

Grade 5 Continued

Critical Area 5: Classifying two-dimensional figures by properties

Students build on their understanding of angle measures and parallel and perpendicular lines to explore the properties of triangles and quadrilaterals. They develop a foundation for classifying triangles or quadrilaterals by comparing the commonalities and differences of triangles or between types of quadrilaterals.

Critical Skills from 4th Grade that Connect to 5th Grade

ODE Progressions

4th Grade

- Draw and identify lines and angles, and classify shapes by properties of their lines and angles (4.G.1,2)

Information obtained from:

[Ohio's K-8 Learning Progressions](#)

5th Grade

- Classify two-dimensional figures into categories based on their properties (5.G.3,4)

Information obtained from:

[Ohio's K-8 Learning Progressions](#)

discover a pattern or structure. For instance, students use properties of operations as strategies to add, subtract, multiply and divide with whole numbers, fractions, and decimals. They examine numerical patterns and relate them to a rule or a graphical representation.

MP.8 Look for and express regularity in repeated reasoning. Fifth graders use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and their prior work with operations to understand algorithms to fluently multiply multi-digit numbers and perform all operations with decimals to hundredths. Students explore operations with fractions with visual models and begin to formulate generalizations.

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Additional Content/Informational Resources

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- The [Educators Evaluating the Quality of Instructional Products \(EQulP\) Rubric](#) provides criteria to measure alignment and overall quality of lessons and units.

Grade 5 Continued

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Instructional Resources

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- [YouCubed](#) – Showcases research-based teaching methods, mathematics tasks, videos and ideas on how to bring about high levels of student engagement.
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Andrew Stadel	John Stevens	Michael Fenton
Geoff Krall	Jon Orr	Kyle Pearce

- [Steve Wyborney](#) - Awesome web page for elementary. You will find popular activities (Splat, Hundred Maze, Subitizing, Fraction Splat, Primary Tile, Tile Area, Esti mystery)
- [MCTM Collection of Cognitively Demanding Tasks](#) - Amazing collection of web resources for finding those rich multidimensional math tasks.
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- [Estimation 180](#)-great site to have students work on estimation skills
- [Would You Rather](#)- students are given a prompt and are asked to select a path and justify their response
- [Open Middle](#)-problems that allow multiple ways to approach to solve problems, requiring higher Depth of Knowledge

Grade 5 Continued

- [Numberless Word Problems](#)-numberless word problems are designed to provide scaffolding that allows students the opportunity to develop a better understanding of the underlying structure of word problems
- [DESMOS Activities \(Grades 3-5\)](#)-these activities are designed for playful exploration of mathematical ideas

Assessment Resources

Assessment data can be collected in many forms. In most cases understanding where students are in their learning pathway is about listening to their thinking during a Number Talk, rich tasks, solution pathways used in curricular work, etc. Understanding student thinking towards a specific goal will be more impactful than focusing on what they know or don't know. A sound use of formative assessment (conversations, observations, written, thinking) in real time can offer much more instructional information than any given assessment.

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**Struggle is a situation and should not become an identity. We need to ensure mindful, appropriate responses to all assessment.*

Grade 6

What Students Learn (Critical Areas/Big Ideas) [ODE Critical Areas of Focus](#)

Critical Area 1: Connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems

Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.

Critical Skills from 5th Grade that Connect to 6th grade [ODE Progressions](#)

5th Grade

- Understand the place value system (5.NBT.1,2,3,4)
- Perform operations with multi-digit whole numbers and with decimals to hundredths (5.NBT.5,6,7)
- Use equivalent fractions as a strategy to add and subtract fractions (Fractions need not be simplified.) (5.NF.1,2)
- Apply and extend previous understandings of multiplication and division to multiply and divide fractions. (Fractions need not be simplified.) (5.NF.4,5,6,7)

6th Grade

- Understand ratio concepts and use ratio reasoning to solve problems. (6.RP.1,2,3)

Critical Area 2: Completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers

Students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understanding of numbers and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of

How to Facilitate Learning (We believe students should be doing the thinking)

[PDF Executive Summary of NCTM's Principles to Actions](#)

(The big picture of what our students deserve)

[Grade 6 Model Curriculum](#)

Instructional Supports for...

