Michigan Merit Curriculum

Course/Credit Requirements

ALGEBRA II

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1 Credit

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Welcome

This guide was developed to assist teachers in successfully implementing the Michigan Merit Curriculum. The identified content expectations and guidelines provide a useful framework for designing curriculum, assessments and relevant learning experiences for students. Through the collaborative efforts of Governor Jennifer M. Granholm, the State Board of Education, and the State Legislature, these landmark state graduation requirements are being implemented to give Michigan students the knowledge and skills to succeed in the 21st Century and drive Michigan's economic success in the global economy. Working together, teachers can explore varied pathways to help students demonstrate proficiency in meeting the content expectations and guidelines.

Curriculum Unit Design

One of the ultimate goals of teaching is for students to acquire transferable knowledge. To accomplish this, learning needs to result in a deep understanding of content and mastery level of skills. As educational designers, teachers must use both the art and the science of teaching. In planning coherent, rigorous instructional units of study, it is best to begin with the end in mind.

Engaging and effective units include:

- appropriate content expectations
- students setting goals and monitoring own progress
- a focus on big ideas that have great transfer value
- focus and essential questions that stimulate inquiry and connections
- identified valid and relevant skills and processes
- purposeful real-world applications
- relevant and worthy learning experiences
- varied flexible instruction for diverse learners
- research-based instructional strategies
- explicit and systematic instruction
- adequate teacher modeling and guided practice
- substantial time to review or apply new knowledge
- opportunities for revision of work based on feedback
- student evaluation of the unit
- culminating celebrations

Relevance

Instruction that is clearly relevant to today's rapidly changing world is at the forefront of unit design. Content knowledge cannot by itself lead all students to academic achievement. Classes and projects that spark student interest and provide a rationale for why the content is worth learning, enable students to make connections between what they read and learn in school, their lives, and their futures. An engaging and effective curriculum provides opportunities for exploration and exposure to new ideas. Real-world learning experiences provide students with opportunities to transfer and apply knowledge in new diverse situations.

Student Assessment

The assessment process can be a powerful tool for learning when students are actively involved in the process. Both assessment of learning and assessment for learning, are essential. Reliable formative and summative assessments provide teachers with information they need to make informed instructional decisions that are more responsive to students' needs. Engagement empowers students to take ownership of their learning and builds confidence over time.

Sound assessments:

- align with learning goals
- vary in type and format
- use authentic performance tasks
- use criteria scoring tools such as rubrics or exemplars
- allow teachers and students to track growth over time
- validate the acquisition of transferable knowledge
- give insight into students' thinking processes
- cause students to use higher level thinking skills
- address guiding questions and identified skills and processes
- provide informative feedback for teachers and students
- ask students to reflect on their learning

High School Content Expectation Codes

To allow for ease in referencing expectations, each mathematics expectation has been coded by strand, standard, topic, and expectation. For example:

A1.2.3
- A: Algebra and Functions Strand
- A1: Standard 1 of the Algebra and Functions Strand
- A1.2: Topic 2 in Standard A1
- A.1.2.3: 3rd expectation in the 2nd topic of Standard A1

Organizational Structure of Mathematics HSCE

STRAND 1 Quantitative Literacy and Logic (L)	**STRAND** 2 Algebra and Functions (A)
STANDARDS (and number of core expectations in each standard)	
L1: Reasoning About Numbers, Systems and Quantitative Situations (13) L2: Calculation, Algorithms, and Estimation (13) L3: Mathematical Reasoning, Logic, and Proof (10)	A1: Expressions, Equations, and Inequalities (16) A2: Functions (16) A3: Families of Functions (27)

STRAND 3 Geometry and Trigonometry (G)	STRAND 4 Statistics and Probability (S)
STANDARDS (and number of core expectations in each standard)	
G1: Figures and Their Properties (29) G2: Relationships Between Figures (10) G3: Transformations of Figures in the Plane (5)	S1: Univariate Data—Examining Distributions (9) S2: Bivariate Data—Examining Relationships (6) S3: Samples, Surveys, and Experiments (3) S4: Probability Models and Probability Calculation (4)

Organization of this Document

In the Mathematics credit requirement documents, the expectations are organized by strand and standard underneath topic headings. The organization in no way implies an instructional sequence. Curriculum personnel or teachers are encouraged to organize these topics and expectations in a manner that encourages connections between strands and among topics within a strand.

