONTENT EXPECTATIONS

3 MATH

v.12.05

NUMBER & OPERATIONS

ALGEBRA

MEASUREMENT

GEOMETRY

DATA & PROBABILITY

Welcome to Michigan's K-8 Grade Level Content Expectations

Purpose & Overview

In 2004, the Michigan Department of Education embraced the challenge of creating Grade Level Content Expectations in response to the federal No Child Left Behind Act of 2001. This act mandated the existence of a set of comprehensive state grade level assessments that are designed based on rigorous grade level content.

In this global economy, it is essential that Michigan students possess personal, social, occupational, civic, and quantitative literacy. Mastery of the knowledge and essential skills defined in Michigan's Grade Level Content Expectations will increase students' ability to be successful academically, contribute to the future businesses that employ them and the communities in which they choose to live.

The Grade Level Content Expectations build from the Michigan Curriculum Framework and its Teaching and Assessment Standards. Reflecting best practices and current research, they provide a set of clear and rigorous expectations for all students and provide teachers with clearly defined statements of what students should know and be able to do as they progress through school.

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MICHIGAN Department of Education
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M - Measurement strand

UN - Units & systems of measurement domain of the Measurement strand

00 - Kindergarten Expectation

01 - First Expectation in the Grade-Level view of the Measurement strand

Strand 1 **Number & Operations**	Strand 2 **Algebra**	Strand 3 **Measurement**	Strand 4 **Geometry**	Strand 5 **Data and Probability**
Domains				
Meaning, notation, place value, and comparisons (ME) Number relationships and meaning of operations (MR) Fluency with operations and estimation (FL)	Patterns, relations, functions, and change (PA) Representation (RP) Formulas, expressions, equations, and inequalities (RP)	Units and systems of measurement (UN) Techniques and formulas for measurement (TE) Problem solving involving measurement (PS)	Geometric shape, properties, and mathematical arguments (GS) Location and spatial relationships (LO) Spatial reasoning and geometric modeling (SR) Transformation and symmetry (TR)	Data representation (RE) Data interpretation and analysis (AN) Probability (PR)

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NUMBER AND

OPERATIONS

Understand and use number notation and place value

N.ME.03.01 Read and write numbers to 10,000 in both numerals and words, and relate them to the quantities they represent, e.g., relate numeral or written word to a display of dots or objects.

N.ME.03.02 *Identify the place value of a digit in a number, e.g., in 3,241, 2 is in the hundreds place. Recognize and use expanded notation for numbers using place value through 9,999, e.g., 2,517 is 2000+ 500+10+ 7; 4 hundreds and 2 ones is 402.**

N.ME.03.03 Compare and order numbers up to 10,000.

Count in steps, and understand even and odd numbers

N.ME.03.04 Count orally by 6's, 7's, 8's, and 9's starting with 0, making the connection between repeated addition and multiplication.

N.ME.03.05 Know that even numbers end in 0, 2, 4, 6,or 8; name a whole number quantity that can be shared in two equal groups or grouped into pairs with no remainders; recognize even numbers as multiples of 2. Know that odd numbers end in 1, 3, 5, 7, or 9, and work with patterns involving even and odd numbers.

Add and subtract whole numbers

N.FL.03.06 *Add and subtract fluently two numbers through 999 with regrouping and through 9,999 without regrouping.**

N.FL.03.07 Estimate the sum and difference of two numbers with three digits (sums up to 1,000), and judge reasonableness of estimates.

N.FL.03.08 Use mental strategies to fluently add and subtract two-digit numbers.

Multiply and divide whole numbers

N.MR.03.09 Use multiplication and division fact families to understand the inverse relationship of these two operations, e.g., because 3 x 8 = 24, we know that 24 ÷ 8 = 3 or 24 ÷ 3 = 8; express a multiplication statement as an equivalent division statement.

N.MR.03.10 *Recognize situations that can be solved using multiplication and division including finding "How many groups?" and "How many in a group?" and write mathematical statements to represent those situations.**

N.FL.03.11 Find products fluently up to 10 x 10; find related quotients using multiplication and division relationships.

N.MR.03.12 Find solutions to open sentences, such as 7 x □ = 42 or 12 ÷ □ = 4, using the inverse relationship between multiplication and division.

N.FL.03.13 Mentally calculate simple products and quotients up to a three-digit number by a one-digit number involving multiples of 10, e.g., 500 x 6, or 400 ÷ 8.

N.MR.03.14 *Solve division problems involving remainders, viewing the remainder as the "number left over"; interpret based on problem context, e.g., when we have 25 children with 4 children per group then there are 6 groups with 1 child left over.**

*revised expectations in italics

Problem-solving with whole numbers

N.MR.03.15 Given problems that use any one of the four operations with appropriate numbers, represent with objects, words (including "product" and "quotient"), and mathematical statements; solve.

Understand simple fractions, relation to the whole, and addition and subtraction of fractions

N.ME.03.16 Understand that fractions may represent a portion of a whole unit that has been partitioned into parts of equal area or length; use the terms "numerator" and "denominator."

N.ME.03.17 Recognize, name, and use equivalent fractions with denominators 2, 4, and 8, using strips as area models.

N.ME.03.18 Place fractions with denominators of 2, 4, and 8 on the number line; relate the number line to a ruler; compare and order up to three fractions with denominators 2, 4, and 8.

N.ME.03.19 Understand that any fraction can be written as a sum of unit fractions, e.g., $\frac{3}{4} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4}$.

N.MR.03.20 Recognize that addition and subtraction of fractions with equal denominators can be modeled by joining or taking away segments on the number line.

Understand simple decimal fractions in relation to money

N.ME.03.21 *Understand and relate decimal fractions to fractional parts of a dollar, e.g., $\frac{1}{2}$ dollar = $0.50; $\frac{1}{4}$ dollar = $0.25.**

MEASUREMENT

Measure and use units for length, weight, temperature and time

M.UN.03.01 Know and use common units of measurements in length, weight, and time.

M.UN.03.02 Measure in mixed units within the same measurement system for length, weight, and time: feet and inches, meters and centimeters, kilograms and grams, pounds and ounces, liters and milliliters, hours and minutes, minutes and seconds, years and months.

M.UN.03.03 Understand relationships between sizes of standard units, e.g., feet and inches, meters and centimeters.

M.UN.03.04 Know benchmark temperatures such as freezing (32°F, 0°C); boiling (212°F, 100°C); and compare temperatures to these, e.g., cooler, warmer.