[Critical Area 1: Ratios](#)

[Critical Area 2: The Number System](#)

[Critical Area 3: Expressions and Equations](#)

[Critical Area 4: Geometry](#)

[Critical Area 5: Statistics and Probability](#)

(The links shown above direct teachers to GREAT resources for each critical area! Many examples are shown to give more meaning to standards. And, many links are provided to other resources that can support each standard cluster.)

[Teaching for Robust Learning \(Tru\) Framework](#) (Explore the five dimensions of powerful classrooms)

[Restarting School: Planning for Acceleration in 20/21](#) (Embedding missed content into current grade level material)

[Nix the Tricks](#) (Ideas for teaching concepts mathematically to help students learn)

[6th Grade Standards for Mathematical Practice](#) (Imagine these are your instructional goals; the content standards are the vehicle you use to get students behaving mathematically)

MP.1 Make sense of problems and persevere in solving them. In grade 6, students solve problems involving ratios and rates and discuss how they solved them. Students solve real-world problems through the application of algebraic and geometric

Grade 6 Continued

rational numbers and about the location of points in all four quadrants of the coordinate plane.

Critical Skills from 5th Grade that Connect to 6th grade

ODE Progressions

5th Grade

- Understand the place value system (5.NBT.1,2,3,4)
- Perform operations with multi-digit whole numbers and with decimals to hundredths (5.NBT.5,6,7)
- Use equivalent fractions as a strategy to add and subtract fractions (Fractions need not be simplified.) (5.NF.1,2)
- Apply and extend previous understandings of multiplication and division to multiply and divide fractions. (Fractions need not be simplified.) (5.NF.4,5,6,7)

6th Grade

- Apply and extend previous understandings of multiplication and division to divide fractions by fractions. (6.NS.1)
- Compute fluently with multi-digit numbers and find common factors and multiples. (6.NS.2,3,4)
- Apply and extend previous understandings of numbers to the system of rational numbers. (6.NS.5,6,7,8)

Critical Area 3: Writing, interpreting, and using expressions and equations

Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as $3x = y$) to describe relationships between quantities.

Critical Skills from 5th Grade that Connect to 6th grade

ODE Progressions

5th Grade

- Write and interpret numerical expressions. (5.OA.1,2)
- Analyze patterns and relationships. (5.OA.3)

6th Grade

concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, “What is the most efficient way to solve the problem?”, “Does this make sense?”, and “Can I solve the problem in a different way?”. Students can explain the relationships between equations, verbal descriptions, and tables and graphs. Mathematically proficient students check their answers to problems using a different method.

MP.2 Reason abstractly and quantitatively. In grade 6, students represent a wide variety of real-world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations or other meaningful moves. To reinforce students’ reasoning and understanding, teachers might ask, “How do you know?” or “What is the relationship of the quantities?”.

MP.3 Construct viable arguments and critique the reasoning of others. In grade 6, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like “How did you get that?”, “Why is that true?” “Does that always work?” They explain their thinking to others and respond to others’ thinking.

MP.4 Model with mathematics. In grade 6, students model problem situations symbolically, graphically, in tables, contextually and with drawings of quantities as needed. Students form expressions, equations, or inequalities from real-world contexts and connect symbolic and graphical representations. Students begin to represent two quantities simultaneously. Students use number lines to compare numbers and represent inequalities. They use measures of center and variability and data displays (i.e. box plots and histograms) to draw inferences about and make comparisons between data sets. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate and apply them to a problem context. Students should be encouraged to answer questions

Grade 6 Continued

- Apply and extend previous understandings of arithmetic to algebraic expressions. (6.EE.1,2,3,4)
- Reason about and solve one-variable equations and inequalities. (6.EE.5,6,7,8)
- Represent and analyze quantitative relationships between dependent and independent variables. (6.EE.9)

Critical Area 4 : Developing understanding of statistical problem solving

Building on and reinforcing their understanding of numbers, students begin to develop their ability to think statistically. The GAISE model is used as a statistical problem solving framework. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (range and interquartile range) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, gaps, peaks, and outliers in a distribution, considering the context in which the data were collected.