Changes to Algebra II Course/Credit Descriptions

The changes to the Algebra II course description are a result of a combination of factors. Foremost among them is the need to align Michigan's Mathematics HSCE with ACT's college and work readiness standards. The course description was also aligned with Achieve's America Diploma Project Algebra II course. This revised Algebra II course description also reflects the proposed Common Core College and Career Readiness Standards that Michigan expects to adopt. This change means that some of Michigan's Mathematics HSCE are not assigned to the three required credits, Algebra I, Geometry, and Algebra II. The Mathematics HSCE describe what students should know and be able to do when they complete high school. They were not originally written to define three credits of high school mathematics. While no longer required to earn Algebra II credit, these unassigned expectations represent knowledge and skill students should have by the end of high school. Districts may integrate these expectations into their current mathematics course offerings or design additional courses to specifically teach the statistics, probability, and trigonometry concepts represented by the expectations removed from the Algebra II description.

In summary, the following 25 Mathematics High School Content Expectations were removed from the Algebra II Course/Credit Requirements (11/07 Version):

Quantitative Literacy

- Expectations: L1.3.2 and L1.3.3 (probability)
- Topic L2.4 Understanding Error (L2.4.1-3)

Algebra and Functions

- Expectation A1.2.10 (trigonometry)
- Topic A3.7 Trigonometric Functions (A3.7.1-5)

Statistics and Probability

- Expectations S1.1.2, S1.2.2, S1.2.3 (examining distributions)
- Topic S1.3 The Normal Distribution (S1.3.1-4)
- Standard S3 Samples, Surveys and Experiments (S3.1.1-3)
- Standard S4 Probability Models and Calculations (S4.1.1-2; S4.2.1-2)

Introduction to Algebra II

The increasing use of quantitative methods in all disciplines has made algebra the fundamental tool for mathematical applications. Algebraic thinking is learned most effectively when it is studied in the context of applications, both mathematical and real-world. These applications reveal the power of algebra to model real problems and to generalize new situations. Algebra is not only a theoretical tool for analyzing and describing mathematical relationships, but it is also a powerful tool for the mathematical modeling and solving of real-world problems. These problems can be found all around us: the workplace, the sciences, technology, engineering, and mathematics.

Algebra II Goal Statement

The goal of Algebra II is to build upon the concepts taught in Algebra I and Geometry while adding new concepts to the students' repertoire of mathematics. In Algebra I, students studied the concept of functions in various forms such as linear, quadratic, polynomial, and exponential. In Algebra II, students continue the study of exponential and logarithmic functions and further enlarge their catalog of function families. The topic of conic sections fuses algebra with geometry. Students will also extend their knowledge of sequences and iteration as well as univariate statistical applications.

It is also the goal of this model to help students see the connections in the mathematics that they have already learned.

Throughout Algebra I and II, students will experience mathematics generally, and algebra in particular, not only as the study of mathematical patterns and relationships, but also as a language that allows us to make sense of mathematical symbols. Moreover, students will develop an understanding that algebraic thinking is an accessible and powerful tool that can be used to model and solve real-world problems.

Algebra II Content Expectations Outline

STANDARD L1: REASONING ABOUT NUMBERS, SYSTEMS, AND QUANTITATIVE SITUATIONS

- L1.2 Representations and Relationships
- L1.3 Counting and Probabilistic Reasoning

STANDARD L2: CALCULATION, ALGORITHMS, AND ESTIMATION

- L2.1 Calculation Using Real and Complex Numbers
- L2.2 Sequences and Iteration
- L2.3 Measurement Units, Calculations and Scales

STANDARD A1: EXPRESSIONS, EQUATIONS, AND INEQUALITIES

- A1.1 Construction, Interpretation, and Manipulation of Expressions
- A1.2 Solutions of Equations and Inequalities

STANDARD A2: FUNCTIONS

- A2.1 Definitions, Representations, and Attributes of Functions
- A2.2 Operations and Transformations with Functions
- A2.3 Representations of Functions
- A2.4 Models of Real-World Situations Using Families of Functions

STANDARD A3: FAMILIES OF FUNCTIONS

A3.2 Exponential and Logarithmic Functions

A3.6 Rational Functions

STANDARD G1: FIGURES AND THEIR PROPERTIES

G1.7 Conic Sections and Their Properties

STANDARD S1: UNIVARIATE DATA – EXAMINING DISTRIBUTIONS

S1.1 Producing and Interpreting Plots

S1.2 Measures of Center and Variation

CONTENT EXPECTATIONS FOR ALGEBRA II

STANDARD L1: REASONING ABOUT NUMBERS, SYSTEMS, AND QUANTITATIVE SITUATIONS

L1.2 Representations and Relationships

L1.2.1 Use mathematical symbols to represent quantitative relationships and situations.

L1.3 Counting and Probabilistic Reasoning

L1.3.1 Describe, explain, and apply various counting techniques; relate combinations to Pascal's triangle; know when to use each technique.

STANDARD L2: CALCULATION, ALGORITHMS, AND ESTIMATION

L2.1 Calculation Using Real and Complex Numbers

L2.1.3 Explain the exponential relationship between a number and its base 10 logarithm, and use it to relate rules of logarithms to those of exponents in expressions involving numbers.