Understand meaning of area and perimeter and apply in problems

M.UN.03.05 Know the definition of area and perimeter and calculate the perimeter of a square and rectangle given whole number side lengths.

M.UN.03.06 Use square units in calculating area by covering the region and counting the number of square units.

M.UN.03.07 Distinguish between units of length and area and choose a unit appropriate in the context.

M.UN.03.08 Visualize and describe the relative sizes of one square inch and one square centimeter.

revised expectations in italics

Estimate perimeter and area

M.TE.03.09 Estimate the perimeter of a square and rectangle in inches and centimeters; estimate the area of a square and rectangle in square inches and square centimeters.

Solve measurement problems

M.PS.03.10 Add and subtract lengths, weights, and times using mixed units within the same measurement system.

M.PS.03.11 Add and subtract money in dollars and cents.

M.PS.03.12 Solve applied problems involving money, length, and time.

M.PS.03.13 Solve contextual problems about perimeters of rectangles and areas of rectangular regions.

GEOMETRY

Recognize the basic elements of geometric objects

G.GS.03.01 Identify points, line segments, lines, and distance.

G.GS.03.02 Identify perpendicular lines and parallel lines in familiar shapes and in the classroom.

G.GS.03.03 Identify parallel faces of rectangular prisms in familiar shapes and in the classroom.

Name and explore properties of shapes

G.GS.03.04 Identify, describe, compare, and classify two-dimensional shapes, e.g., parallelogram, trapezoid, circle, rectangle, square, and rhombus, based on their component parts (angles, sides, vertices, line segment) and on the number of sides and vertices.

G.SR.03.05 Compose and decompose triangles and rectangles to form other familiar two-dimensional shapes, e.g., form a rectangle using two congruent right triangles, or decompose a parallelogram into a rectangle and two right triangles.

Explore and name three-dimensional solids

G.GS.03.06 Identify, describe, build, and classify familiar three-dimensional solids, e.g., cube, rectangular prism, sphere, pyramid, cone, based on their component parts (faces, surfaces, bases, edges, vertices).

G.SR.03.07 Represent front, top, and side views of solids built with cubes.

DATA AND PROBABILITY

Use bar graphs

D.RE.03.01 Read and interpret bar graphs in both horizontal and vertical forms.

D.RE.03.02 Read scales on the axes and identify the maximum, minimum, and range of values in a bar graph.

D.RE.03.03 Solve problems using information in bar graphs, including comparison of bar graphs.

GRADE LEVEL CONTENT EXPECTATIONS

4 **MATH**

v.12.05

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NUMBER AND OPERATIONS

Understand and use number notation and place value

N.ME.04.01 Read and write numbers to 1,000,000; relate them to the quantities they represent; compare and order.

N.ME.04.02 Compose and decompose numbers using place value to 1,000,000's, e.g., 25,068 is 2 ten thousands, 5 thousands, 0 hundreds, 6 tens, and 8 ones.

N.ME.04.03 Understand the magnitude of numbers up to 1,000,000; recognize the place values of numbers and the relationship of each place value to the place to its right, e.g., 1,000 is 10 hundreds.

Use factors and multiples

N.ME.04.04 *Find all factors of any whole number through 50, list factor pairs, and determine if a one-digit number is a factor of a given whole number.**

N.ME.04.05 *List the first ten multiples of a given one-digit whole number; determine if a whole number is a multiple of a given one-digit whole number.**

N.MR.04.06 Know that some numbers including 2, 3, 5, 7, and 11 have exactly two factors (1 and the number itself) and are called prime numbers.

N.MR.04.07 *Use factors and multiples to compose and decompose whole numbers.**

Add and subtract whole numbers

N.FL.04.08 Add and subtract whole numbers fluently.

Multiply and divide whole numbers

N.ME.04.09 Multiply two-digit numbers by 2, 3, 4, and 5 using the distributive property, e.g., $21 \times 3 = (1 + 20) \times 3 = (1 \times 3) + (20 \times 3) = 3 + 60 = 63$.

N.FL.04.10 Multiply fluently any whole number by a one-digit number and a three-digit number by a two-digit number; for a two-digit by one-digit multiplication use distributive property to develop meaning for the algorithm.

N.FL.04.11 Divide numbers up to four-digits by one-digit numbers and by 10.

N.FL.04.12 *Find the value of the unknowns in equations such as $a \div 10 = 25$; $125 \div b = 25$.**

N.MR.04.13 Use the relationship between multiplication and division to simplify computations and check results.

N.MR.04.14 *Solve contextual problems involving whole number multiplication and division.**

Read, interpret and compare decimal fractions

N.ME.04.15 Read and interpret decimals up to two decimal places; relate to money and place value decomposition.

N.ME.04.16 Know that terminating decimals represents fractions whose denominators are 10, 10×10, $10 \times 10 \times 10$, etc., e.g., powers of 10.

N.ME.04.17 Locate tenths and hundredths on a number line.

N.ME.04.18 Read, write, interpret, and compare decimals up to two decimal places.

N.MR.04.19 Write tenths and hundredths in decimal and fraction forms, and know the decimal equivalents for halves and fourths.

* revised expectations in italics

Understand fractions

N.ME.04.20 Understand fractions as parts of a set of objects.

N.MR.04.21 Explain why equivalent fractions are equal, using models such as fraction strips or the number line for fractions with denominators of 12 or less, or equal to 100.

N.MR.04.22 *Locate fractions with denominators of 12 or less on the number line; include mixed numbers.**

N.MR.04.23 Understand the relationships among halves, fourths, and eighths and among thirds, sixths, and twelfths.

N.ME.04.24 *Know that fractions of the form $\frac{m}{n}$ where m is greater than n, are greater than 1 and are called improper fractions; locate improper fractions on the number line.**

N.MR.04.25 Write improper fractions as mixed numbers, and understand that a mixed number represents the number of "wholes" and the part of a whole remaining, e.g., $\frac{5}{4} = 1 + \frac{1}{4} = 1\frac{1}{4}$.

N.MR.04.26 Compare and order up to three fractions with denominators 2, 4, and 8, and 3, 6, and 12, including improper fractions and mixed numbers.

