ESSENTIAL ELEMENTS FOR GRADE 8: MATHEMATICS

**Claim #1: Students demonstrate increasingly complex understanding of number sense.

The Number System

Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.NS.1: Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.			
EE.8.NS.1: Subtract fractions with like denominators (halves, thirds, fourths, and tenths) with minuends less than or equal to one.	EE.8.NS.H.1: The student can add and subtract fractions with common denominators (limited to halves, thirds, fourths and tenths) with sums and differences less than or equal to one.	EE.8.NS.M.1: The student can add and subtract fractions with common denominators with sums or differences less than or equal to one and limited to halves, thirds, and fourths (fractions shown as models).	EE.8.NS.L.1: The student can recognize that subtracting one-half from one whole equals one-half.
Michigan Grade 8 Standard for Mathematics: 8.NS.2: Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π2). *For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.*			
EE.8.NS.2.a: Express a fraction with a denominator of 100 as a decimal.	EE.8.NS.H.2.a: The student can express a fraction with a denominator of 100 as a decimal. Functional skill is expressing money as a fraction/decimal of a dollar (e.g. 23/100 of a dollar = $0.23, etc.)	EE.8.NS.M.2.a: The student can identify a combination of coins and bills up to $5 using decimal notation (e.g., $2.50 is equal to two one-dollar bills and two quarters.)	EE.8.NS.L.2.a: The student can differentiate coins and bills from each other and from other similar objects.
EE.8.NS.2.b: Compare quantities represented as decimals in real-world examples to hundredths.	**Michigan Range of Complexity: See EE.8.NS.2.a.**		

Expressions and Equations

Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.EE.1: Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.			
EE.8.EE.2: Identify the meaning of an exponent (limited to exponents of 2 and 3).	**Michigan Range of Complexity:** See **EE.8.EE.3-4**.		
Michigan Grade 8 Standard for Mathematics: 8.EE.2: Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.			
EE.8.EE.2: Identify a geometric sequence of whole numbers with a whole number common ratio.	**Michigan Range of Complexity:** Not measured at state level, range of complexity determined at classroom level.		
Michigan Grade 8 Standard for Mathematics: 8.EE.3: Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.* **Michigan Grade 8 Standard for Mathematics: 8.EE.4**: Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation, and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.			
EE.8.EE.3-4: Compose and decompose whole numbers up to 999.	**EE.8.EE.H.3-4**: The student can compose and decompose whole numbers.	**EE.8.EE.M.3-4**: The student can compose and decompose two-digit whole numbers with base-10 blocks.	**EE.8.EE.L.3-4**: The student can differentiate between a single unit or a few single blocks and a group of 10.

Mathematics Essential Elements Grade 8

Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.EE.5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.* **Michigan Grade 8 Standard for Mathematics: 8.EE.6**: Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation *y = mx* for a line through the origin and the equation *y = mx + b* for a line intercepting the vertical axis at *b.*			
EE.8.EE.5-6: Graph a simple ratio by connecting the origin to a point representing the ratio in the form of *y/x*. For example, when given a ratio in standard form (2:1), convert to 2/1, and plot the point (1,2).	**Michigan Range of Complexity:** Not measured at state level, range of complexity determined at classroom level.		

**Claim #2: Students demonstrate increasingly complex spatial reasoning and understanding of geometric principles.

Geometry

Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.G.1: Verify experimentally the properties of rotations, reflections, and translations. **Michigan Grade 8 Standard for Mathematics: 8.G.1.a**: Lines are taken to lines, and line segments to line segments of the same length. **Michigan Grade 8 Standard for Mathematics: 8.G.1.b**: Angles are taken to angles of the same measure. **Michigan Grade 8 Standard for Mathematics: 8.G.1.c**: Parallel lines are taken to parallel lines.			
EE.8.G.1: Recognize translations, rotations, and reflections of shapes.	**Michigan Range of Complexity:** Not measured at state level, range of complexity determined at classroom level.		
Michigan Grade 8 Standard for Mathematics: 8.G.2: Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.			
EE.8.G.2: Identify shapes that are congruent.	**EE.8.G.H.2**: The student can identify shapes that are congruent.	**EE.8.G.M.2**: The student can identify similar shapes without rotation.	**EE.8.G.L.2**: The student can match similar two-dimensional shapes, limited to circle, square, rectangle, and triangle when presented without rotation.