L2.1.5 Add, subtract, and multiply complex numbers; use conjugates to simplify quotients of complex numbers.

L2.2 Sequences and Iteration

L2.2.1 Find the *n*th term in arithmetic, geometric, or other simple sequences.

L2.2.2 Compute sums of finite arithmetic and geometric sequences.

L2.2.3 Use iterative processes in such examples as computing compound interest or applying approximation procedures.

L2.3 Measurement Units, Calculations, and Scales

L2.3.2 Describe and interpret logarithmic relationships in such contexts as the Richter scale, the pH scale, or decibel measurements; solve applied problems.

STANDARD A1: EXPRESSIONS, EQUATIONS, AND INEQUALITIES

A1.1 Construction, Interpretation, and Manipulation of Expressions

A1.1.1 Give a verbal description of an expression that is presented in symbolic form, write an algebraic expression from a verbal description, and evaluate expressions given values of the variables.

A1.1.4 Add, subtract, multiply, and simplify polynomials and rational expressions.

A1.1.5 Divide a polynomial by a monomial.

A1.1.6 Transform exponential and logarithmic expressions into equivalent forms using the properties of exponents and logarithms, including the inverse relationship between exponents and logarithms.

A1.2 Solutions of Equations and Inequalities

A1.2.2 Associate a given equation with a function whose zeros are the solutions of the equation.

A1.2.5 Solve polynomial equations and equations involving rational expressions and justify steps in the solution.

A1.2.7 Solve exponential and logarithmic equations and justify steps in the solution.

A1.2.8 Solve an equation involving several variables (with numerical or letter coefficients) for a designated variable, and justify steps in the solution.

A1.2.9 Know common formulas and apply appropriately in contextual situations.

STANDARD A2: FUNCTIONS

A2.1 Definitions, Representations, and Attributes of Functions

A2.1.1 Recognize whether a relationship (given in contextual, symbolic, tabular, or graphical form) is a function, and identify its domain and range.

A2.1.2 Read, interpret, and use function notation, and evaluate a function at a value in its domain.

A2.1.3 Represent functions in symbols, graphs, tables, diagrams, or words, and translate among representations.

A2.1.6 Identify the zeros of a function, the intervals where the values of a function are positive or negative, and describe the behavior of a function as x approaches positive or negative infinity, given the symbolic and graphical representations.

A2.1.7 Identify and interpret the key features of a function from its graph or its formula(s).

A2.2 Operations and Transformations with Functions

A2.2.1 Combine functions by addition, subtraction, multiplication, and division.

A2.2.2 Apply given transformations to parent functions, and represent symbolically.

A2.2.3 Recognize whether a function (given in tabular or graphical form) has an inverse, and recognize simple inverse pairs.

A2.3 Representations of Functions

A2.3.1 Identify a function as a member of a family of functions based on its symbolic or graphical representation; recognize that different families of functions have different asymptotic behavior.

A2.3.3 Write the general symbolic forms that characterize each family of functions.

A2.4 Models of Real-World Situations Using Families of Functions

A2.4.1 Identify the family of functions best suited for modeling a given real-world situation.

A2.4.2 Adapt the general symbolic form of a function to one that fits the specifications of a given situation by using the information to replace arbitrary constants with numbers.

A2.4.3 Using the adapted general symbolic form, draw reasonable conclusions about the situation being modeled.

STANDARD A3: FAMILIES OF FUNCTIONS

A3.2 Exponential and Logarithmic Functions

A3.2.2 Interpret the symbolic forms and recognize the graphs of exponential and logarithmic functions.

A3.2.3 Apply properties of exponential and logarithmic functions.

A3.6 Rational Functions

A3.6.1 Write the symbolic form and sketch the graph of simple rational functions.

A3.6.2 Analyze graphs of simple rational functions and understand the relationship between the zeros of the numerator and denominator, and the function's intercepts, asymptotes, and domain.

STANDARD G1: FIGURES AND THEIR PROPERTIES

G1.7 Conic Sections and Their Properties

G1.7.1 Find an equation of a circle given its center and radius; given the equation of a circle, find its center and radius.

G1.7.2 Identify and distinguish among geometric representations of parabolas, circles, ellipses, and hyperbolas; describe their symmetries, and explain how they are related to cones.

G1.7.3 Graph ellipses and hyperbolas with axes parallel to the *x*- and *y*-axes, given equations.