Add and subtract fractions

N.MR.04.27 *Add and subtract fractions less than 1 with denominators through 12 and/or 100, in cases where the denominators are equal or when one denominator is a multiple of the other, e.g., $\frac{1}{12} + \frac{5}{12} = \frac{6}{12}$; $\frac{1}{6} + \frac{5}{12} = \frac{7}{12}$; $\frac{3}{10} - \frac{23}{100} = \frac{7}{100}$.**

N.MR.04.28 *Solve contextual problems involving sums and differences for fractions where one denominator is a multiple of the other (denominators 2 through 12, and 100).**

N.MR.04.29 *Find the value of an unknown in equations such as $\frac{1}{8} + x = \frac{5}{8}$ or $\frac{3}{4} - y = \frac{1}{2}$.**

Multiply fractions by whole numbers

N.MR.04.30 Multiply fractions by whole numbers, using repeated addition and area or array models.

Add and subtract decimal fractions

N.MR.04.31 *For problems that use addition and subtraction of decimals through hundredths, represent with mathematical statements and solve.**

N.FL.04.32 *Add and subtract decimals through hundredths.**

Multiply and divide decimal fractions

N.FL.04.33 Multiply and divide decimals up to two decimal places by a one-digit whole number where the result is a terminating decimal, e.g., $0.42 \div 3 = 0.14$, but not $5 \div 3 = 1.\overline{6}$.

Estimate

N.FL.04.34 Estimate the answers to calculations involving addition, subtraction, or multiplication.

N.FL.04.35 Know when approximation is appropriate and use it to check the reasonableness of answers; be familiar with common place-value errors in calculations.

N.FL.04.36 Make appropriate estimations and calculations fluently with whole numbers using mental math strategies.

* revised expectations in italics

MEASUREMENT	**Measure using common tools and appropriate units**

M.UN.04.01 Measure using common tools and select appropriate units of measure.

M.PS.04.02 Give answers to a reasonable degree of precision in the context of a given problem.

M.UN.04.03 Measure and compare integer temperatures in degrees.

M.TE.04.04 Measure surface area of cubes and rectangular prisms by covering and counting area of the faces.

Convert measurement units

M.TE.04.05 Carry out the following conversions from one unit of measure to a larger or smaller unit of measure: meters to centimeters, kilograms to grams, liters to milliliters, hours to minutes, minutes to seconds, years to months, weeks to days, feet to inches, ounces to pounds (using numbers that involve only simple calculations).

Use perimeter and area formulas

M.TE.04.06 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.

M.TE.04.07 Find one dimension of a rectangle given the other dimension and its perimeter or area.

M.TE.04.08 Find the side of a square given its perimeter or area.

M.PS.04.09 Solve contextual problems about perimeter and area of squares and rectangles in compound shapes.

Understand right angles

M.TE.04.10 Identify right angles and compare angles to right angles.

Problem-solving

M.PS.04.11 Solve contextual problems about surface area.

GEOMETRY	**Understand perpendicular, parallel, and intersecting lines**

G.GS.04.01 Identify and draw perpendicular, parallel, and intersecting lines using a ruler and a tool or object with a square (90°) corner.

Identify basic geometric shapes and their components, and solve problems

G.GS.04.02 Identify basic geometric shapes including isosceles, equilateral, and right triangles, and use their properties to solve problems.

G.SR.04.03 Identify and count the faces, edges, and vertices of basic three-dimensional geometric solids including cubes, rectangular prisms, and pyramids; describe the shape of their faces.

GEOMETRY	**Recognize symmetry and transformations**

G.TR.04.04 Recognize plane figures that have line symmetry.

G.TR.04.05 Recognize rigid motion transformations (flips, slides, turns) of a two-dimensional object.

DATA AND	**Represent and solve problems for given data**
PROBABILITY	

D.RE.04.01 Construct tables and bar graphs from given data.

D.RE.04.02 Order a given set of data, find the median, and specify the range of values.

D.RE.04.03 Solve problems using data presented in tables and bar graphs, e.g., compare data represented in two bar graphs and read bar graphs showing two data sets.

GRADE LEVEL CONTENT EXPECTATIONS

5 MATH

v.12.05

NUMBER & OPERATIONS

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Meaning, notation, place value, and comparisons (ME) Number relationships and meaning of operations (MR) Fluency with operations and estimation (FL)	Patterns, relations, functions, and change (PA) Representation (RP) Formulas, expressions, equations, and inequalities (RP)	Units and systems of measurement (UN) Techniques and formulas for measurement (TE) Problem solving involving measurement (PS)	Geometric shape, properties, and mathematical arguments (GS) Location and spatial relationships (LO) Spatial reasoning and geometric modeling (SR) Transformation and symmetry (TR)	Data representation (RE) Data interpretation and analysis (AN) Probability (PR)

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NUMBER AND	**Understand division of whole numbers**
OPERATIONS	

N.MR.05.01 Understand the meaning of division of whole numbers with and without remainders; relate division to fractions and to repeated subtraction.

N.MR.05.02 Relate division of whole numbers with remainders to the form
a = bq + r, e.g., 34 ÷ 5 = 6 r 4, so 5 • 6 + 4 = 34; note remainder (4) is less than divisor (5).

N.MR.05.03 Write mathematical statements involving division for given situations.

Multiply and divide whole numbers

N.FL.05.04 Multiply a multi-digit number by a two-digit number; recognize and be able to explain common computational errors such as not accounting for place value.

N.FL.05.05 *Solve applied problems involving multiplication and division of whole numbers.**

N.FL.05.06 Divide fluently up to a four-digit number by a two-digit number.

Find prime factorizations of whole numbers

N.MR.05.07 *Find the prime factorization of numbers from 2 through 50, express in exponential notation, e.g., $24 = 2^3 \times 3^1$, and understand that every whole number greater than 1 is either prime or can be expressed as a product of primes.**

Understand meaning of decimal fractions and percentages

N.ME.05.08 Understand the relative magnitude of ones, tenths, and hundredths and the relationship of each place value to the place to its right, e.g., one is 10 tenths, one tenth is 10 hundredths.

N.ME.05.09 Understand percentages as parts out of 100, use % notation, and express a part of a whole as a percentage.

Understand fractions as division statements; find equivalent fractions

N.ME.05.10 Understand a fraction as a statement of division, e.g., $2 \div 3 = \frac{2}{3}$, using simple fractions and pictures to represent.