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Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.G.4: Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.			
EE.8.G.4: Identify similar shapes with and without rotation.	EE.8.G.H.4: The student can identify similar shapes and/or letters with and without rotation.	EE.8.G.M.4: The student can identify similar shapes and/or letters with and without rotation (limited to quarter- and half-turns).	EE.8.G.L.4: The student can match similar two-dimensional shapes, limited to circle, square, star, and triangle with the same shape highlighted within a functional context (e.g., a square and square window frame).
Michigan Grade 8 Standard for Mathematics: 8.G.5: Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*			
EE.8.G.5: Compare any angle to a right angle, and describe the angle as greater than, less than, or congruent to a right angle.	EE.8.G.H.5: The student can recognize an angle as being greater than, less than, or equal to a right angle when given a model of a right angle.	EE.8.G.M.5: The student can recognize a right angle.	EE.8.G.L.5: The student can identify a corner when compared with another attribute or shape without a corner.

Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.G.9: Know the formulas for the volumes of cones, cylinders, and spheres, and use them to solve real-world and mathematical problems.			
EE.8.G.9: Use the formulas for perimeter, area, and volume to solve real-world and mathematical problems (limited to perimeter and area of rectangles and volume of rectangular prisms).	EE.8.G.H.9: When given the formulas for perimeter, area, and volume, the student can use the formulas to solve real-world and mathematical problems, limited to rectangles and rectangular prisms.	EE.8.G.M.9: The student can identify the area or perimeter using models and dimensions of rectangles, limited to single-digit numbers (e.g., 2 + 3 + 2 + 3) with a shape that also contains unit squares.	EE.8.G.L.9: The student can use informal units to determine the perimeter of a rectangle of 8 units or less without using the word perimeter (e.g., how many steps, blocks, etc.).

**Claim #3: Students demonstrate increasingly complex understanding of measurement, data and analytic procedures.

Statistics and Probability

Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.SP.4: Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example: Collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*			
EE.8.SP.4: Construct a graph or table from given categorical data, and compare data categorized in the graph or table.	**EE.8.SP.H.4**: The student can match given data with a graph or table that shows this data and compare data categorized in a graph or table.	**EE.8.SP.M.4**: The student can identify a graph or table that matches given information, limited to 3 data entries.	**EE.8.SP.L.4**: The student can sort given data into two groups.

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**Claim #4: Students solve increasingly complex mathematical problems, making productive use of algebra and functions.

Solving Expressions and Equations

Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.EE.7: Solve linear equations in one variable. **Michigan Grade 8 Standard for Mathematics: 8.EE.7.a**: Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers). **Michigan Grade 8 Standard for Mathematics: 8.EE.7.b**: Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.			
EE.8.EE.7: Solve simple algebraic equations with one variable using addition and subtraction.	**EE.8.EE.H.7**: The student can solve algebraic equations with one variable using addition and subtraction.	**EE.8.EE.M.7**: The student can select appropriate numbers in order to solve addition and subtraction problems and solve as appropriate.	**EE.8.EE.L.7**: The student can identify which of two choices is needed to answer a question or solve a problem.

Functions

Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.F.1: Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. **Michigan Grade 8 Standard for Mathematics: 8.F.2**: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* **Michigan Grade 8 Standard for Mathematics: 8.F.3**: Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.*			
EE.8.F.1-3: Given a function table containing at least 2 complete ordered pairs, identify a missing number that completes another ordered pair (limited to linear functions).	**EE.8.F.H.1-3**: The student can identify the missing number that completes an ordered pair in a function table.	**EE.8.F.M.1-3**: The student can recognize a growing or shrinking pattern in a data table that contains at least 3 data points.	**EE.8.F.L.1-3**: The student can extend or describe patterns involving objects or symbols.
Michigan Grade 8 Standard for Mathematics: 8.F.4: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x, y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.			
EE.8.F.4: Determine the values or rule of a function using a graph or a table.	**Michigan Range of Complexity:** Not measured at state level, range of complexity determined at classroom level.		

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Target Essential Element	Michigan Range of Complexity		
	High Range	**Medium Range**	**Low Range**
Michigan Grade 8 Standard for Mathematics: 8.F.5: Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.			
EE.8.F.5: Describe how a graph represents a relationship between two quantities.	EE.8.F.H.5: The student can describe a relationship between two quantities shown on a graph using increasing, decreasing, or maintaining.	EE.8.F.M.5: The student can identify a relationship between two quantities shown in a graph as more than or less than.	EE.8.F.L.5: The student can identify the topic of information presented in a picture graph or bar graph (e.g., use a model of a graph to identify the topic of favorite pizza toppings).

Target Essential Elements as developed by: Dynamic Learning Maps Consortium (2013). Dynamic Learning Maps Essential Elements for Mathematics. Lawrence, KS: University of Kansas.