STANDARD S1: UNIVARIATE DATA-EXAMINING DISTRIBUTIONS

S1.1 Producing and Interpreting Plots

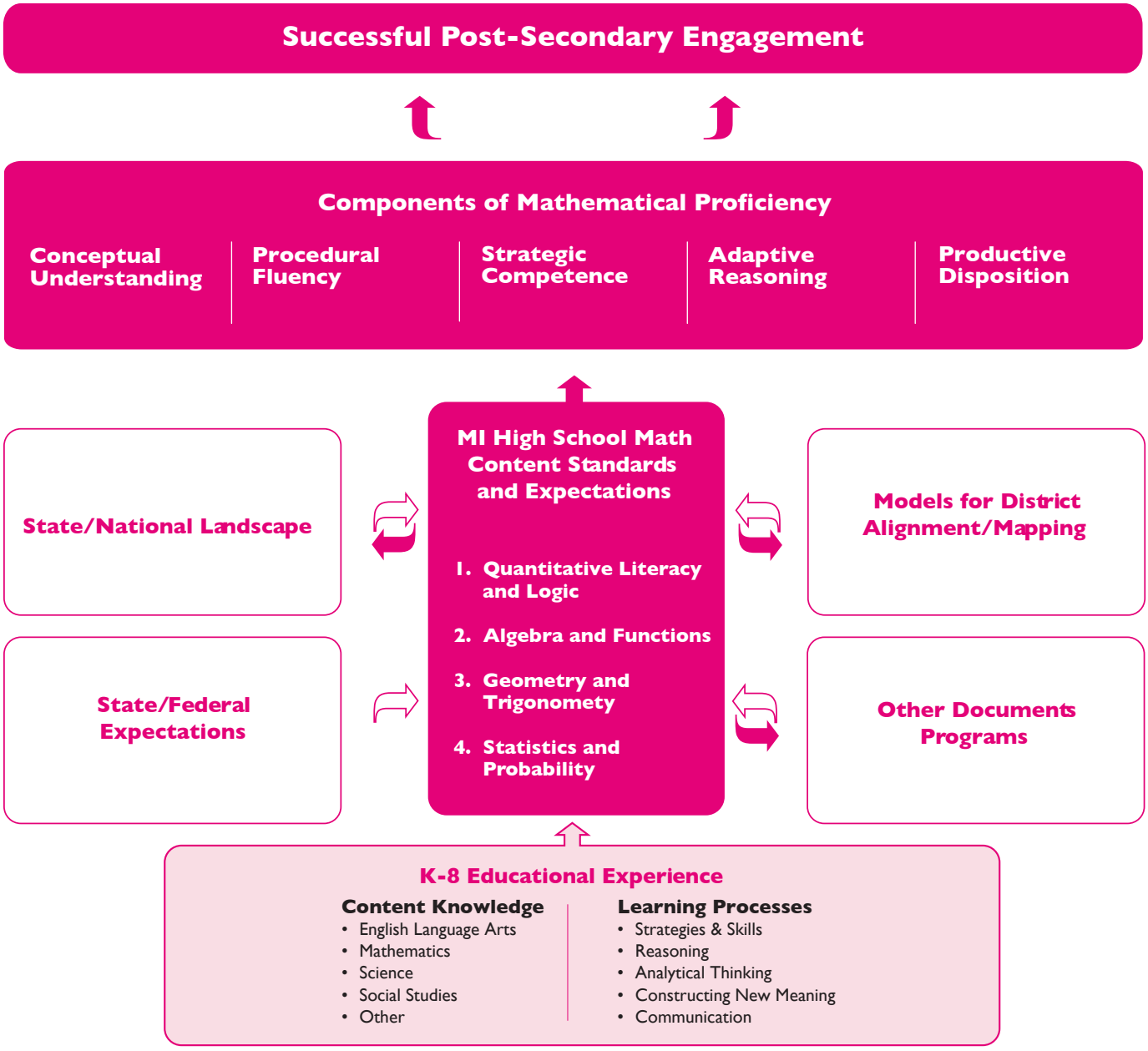
S1.1.1 Construct and interpret dot plots, histograms, relative frequency histograms, bar graphs, basic control charts, and box plots with appropriate labels and scales; determine which kinds of plots are appropriate for different types of data; compare data sets and interpret differences based on graphs and summary statistics.

S1.2 Measures of Center and Variation

S1.2.1 Calculate and interpret measures of center including: mean, median, and mode; explain uses, advantages and disadvantages of each measure given a particular set of data and its context.

Preparing Students for Successful Post-Secondary Engagement

As educators use these standards and expectations to develop rigorous and relevant units of instruction, it is critical to keep in mind that content knowledge alone will not provide adequate preparation for success in entry-level university courses or entry-level positions in today's workforce. Successful post-secondary engagement requires that students must be able to apply knowledge in new situations; to solve problems by generating new ideas; and to make connections between what they read and hear in class, and the world around them. Therefore educators must model for and develop in students, the cognitive skills and habits of mind that will result in mathematical proficiency and successful post-secondary engagement.



The above chart provides a structural overview of the information on pages 3-7.
The complete chart can be found in the Math HSCE document.

NOTES