N.ME.05.11 *Given two fractions, e.g., $\frac{1}{2}$ and $\frac{1}{4}$, express them as fractions with a common denominator, but not necessarily a <u>least</u> common denominator, e.g., $\frac{1}{2} = \frac{4}{8}$ and $\frac{3}{4} = \frac{6}{8}$; use denominators less than 12 or factors of 100.**

Multiply and divide fractions

N.ME.05.12 *Find the product of two unit fractions with small denominators using an area model.**

N.MR.05.13 *Divide a fraction by a whole number and a whole number by a fraction, using simple unit fractions.**

Add and subtract fractions using common denominators

N.FL.05.14 *Add and subtract fractions with unlike denominators through 12 and/or 100, using the common denominator that is the product of the denominators of the 2 fractions, e.g., $\frac{3}{8} + \frac{7}{10}$: use 80 as the common denominator.**

* revised expectations in italics

Multiply and divide by powers of ten

N.MR.05.15 Multiply a whole number by powers of 10: 0.01, 0.1, 1, 10, 100, 1,000; and identify patterns.

N.FL.05.16 Divide numbers by 10's, 100's, 1,000's using mental strategies.

N.MR.05.17 Multiply one-digit and two-digit whole numbers by decimals up to two decimal places.

Solve applied problems with fractions

N.FL.05.18 *Use mathematical statements to represent an applied situation involving addition and subtraction of fractions.**

N.MR.05.19 *Solve contextual problems that involve finding sums and differences of fractions with unlike denominators using knowledge of equivalent fractions.**

N.FL.05.20 *Solve applied problems involving fractions and decimals; include rounding of answers and checking reasonableness.**

N.MR.05.21 *Solve for the unknown in equations such as* $\frac{1}{4} + x = \frac{7}{12}$ *.**

Express, interpret, and use ratios; find equivalences

N.MR.05.22 Express fractions and decimals as percentages and vice versa.

N.ME.05.23 Express ratios in several ways given applied situations, e.g., 3 cups to 5 people, $3 : 5, \frac{3}{5}$; recognize and find equivalent ratios.

MEASUREMENT

Know, and convert among, measurement units within a given system

M.UN.05.01 Recognize the equivalence of 1 liter, 1,000 ml and 1,000 cm^3 and include conversions among liters, milliliters, and cubic centimeters.

M.UN.05.02 Know the units of measure of volume: cubic centimeter, cubic meter, cubic inches, cubic feet, cubic yards, and use their abbreviations (cm^3, m^3, in^3, ft^3, yd^3).

M.UN.05.03 Compare the relative sizes of one cubic inch to one cubic foot, and one cubic centimeter to one cubic meter.

M.UN.05.04 Convert measurements of length, weight, area, volume, and time within a given system using easily manipulated numbers.

Find areas of geometric shapes using formulas

M.PS.05.05 Represent relationships between areas of rectangles, triangles, and parallelograms using models.

M.TE.05.06 Understand and know how to use the area formula of a triangle:
$A = \frac{1}{2}bh$ (where b is length of the base and h is the height), and represent using models and manipulatives.

M.TE.05.07 Understand and know how to use the area formula for a parallelogram:
$A = bh$, and represent using models and manipulatives.

Understand the concept of volume

M.TE.05.08 Build solids with unit cubes and state their volumes.

M.TE.05.09 Use filling (unit cubes or liquid), and counting or measuring to find the volume of a cube and rectangular prism.

M.PS.05.10 Solve applied problems about the volumes of rectangular prisms using multiplication and division and using the appropriate units.
* revised expectations in italics

GEOMETRY	## Know the meaning of angles, and solve problems

G.TR.05.01 Associate an angle with a certain amount of turning; know that angles are measured in degrees; understand that 90°, 180°, 270°, and 360° are associated respectively, with $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$, and full turns.

G.GS.05.02 Measure angles with a protractor and classify them as acute, right, obtuse, or straight.

G.GS.05.03 Identify and name angles on a straight line and vertical angles.

G.GS.05.04 Find unknown angles in problems involving angles on a straight line, angles surrounding a point, and vertical angles.

G.GS.05.05 Know that angles on a straight line add up to 180° and angles surrounding a point add up to 360°; justify informally by "surrounding" a point with angles.

G.GS.05.06 Understand why the sum of the interior angles of a triangle is 180° and the sum of the interior angles of a quadrilateral is 360°, and use these properties to solve problems.

Solve problems about geometric shapes

G.GS.05.07 Find unknown angles and sides using the properties of: triangles, including right, isosceles, and equilateral triangles; parallelograms, including rectangles and rhombuses; and trapezoids.

DATA AND	## Construct and interpret line graphs
PROBABILITY	

D.RE.05.01 Read and interpret line graphs, and solve problems based on line graphs, e.g., distance-time graphs, and problems with two or three line graphs on same axes, comparing different data.

D.RE.05.02 Construct line graphs from tables of data; include axis labels and scale.

Find and interpret mean and mode for a given set of data

D.AN.05.03 Given a set of data, find and interpret the mean (using the concept of fair share) and mode.

D.AN.05.04 Solve multi-step problems involving means.

MATHEMATICS

GRADE LEVEL CONTENT EXPECTATIONS

6
MATH
v.12.05

Welcome to Michigan's K-8 Grade Level Content Expectations

Purpose & Overview

In 2004, the Michigan Department of Education embraced the challenge of creating Grade Level Content Expectations in response to the federal No Child Left Behind Act of 2001. This act mandated the existence of a set of comprehensive state grade level assessments that are designed based on rigorous grade level content.

In this global economy, it is essential that Michigan students possess personal, social, occupational, civic, and quantitative literacy. Mastery of the knowledge and essential skills defined in Michigan's Grade Level Content Expectations will increase students' ability to be successful academically, contribute to the future businesses that employ them and the communities in which they choose to live.

The Grade Level Content Expectations build from the Michigan Curriculum Framework and its Teaching and Assessment Standards. Reflecting best practices and current research, they provide a set of clear and rigorous expectations for all students and provide teachers with clearly defined statements of what students should know and be able to do as they progress through school.

Why Create a 12.05 Version of the Expectations?

The Office of School Improvement is committed to creating the best possible product for educators. This commitment served as the impetus for the revision of the 6.04 edition that was previously released in June of 2004. This new version, v.12.05, refines and clarifies the original expectations, while preserving their essence and original intent. As education continues to evolve, it is important to remember that each curriculum document should be considered as a work in progress, and will continue to be refined to improve the quality.