Critical Skills from 5th Grade that Connect to 6th grade

ODE Progressions

5th Grade

- None listed

6th Grade

- Develop understanding of statistical problem solving. (6.SP.1, 2, 3)
- Summarize and describe distributions. (6.SP.4, 5)

Critical Area 5: Solving Problems involving area, surface area, and volume

Students in Grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in Grade 7 by drawing polygons in the coordinate plane.

such as “What are some ways to represent the quantities?” or “What formula might apply in this situation?”

MP.5 Use appropriate tools strategically. Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 6 may decide to represent figures on the coordinate plane to calculate area. Number lines are used to create dot plots, histograms, and box plots to visually compare the center and variability of the data. Visual fraction models can be used to represent situations involving division of fractions. Additionally, students might use physical objects or applets to construct nets and calculate the surface area of three-dimensional figures. Students should be encouraged to answer questions such as “What approach did you try first?” or “Why was it helpful to use?”

MP.6 Attend to precision. In grade 6, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to rates, ratios, geometric figures, data displays, and components of expressions, equations or inequalities. When using ratio reasoning in solving problems, students are careful about specifying units of measure and labeling axes to clarify the correspondence with quantities in a problem. Students also learn to express numerical answers with an appropriate degree of precision when working with rational numbers in a situational problem. Teachers might ask, “What mathematical language, definitions, or properties can you use to explain ___?”

MP.7 Look for and make use of structure. Students routinely seek patterns or structures to model and solve problems. For instance, students recognize patterns that exist in ratio tables recognizing both the additive and multiplicative properties. Students apply properties to generate equivalent expressions (i.e. $6 + 2mn = 2(3 + mn)$ by distributive property) and solve equations (i.e. $2cc + 3 = 15$, $2cc = 12$ by subtraction property of equality; $cc = 6$ by division property of equality). Students compose and decompose two- and three-dimensional figures to solve real-world problems involving area and volume. Teachers might ask, “What do you notice when ___?” or “What parts of the problem might you eliminate, simplify, or ___?”

MP.8 Look for and express regularity in repeated reasoning. In grade 6, students use repeated reasoning to understand

Grade 6 Continued

Critical Skills from 5th Grade that Connect to 6th grade

ODE Progressions

5th Grade

- Graph points on the coordinate plane to solve real-world and mathematical problems (5.G.1, 2)
- Classify two-dimensional figures into categories based on their properties (5.G.3, 4)
- Convert like measurement units within a given measurement system. (5.MD.1)
- Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition. (5.MD.3, 4, 5)

6th Grade

- Solve real-world and mathematical problems involving area, surface area, and volume. (6.G.1, 2, 3, 4)

algorithms and make generalizations about patterns. During multiple opportunities to solve and model problems, they may notice that $aa\ bb \div cc\ dd = aaaa\ bbbb$ and construct other examples and models that confirm their generalization. Students connect place value and their prior work with operations to understand algorithms to fluently divide multi-digit numbers and perform all operations with multi-digit decimals. Students informally begin to make connections between rates and representations showing the relationships between quantities. Students should be encouraged to answer questions such as, “How would we prove that ___?” or “How is this situation like and different from other situations?”

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- [DESMOS Graphing Calculator](#) Online math tool for making tables, graphs, and equations
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- [DESMOS Geometry](#) Online math tool for geometry

Grade 6 Continued

Assessment Resources

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Grade 7

What Students Learn (Critical Areas/Big Ideas) ODE Critical Areas of Focus

Critical Area 1: Developing understanding of and applying proportional relationships

Students extend their understanding of ratios and develop understanding of proportionality to solve single and multi-step problems. Students use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships.

Critical Skills from 6th Grade that Connect to 7th grade ODE Progressions

6th Grade

- Understand ratio concepts and use ratio reasoning to solve problems. (6.RP.1,2,3)
- Solve real-world and mathematical problems involving area, surface area, and volume. (6.G.1,2,3,4)

7th Grade

- Analyze proportional relationships and use them to solve real-world and mathematical problems. (7.RP.1,2,3)
- Draw, construct, and describe geometrical figures and describe the relationships between them. (7.G.1)

Critical Area 2: Developing understanding of operations with rational numbers and working with expressions and linear equations.

Students develop a unified understanding of numbers, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts, e.g., amounts owed or temperatures below zero, students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.

How to Facilitate Learning

(We believe students should be doing the thinking)

PDF Executive Summary of NCTM's Principles to Actions

(The big picture of what our students deserve)

Grade 7 Model Curriculum

Instructional Supports for...

