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| **8th Grade Mathematics – Planning Tool** | | | | | | | | | | |
| Collaborators: | | | | | Academic Year: | | | | | |
| *This planning tool can be used by collaborating teachers across a given school year or term to help insure full implementation of the Iowa Core Content Standards into their classroom instructional and assessment activities.* *Full implementation is accomplished when the district or school is able to provide evidence that an ongoing process is in place to ensure that each and every student is learning the standards and the essential concepts and skills of the Iowa Core. A school that has fully implemented the Iowa Core is engaged in an ongoing process of data gathering and analysis, decision making, identifying actions, and assessing the impact around alignment and professional development focused on content, instruction, and assessment. The school is fully engaged in a continuous improvement process that specifically targets improved student learning and performance.*  ***Effective implementation of the Iowa Core is not a simple checklist. Implementation requires that educators strategically and systematically address the knowledge and skills being taught, engage in collaboration around the use of effective instructional practices and materials and develop activities to elicit evidence of student learning that match the level of rigor called for in the standards.*** | | | | | | | | | | |
| **Mathematic Content Standard** | **Aug.** | **Sept** | **Oct.** | **Nov.** | **Dec.** | **Jan.** | **Feb.** | **Mar** | **Apr.** | **May** |
| **The Number System: Know that there are numbers that are not rational, and approximate them by rational numbers.** | | | | | | | | | | |
| 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. **(8.NS.1.) (DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| 1. 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.* **(8.NS.2.) (DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| **Expressions and Equations: Work with radicals and integer exponents.** | | | | | | | | | | |
| 1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example, 32 × 3–5 = 3–3 = 1/33 = 1/27*. **(8.EE.1.)(DOK 1)** |  |  |  |  |  |  |  |  |  |  |
| 1. Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. **(8.EE.2.) (DOK 1)** |  |  |  |  |  |  |  |  |  |  |

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| 1. 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 × 108 and the population of the world as 7 × 109, and determine that the world population is more than 20 times larger.* **(8.EE.3.)(DOK1,2)** |  |  |  |  |  |  |  |  |  |  |
| 1. 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. **(8.EE.4.) (DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| **Expressions and Equations: Understand the connections between proportional relationships, lines, and linear equations.** | | | | | | | | | | |
| 1. 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.* **(8.EE.5.)(DOK 1,2,3)** |  |  |  |  |  |  |  |  |  |  |
| 1. 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*. **(8.EE.6.)(DOK 1,2,3)** |  |  |  |  |  |  |  |  |  |  |
| **Expressions and Equations: Analyze and solve linear equations and pairs of simultaneous linear equations.** | | | | | | | | | | |
| 1. Solve linear equations in one variable. **(8.EE.7.)(DOK 1,2)**    1. 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). |  |  |  |  |  |  |  |  |  |  |
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| 1. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. |  |  |  |  |  |  |  |  |  |  |
| 1. Analyze and solve pairs of simultaneous linear equations. **(8.EE.8.)(DOK 1,2,3)**    1. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. |  |  |  |  |  |  |  |  |  |  |
| * 1. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.* |  |  |  |  |  |  |  |  |  |  |
| * 1. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.* |  |  |  |  |  |  |  |  |  |  |
| **Functions: Define, evaluate, and compare functions.** | | | | | | | | | | |
| 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. **(8.F.1.) (DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| 1. 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.* **(8.F.2.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |

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| 1. 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 = s2 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.* **(8.F.3.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| **Functions:** **Use functions to model relationships between quantities.** | | | | | | | | | | |
| 1. 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. **(8.F.4.) (DOK 1,2,3)** |  |  |  |  |  |  |  |  |  |  |
| 1. 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. **(8.F.5.) (DOK 1,2,3)** |  |  |  |  |  |  |  |  |  |  |
| **Geometry: Understand congruence and similarity using physical models, transparencies, or geometry software.** | | | | | | | | | | |
| 1. Verify experimentally the properties of rotations, reflections, and translations: **(8.G.1.)DOK 2)**    1. Lines are taken to lines, and line segments to line segments of the same length. |  |  |  |  |  |  |  |  |  |  |
| * 1. Angles are taken to angles of the same measure. |  |  |  |  |  |  |  |  |  |  |
| * 1. Parallel lines are taken to parallel lines. |  |  |  |  |  |  |  |  |  |  |
| 1. 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. **(8.G.2.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| 1. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. **(8.G.3.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |

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| 1. 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. **(8.G.4.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| 1. 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.* **(8.G.5.)(DOK 1,2,3)** |  |  |  |  |  |  |  |  |  |  |
| **Geometry: Understand and apply the Pythagorean Theorem.** | | | | | | | | | | |
| 1. Explain a proof of the Pythagorean Theorem and its converse. **(8.G.6.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| 1. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **(8.G.7.)** |  |  |  |  |  |  |  |  |  |  |
| 1. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. **(8.G.8.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| **Geometry: Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.** | | | | | | | | | | |
| 1. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. **(8.G.9.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| **Statistics and Probability : Investigate patterns of association in bivariate data.** | | | | | | | | | | |
| 1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. **(8.SP.1.)(DOK 1,2,3)** |  |  |  |  |  |  |  |  |  |  |
| 1. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. **(8.SP.2.)(DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
|  | **Aug.** | **Sept** | **Oct.** | **Nov.** | **Dec.** | **Jan.** | **Feb.** | **Mar** | **Apr.** | **May** |
| 1. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.* **(8.SP.3.) (DOK 1,2)** |  |  |  |  |  |  |  |  |  |  |
| 1. 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?* **(8.SP.4.)(DOK 1,2,3)** |  |  |  |  |  |  |  |  |  |  |

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| **Mathematics Depth-Of-Knowledge Definitions - Mathematics** |

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| *Level 1 (Recall of a fact or information procedure)* includes the recall of information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm or applying a formula. That is, in mathematics a one-step, well-defined, and straight algorithmic procedure should be included at this lowest level. Other key words that signify a Level 1 include “identify,” “recall,” “recognize,” “use,” and “measure.” Verbs such as “describe” and “explain” could be classified at different levels depending on what is to be described and explained. Examples: |

* Recall or recognize a fact, term or property
* Represent in words, pictures or symbols in a math object or relationship
* Perform routine procedure like measuring

Level 2 (Basic Reasoning: Use information or conceptual knowledge, two or more steps) includes the engagement of some mental processing beyond a habitual response. A Level 2 assessment item requires students to make some decisions as to how to approach the problem or activity, whereas Level 1 requires students to demonstrate a rote response, perform a well-known algorithm, follow a set procedure (like a recipe), or perform a clearly defined series of steps. Keywords that generally distinguish a Level 2 item include “classify,” “organize,” ”estimate,” “make observations,” “collect and display data,” and “compare data.” These actions imply more than one step. For example, to compare data requires first identifying characteristics of the objects or phenomenon and then grouping or ordering the objects.

Some action verbs, such as “explain,” “describe,” or “interpret” could be classified at different levels depending on the object of the action. For example, if an item required students to explain how light affects mass by indicating there is a relationship between light and heat, this is considered a Level 2. Other Level 2 activities include explaining the purpose and use of experimental procedures; carrying out experimental procedures; making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

* Specify and explain relationships between facts, terms, properties or operations
* Select procedure according to criteria and perform it
* Solve routine multiple-step problems

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| *Level 3 (Complex Reasoning: Requires reasoning, developing a plan or a sequence of steps, working with some complexity, and considering more than one possible approach and answer)* requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. In most instances, requiring students to explain their thinking is a Level 3. Activities that require students to make conjectures are also at this level. The cognitive demands at Level 3 are complex and abstract. The complexity does **not** result from the fact that there are multiple answers, a possibility for both Levels 1 and 2, but because the task requires more demanding reasoning. An activity, however, that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve problems. |

* Analyze similarities and differences between procedures
* Formulate original problem given situation
* Formulate mathematical model for complex situation

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| *Level 4 (Extended Reasoning: Requires an investigation, time to think and process multiple conditions of the problem)* requires complex reasoning, planning, developing, and thinking most likely over an extended period of time. The extended time period is **not** a distinguishing factor if the required work is only repetitive and does **not** require applying significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2. However, if the student is to conduct a river study that requires taking into consideration a number of variables, this would be a Level 4. At Level 4, the cognitive demands of the task should be high and the work should be very complex. Students should be required to make several connections—relate ideas within the content area or among content areas—and have to select one approach among many alternatives on how the situation should be solved, in order to be at this highest level. Level 4 activities include designing and conducting experiments; making connections between a finding and related concepts and phenomena; combining and synthesizing ideas into new concepts; and critiquing experimental designs. |

* Apply mathematical model to illuminate a problem, situation
* Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results
* Design a mathematical model to inform and solve a practical or abstract situation