The revision process greatly improved the continuity from one grade to the next, and better ensured coherence both in content and pedagogy. To obtain more specific details about the revisions, please refer to the addendum included in this document. The forward of the *Across the Grades v.12.05* companion document also clarifies the types of changes made. Educators can access the *Across the Grades* companion document by visiting the Michigan Department of Education Grade Level Content Expectations web page at www.michigan.gov/glce.

Assessment

The Grade Level Content Expectations document is intended to be a state assessment tool with the expectations written to convey expected performances by students. The Office of Assessment and Accountability was involved in the development of version 12.05 and has incorporated the changes in the construction of test and item specifications for the K-8 Michigan Education Assessment Program (MEAP) and MI-Access. This updated version will assist us in the creation of companion documents, content examples, and to guide program planners in focusing resources and energy.

Curriculum

Using this document as a focal point in the school improvement process, schools and districts can generate conversations among stakeholders concerning current policies and practices to consider ways to improve and enhance student achievement. Together, stakeholders can use these expectations to guide curricular and instructional decisions, identify professional development needs, and assess student achievement.

Understanding the Organizational Structure

The expectations in this document are divided into strands with multiple domains within each, as shown below. The skills and content addressed in these expectations will in practice be woven together into a coherent, Mathematics curriculum. The domains in each mathematics strand are broader, more conceptual groupings. In several of the strands, the "domains" are similar to the "standards" in Principles and Standards for School Mathematics from the National Council of Teachers of Mathematics.

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Through the collaborative efforts of Michigan educators and creation of professional learning communities, we can enable our young people to attain the highest standards, and thereby open doors for them to have fulfilling and successful lives.

NUMBER AND	**Multiply and divide fractions**
OPERATIONS	

N.MR.06.01 Understand division of fractions as the inverse of multiplication, e.g., if $\frac{4}{5} \div \frac{2}{3} = \square$, then $\frac{2}{3} \cdot \square = \frac{4}{5}$, so $\square = \frac{4}{5} \cdot \frac{3}{2} = \frac{12}{10}$.

N.FL.06.02 Given an applied situation involving dividing fractions, write a mathematical statement to represent the situation.

N.MR.06.03 Solve for the unknown in equations such as $\frac{1}{4} \div \square = 1$, $\frac{3}{4} \div \square = \frac{1}{4}$, and $\frac{1}{2} = 1 \cdot \square$.

N.FL.06.04 Multiply and divide any two fractions, including mixed numbers, fluently.

Represent rational numbers as fractions or decimals

N.ME.06.05 Order rational numbers and place them on the number line.

N.ME.06.06 Represent rational numbers as fractions or terminating decimals when possible, and translate between these representations.

N.ME.06.07 Understand that a fraction or a negative fraction is a quotient of two integers, e.g., $-\frac{8}{3}$ is -8 divided by 3.

Add and subtract integers and rational numbers

N.MR.06.08 *Understand integer subtraction as the inverse of integer addition. Understand integer division as the inverse of integer multiplication.*

N.FL.06.09 *Add and multiply integers between -10 and 10; subtract and divide integers using the related facts. Use the number line and chip models for addition and subtraction.*

N.FL.06.10 Add, subtract, multiply and divide positive rational numbers fluently.

Find equivalent ratios

N.ME.06.11 Find equivalent ratios by scaling up or scaling down.

Solve decimal, percentage and rational number problems

N.FL.06.12 Calculate part of a number given the percentage and the number.

N.MR.06.13 *Solve contextual problems involving percentages such as sales taxes and tips.*

N.FL.06.14 For applied situations, estimate the answers to calculations involving operations with rational numbers.

N.FL.06.15 Solve applied problems that use the four operations with appropriate decimal numbers.

Use exponents

N.ME.06.16 *Understand and use integer exponents, excluding powers of negative bases; express numbers in scientific notation.*

Understand rational numbers and their location on the number line

N.ME.06.17 Locate negative rational numbers (including integers) on the number line; know that numbers and their negatives add to 0, and are on opposite sides and at equal distance from 0 on a number line.

N.ME.06.18 Understand that rational numbers are quotients of integers (non zero denominators), e.g., a rational number is either a fraction or a negative fraction.

N.ME.06.19 Understand that 0 is an integer that is neither negative nor positive.

N.ME.06.20 Know that the absolute value of a number is the value of the number ignoring the sign; or is the distance of the number from 0.

* revised expectations in italics

ALGEBRA	**Calculate rates**

A.PA.06.01 Solve applied problems involving rates, including speed, e.g., if a car is going 50 mph, how far will it go in $3\frac{1}{2}$ hours?

Understand the coordinate plane

A.RP.06.02 Plot ordered pairs of integers and use ordered pairs of integers to identify points in all four quadrants of the coordinate plane.

Use variables, write expressions and equations, and combine like terms

A.FO.06.03 Use letters, with units, to represent quantities in a variety of contexts, e.g., y lbs., k minutes, x cookies.

A.FO.06.04 Distinguish between an algebraic expression and an equation.

A.FO.06.05 Use standard conventions for writing algebraic expressions, e.g., 2x + 1 means "two times x, plus 1" and 2(x + 1) means "two times the quantity (x + 1)."

A.FO.06.06 Represent information given in words using algebraic expressions and equations.

A.FO.06.07 Simplify expressions of the first degree by combining like terms, and evaluate using specific values.

Represent linear functions using tables, equations, and graphs

A.RP.06.08 Understand that relationships between quantities can be suggested by graphs and tables.

A.PA.06.09 *Solve problems involving linear functions whose input values are integers; write the equation; graph the resulting ordered pairs of integers, e.g., given c chairs, the "leg function" is 4c; if you have 5 chairs, how many legs?; if you have 12 legs, how many chairs?**

A.RP.06.10 Represent simple relationships between quantities using verbal descriptions, formulas or equations, tables, and graphs, e.g., perimeter-side relationship for a square, distance-time graphs, and conversions such as feet to inches.

Solve equations

A.FO.06.11 *Relate simple linear equations with integer coefficients, e.g., 3x = 8 or x + 5 = 10, to particular contexts and solve.**

A.FO.06.12 Understand that adding or subtracting the same number to both sides of an equation creates a new equation that has the same solution.

A.FO.06.13 Understand that multiplying or dividing both sides of an equation by the same non-zero number creates a new equation that has the same solutions.

A.FO.06.14 Solve equations of the form ax + b = c, e.g., 3x + 8 = 15 by hand for positive integer coefficients less than 20, use calculators otherwise, and interpret the results.

MEASUREMENT	**Convert within measurement systems**

M.UN.06.01 Convert between basic units of measurement within a single measurement system, e.g., square inches to square feet.

Find volume and surface area

M.PS.06.02 Draw patterns (of faces) for a cube and rectangular prism that, when cut, will cover the solid exactly (nets).

M.TE.06.03 Compute the volume and surface area of cubes and rectangular prisms given the lengths of their sides, using formulas.

* revised expectations in italics

GEOMETRY	## Understand and apply basic properties

G.GS.06.01 Understand and apply basic properties of lines, angles, and triangles, including:

- triangle inequality
- relationships of vertical angles, complementary angles, supplementary angles
- congruence of corresponding and alternate interior angles when parallel lines are cut by a transversal, and that such congruencies imply parallel lines
- locate interior and exterior angles of any triangle, and use the property that an exterior angle of a triangle is equal to the sum of the remote (opposite) interior angles
- know that the sum of the exterior angles of a convex polygon is 360°.

Understand the concept of congruence and basic transformations

G.GS.06.02 Understand that for polygons, congruence means corresponding sides and angles have equal measures.

G.TR.06.03 Understand the basic rigid motions in the plane (reflections, rotations, translations), relate these to congruence, and apply them to solve problems.

G.TR.06.04 Understand and use simple compositions of basic rigid transformations, e.g., a translation followed by a reflection.

Construct geometric shapes

G.SR.06.05 Use paper folding to perform basic geometric constructions of perpendicular lines, midpoints of line segments and angle bisectors; justify informally.

DATA AND
PROBABILITY

Understand the concept of probability and solve problems

D.PR.06.01 Express probabilities as fractions, decimals, or percentages between 0 and 1; know that 0 probability means an event will not occur and that probability 1 means an event will occur.

D.PR.06.02 Compute probabilities of events from simple experiments with equally likely outcomes, e.g., tossing dice, flipping coins, spinning spinners, by listing all possibilities and finding the fraction that meets given conditions.

GRADE LEVEL CONTENT EXPECTATIONS

7 MATH

v12.05

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MICHIGAN Department of
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NUMBER AND OPERATIONS

Understand derived quantities

N.MR.07.02 *Solve problems involving derived quantities such as density, velocity, and weighted averages.**

Understand and solve problems involving rates, ratios, and proportions

N.FL.07.03 Calculate rates of change including speed.

N.MR.07.04 Convert ratio quantities between different systems of units, such as feet per second to miles per hour.

N.FL.07.05 *Solve proportion problems using such methods as unit rate, scaling, finding equivalent fractions, and solving the proportion equation a/b = c/d; know how to see patterns about proportional situations in tables.**

Recognize irrational numbers

N.MR.07.06 Understand the concept of square root and cube root, and estimate using calculators.

Compute with rational numbers

N.FL.07.07 Solve problems involving operations with integers.

N.FL.07.08 *Add, subtract, multiply, and divide positive and negative rational numbers fluently.**

N.FL.07.09 Estimate results of computations with rational numbers.

* revised expectations in italics

ALGEBRA

Understand and apply directly proportional relationships and relate to linear relationships

A.PA.07.01 *Recognize when information given in a table, graph, or formula suggests a directly proportional or linear relationship.**

A.RP.07.02 Represent directly proportional and linear relationships using verbal descriptions, tables, graphs, and formulas, and translate among these representations.

A.PA.07.03 *Given a directly proportional or other linear situation, graph and interpret the slope and intercept(s) in terms of the original situation; evaluate y = mx + b for specific x values, e.g., weight vs. volume of water, base cost plus cost per unit.**

A.PA.07.04 For directly proportional or linear situations, solve applied problems using graphs and equations, e.g., the heights and volume of a container with uniform cross-section; height of water in a tank being filled at a constant rate; degrees Celsius and degrees Fahrenheit; distance and time under constant speed.

A.PA.07.05 *Recognize and use directly proportional relationships of the form y = mx, and distinguish from linear relationships of the form y = mx + b, b non-zero; understand that in a directly proportional relationship between two quantities one quantity is a constant multiple of the other quantity.**

Understand and represent linear functions

A.PA.07.06 Calculate the slope from the graph of a linear function as the ratio of "rise/run" for a pair of points on the graph, and express the answer as a fraction and a decimal; understand that linear functions have slope that is a constant rate of change.

A.PA.07.07 Represent linear functions in the form y = x + b, y = mx, and y = mx + b, and graph, interpreting slope and y-intercept.

A.FO.07.08 *Find and interpret the x and/or y intercepts of a linear equation or function. Know that the solution to a linear equation of the form ax+b=0 corresponds to the point at which the graph of y=ax+b crosses the x axis.**

Understand and solve problems about inversely proportional relationships

A.PA.07.09 Recognize inversely proportional relationships in contextual situations; know that quantities are inversely proportional if their product is constant, e.g., the length and width of a rectangle with fixed area, and that an inversely proportional relationship is of the form y = k/x where k is some non-zero number.

A.RP.07.10 Know that the graph of y = k/x is not a line, know its shape, and know that it crosses neither the x nor the y-axis.

Apply basic properties of real numbers in algebraic contexts

A.PA.07.11 Understand and use basic properties of real numbers: additive and multiplicative identities, additive and multiplicative inverses, commutativity, associativity, and the distributive property of multiplication over addition.

Combine algebraic expressions and solve equations

A.FO.07.12 *Add, subtract, and multiply simple algebraic expressions of the first degree, e.g., (92x + 8y) – 5x + y, or x(x+2) and justify using properties of real numbers.**

A.FO.07.13 From applied situations, generate and solve linear equations of the form ax + b = c and ax + b = cx + d, and interpret solutions.

* revised expectations in italics

GEOMETRY	**Draw and construct geometric objects**

G.SR.07.01 Use a ruler and other tools to draw squares, rectangles, triangles, and parallelograms with specified dimensions.

G.SR.07.02 Use compass and straightedge to perform basic geometric constructions: the perpendicular bisector of a segment, an equilateral triangle, and the bisector of an angle; understand informal justifications.

Understand the concept of similar polygons, and solve related problems

G.TR.07.03 Understand that in similar polygons, corresponding angles are congruent and the ratios of corresponding sides are equal; understand the concepts of similar figures and scale factor.

G.TR.07.04 Solve problems about similar figures and scale drawings.

G.TR.07.05 Show that two triangles are similar using the criteria: corresponding angles are congruent (AAA similarity); the ratios of two pairs of corresponding sides are equal and the included angles are congruent (SAS similarity); ratios of all pairs of corresponding sides are equal (SSS similarity); use these criteria to solve problems and to justify arguments.

G.TR.07.06 Understand and use the fact that when two triangles are similar with scale factor of r, their areas are related by a factor of r^2.

DATA AND	**Represent and interpret data**
PROBABILITY	

D.RE.07.01 Represent and interpret data using circle graphs, stem and leaf plots, histograms, and box-and-whisker plots, and select appropriate representation to address specific questions.

D.AN.07.02 Create and interpret scatter plots and find line of best fit; use an estimated line of best fit to answer questions about the data.

Compute statistics about data sets

D.AN.07.03 Calculate and interpret relative frequencies and cumulative frequencies for given data sets.

D.AN.07.04 Find and interpret the median, quartiles, and interquartile range of a given set of data.

GRADE LEVEL CONTENT EXPECTATIONS

8 MATH

v.12.05

Welcome to Michigan's K-8 Grade Level Content Expectations

Purpose & Overview

In 2004, the Michigan Department of Education embraced the challenge of creating Grade Level Content Expectations in response to the federal No Child Left Behind Act of 2001. This act mandated the existence of a set of comprehensive state grade level assessments that are designed based on rigorous grade level content.

In this global economy, it is essential that Michigan students possess personal, social, occupational, civic, and quantitative literacy. Mastery of the knowledge and essential skills defined in Michigan's Grade Level Content Expectations will increase students' ability to be successful academically, contribute to the future businesses that employ them and the communities in which they choose to live.

The Grade Level Content Expectations build from the Michigan Curriculum Framework and its Teaching and Assessment Standards. Reflecting best practices and current research, they provide a set of clear and rigorous expectations for all students and provide teachers with clearly defined statements of what students should know and be able to do as they progress through school.

Why Create a 12.05 Version of the Expectations?

The Office of School Improvement is committed to creating the best possible product for educators. This commitment served as the impetus for the revision of the 6.04 edition that was previously released in June of 2004. This new version, v.12.05, refines and clarifies the original expectations, while preserving their essence and original intent. As education continues to evolve, it is important to remember that each curriculum document should be considered as a work in progress, and will continue to be refined to improve the quality.

The revision process greatly improved the continuity from one grade to the next, and better ensured coherence both in content and pedagogy. To obtain more specific details about the revisions, please refer to the addendum included in this document. The forward of the *Across the Grades v.12.05* companion document also clarifies the types of changes made. Educators can access the *Across the Grades* companion document by visiting the Michigan Department of Education Grade Level Content Expectations web page at www.michigan.gov/glce.

Assessment

The Grade Level Content Expectations document is intended to be a state assessment tool with the expectations written to convey expected performances by students. The Office of Assessment and Accountability was involved in the development of version 12.05 and has incorporated the changes in the construction of test and item specifications for the K-8 Michigan Education Assessment Program (MEAP) and MI-Access. This updated version will assist us in the creation of companion documents, content examples, and to guide program planners in focusing resources and energy.

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Curriculum

Using this document as a focal point in the school improvement process, schools and districts can generate conversations among stakeholders concerning current policies and practices to consider ways to improve and enhance student achievement. Together, stakeholders can use these expectations to guide curricular and instructional decisions, identify professional development needs, and assess student achievement.

Understanding the Organizational Structure

The expectations in this document are divided into strands with multiple domains within each, as shown below. The skills and content addressed in these expectations will in practice be woven together into a coherent, Mathematics curriculum. The domains in each mathematics strand are broader, more conceptual groupings. In several of the strands, the "domains" are similar to the "standards" in Principles and Standards for School Mathematics from the National Council of Teachers of Mathematics.

To allow for ease in referencing expectations, each expectation has been coded with a strand, domain, grade-level, and expectation number. For example, **M.UN.00.01** indicates:

M - Measurement strand

UN - Units & systems of measurement domain of the Measurement strand

00 - Kindergarten Expectation

01 - First Expectation in the Grade-Level view of the Measurement strand

Strand 1 **N**umber & Operations	Strand 2 **A**lgebra	Strand 3 **M**easurement	Strand 4 **G**eometry	Strand 5 Data and **P**robability
Domains				
Meaning, notation, place value, and comparisons (ME) Number relationships and meaning of operations (MR) Fluency with operations and estimation (FL)	Patterns, relations, functions, and change (PA) Representation (RP) Formulas, expressions, equations, and inequalities (RP)	Units and systems of measurement (UN) Techniques and formulas for measurement (TE) Problem solving involving measurement (PS)	Geometric shape, properties, and mathematical arguments (GS) Location and spatial relationships (LO) Spatial reasoning and geometric modeling (SR) Transformation and symmetry (TR)	Data representation (RE) Data interpretation and analysis (AN) Probability (PR)

Preparing Students for Academic Success

Within the hands of teachers, the Grade Level Content Expectations are converted into exciting and engaging learning for Michigan's students. As we use these expectations to develop units of instruction and plan instructional delivery, it is critical to keep in mind that content knowledge alone is not sufficient for academic success. Students must be able to apply knowledge in new situations, to solve problems by generating new ideas, and to make connections between what they learn in class to the world around them. The art of teaching is what makes the content of learning become a reality.

Through the collaborative efforts of Michigan educators and creation of professional learning communities, we can enable our young people to attain the highest standards, and thereby open doors for them to have fulfilling and successful lives.

NUMBER AND	**Understand real number concepts**
OPERATIONS	

N.ME.08.01 Understand the meaning of a square root of a number and its connection to the square whose area is the number; understand the meaning of a cube root and its connection to the volume of a cube.

N.ME.08.02 Understand meanings for zero and negative integer exponents.

N.ME.08.03 Understand that in decimal form, rational numbers either terminate or eventually repeat, and that calculators truncate or round repeating decimals; locate rational numbers on the number line; know fraction forms of common repeating decimals, e.g., $0.\overline{1}=\frac{1}{9}$; $0.\overline{3}=\frac{1}{3}$.

N.ME.08.04 Understand that irrational numbers are those that cannot be expressed as the quotient of two integers, and cannot be represented by terminating or repeating decimals; approximate the position of familiar irrational numbers, e.g., $\sqrt{2}, \sqrt{3}, \pi$, on the number line.

N.FL.08.05 Estimate and solve problems with square roots and cube roots using calculators.

N.FL.08.06 Find square roots of perfect squares and approximate the square roots of non-perfect squares by locating between consecutive integers, e.g., $\sqrt{130}$ is between 11 and 12.

Solve problems

N.MR.08.07 Understand percent increase and percent decrease in both sum and product form, e.g., 3% increase of a quantity x is x + .03x = 1.03x.

N.MR.08.08 Solve problems involving percent increases and decreases.

N.FL.08.09 Solve problems involving compounded interest or multiple discounts.

N.MR.08.10 Calculate weighted averages such as course grades, consumer price indices, and sports ratings.

N.FL.08.11 Solve problems involving ratio units, such as miles per hour, dollars per pound, or persons per square mile.

* revised expectations in italics

Understand the concept of non-linear functions using basic examples

A.RP.08.01 *Identify and represent linear functions, quadratic functions, and other simple functions including inversely proportional relationships (y = k/x); cubics (y = ax³); roots (y = √x); and exponentials (y = aˣ , a > 0); using tables, graphs, and equations.**

A.PA.08.02 For basic functions, e.g., simple quadratics, direct and indirect variation, and population growth, describe how changes in one variable affect the others.

A.PA.08.03 Recognize basic functions in problem context, e.g., area of a circle is πr^2, volume of a sphere is $\frac{4}{3}\pi r^3$, and represent them using tables, graphs, and formulas.

A.RP.08.04 Use the vertical line test to determine if a graph represents a function in one variable.

Understand and represent quadratic functions

A.RP.08.05 Relate quadratic functions in factored form and vertex form to their graphs, and vice versa; in particular, note that solutions of a quadratic equation are the x-intercepts of the corresponding quadratic function.

A.RP.08.06 Graph factorable quadratic functions, finding where the graph intersects the x-axis and the coordinates of the vertex; use words "parabola" and "roots"; include functions in vertex form and those with leading coefficient −1, e.g., $y = x^2 - 36$, $y = (x - 2)^2 - 9$; $y = -x^2$; $y = -(x - 3)^2$.

Recognize, represent, and apply common formulas

A.FO.08.07 Recognize and apply the common formulas:

$(a + b)^2 = a^2 + 2ab + b^2$

$(a - b)^2 = a^2 - 2ab + b^2$

$(a + b)(a - b) = a^2 - b^2$; represent geometrically.

A.FO.08.08 Factor simple quadratic expressions with integer coefficients, e.g.,

$x^2 + 6x + 9$, $x^2 + 2x - 3$, and $x^2 - 4$; solve simple quadratic equations, e.g., $x^2 = 16$ or $x^2 = 5$ (by taking square roots); $x^2 - x - 6 = 0$, $x^2 - 2x = 15$ (by factoring); verify solutions by evaluation.

A.FO.08.09 Solve applied problems involving simple quadratic equations.

Understand solutions and solve equations, simultaneous equations, and linear inequalities

A.FO.08.10 Understand that to solve the equation f(x) = g(x) means to find all values of x for which the equation is true, e.g., determine whether a given value, or values from a given set, is a solution of an equation (0 is a solution of $3x^2 + 2 = 4x + 2$, but 1 is not a solution).

A.FO.08.11 Solve simultaneous linear equations in two variables by graphing, by substitution, and by linear combination; estimate solutions using graphs; include examples with no solutions and infinitely many solutions.

A.FO.08.12 Solve linear inequalities in one and two variables, and graph the solution sets.

A.FO.08.13 Set up and solve applied problems involving simultaneous linear equations and linear inequalities.

* revised expectations in italics

GEOMETRY

Understand and use the Pythagorean Theorem

G.GS.08.01 Understand at least one proof of the Pythagorean Theorem; use the Pythagorean Theorem and its converse to solve applied problems including perimeter, area, and volume problems.

G.LO.08.02 Find the distance between two points on the coordinate plane using the distance formula; recognize that the distance formula is an application of the Pythagorean Theorem.

Solve problems about geometric figures

G.SR.08.03 Understand the definition of a circle; know and use the formulas for circumference and area of a circle to solve problems.

G.SR.08.04 Find area and perimeter of complex figures by sub-dividing them into basic shapes (quadrilaterals, triangles, circles).

G.SR.08.05 Solve applied problems involving areas of triangles, quadrilaterals, and circles.

Understand concepts of volume and surface area, and apply formulas

G.SR.08.06 Know the volume formulas for generalized cylinders ((area of base) × height), generalized cones and pyramids ($\frac{1}{3}$(area of base) × height), and spheres ($\frac{4}{3}\pi$ (radius)^3) and apply them to solve problems.

G.SR.08.07 Understand the concept of surface area, and find the surface area of prisms, cones, spheres, pyramids, and cylinders.

Visualize solids

G.SR.08.08 Sketch a variety of two-dimensional representations of three-dimensional solids including orthogonal views (top, front, and side), picture views (projective or isometric), and nets; use such two-dimensional representations to help solve problems.

Understand and apply concepts of transformation and symmetry

G.TR.08.09 Understand the definition of a dilation from a point in the plane, and relate it to the definition of similar polygons.

G.TR.08.10 Understand and use reflective and rotational symmetries of two-dimensional shapes and relate them to transformations to solve problems.

DATA AND PROBABILITY

Draw, explain, and justify conclusions based on data

D.AN.08.01 Determine which measure of central tendency (mean, median, mode) best represents a data set, e.g., salaries, home prices, for answering certain questions; justify the choice made.

D.AN.08.02 Recognize practices of collecting and displaying data that may bias the presentation or analysis.

Understand probability concepts for simple and compound events

D.PR.08.03 *Compute relative frequencies from a table of experimental results for a repeated event. Interpret the results using relationship of probability to relative frequency.**

D.PR.08.04 Apply the Basic Counting Principle to find total number of outcomes possible for independent and dependent events, and calculate the probabilities using organized lists or tree diagrams.

D.PR.08.05 *Find and/or compare the theoretical probability, the experimental probability, and/or the relative frequency of a given event.**

D.PR.08.06 Understand the difference between independent and dependent events, and recognize common misconceptions involving probability, e.g., Alice rolls a 6 on a die three times in a row; she is just as likely to roll a 6 on the fourth roll as she was on any previous roll.

* revised expectations in italics