Critical Area 1: Ratios and Proportional Relationships, Geometry

Critical Area 2: The Number System

Critical Area 3: Geometry, Expressions and Equations

Critical Area 4: Statistics and Probability

Critical Area 5: Statistics and Probability

(The links shown above direct teachers to GREAT resources for each critical area! Many examples are shown to give more meaning to standards. And, many links are provided to other resources that can support each standard cluster.)

Teaching for Robust Learning (Tru) Framework (Explore the five dimensions of powerful classrooms)

Restarting School: Planning for Acceleration in 20/21

(Embedding missed content into current grade level material)

Nix the Tricks

(Ideas for teaching concepts mathematically to help students learn)

7th Grade Standards for Mathematical Practice (Imagine these are your instructional goals; the content standards are the vehicle you use to get students behaving mathematically)

MP.1 Make sense of problems and persevere in solving them. In grade 7, students solve problems involving ratios and rates and discuss how they solved them. Students solve real-world problems through the application of

Grade 7 Continued

Critical Skills from 6th Grade that Connect to 7th grade ODE Progressions

6th Grade

- Apply and extend previous understandings of multiplication and division to divide fractions by fractions. (6.NS.1)
- Compute fluently with multi-digit numbers and find common factors and multiples. (6.NS.2,3,4)
- Apply and extend previous understandings of numbers to the system of rational numbers. (6.NS.5,6,7,8)
- Understand ratio concepts and use ratio reasoning to solve problems. (6.RP.1,2,3)
- Apply and extend previous understandings of arithmetic to algebraic expressions. (6.EE.1,2,3,4)
- Reason about and solve one-variable equations and inequalities. (6.EE.5,6,7,8)
- Represent and analyze quantitative relationships between dependent and independent variables (6.EE.9)

7th Grade

- Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. (7.NS.1,2,3)
- Analyze proportional relationships and use them to solve real-world and mathematical problems. (7.RP.2)
- Use properties of operations to generate equivalent expressions. (7.EE.1,2)
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (7.EE.3, 4)

Critical Area 3: Solving problems involving scale drawings and informal geometric constructions, angles, and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume.

Students continue their work with area from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity in Grade 8 they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. Geometry 7.G Draw, construct, and describe

Critical Skills from 6th Grade that Connect to 7th grade ODE Progressions

algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, “What is the most efficient way to solve the problem?”, “Does this make sense?”, and “Can I solve the problem in a different way?”. When students compare arithmetic and algebraic solutions to the same problem, they identify correspondences between different approaches.

MP.2 Reason abstractly and quantitatively. In grade 7, students represent a wide variety of real-world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. Students contextualize to understand the meaning of the number or variable as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.

MP.3 Construct viable arguments and critique the reasoning of others. In grade 7, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. For example, as students notice when geometric conditions determine a unique triangle, more than one triangle, or no triangle, they have an opportunity to construct viable arguments and critique the reasoning of others. Students should be encouraged to answer questions such as these: “How did you get that?” “Why is that true?” “Does that always work?” They explain their thinking to others and respond to others’ thinking.

MP.4 Model with mathematics. In grade 7, students model problem situations symbolically, graphically, in tables, and contextually. Students form expressions, equations, or inequalities from real-world contexts and connect symbolic and graphical representations. Students use experiments or simulations to generate data sets and create probability models. Proportional relationships present opportunities for modeling. For example, for modeling purposes, the number of people who live in an apartment building might be taken as proportional to the number of stories in the building. Students should be

Grade 7 Continued

6th Grade

- Solve real-world and mathematical problems involving area, surface area, and volume. (6.G.1,2,4)
- Reason about and solve one-variable equations and inequalities. (6.EE.5,6,7)

7th Grade

- Draw, construct, and describe geometrical figures and describe the relationships between them. (7.G.1,2,3)
- Solve real-life and mathematical problems involving angle measure, circles, area, surface area, and volume. (7.G.4,5,6)
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (7.EE.4)

Critical Area 4 : Drawing inferences about populations based on samples.

Students build on their previous work with statistical problem solving through the use of the GAISE model framework. They summarize and describe distributions representing one population and informally compare two populations. Students interpret numerical data sets using mean absolute deviation. They begin informal work with sampling to generate data sets: learn about the importance of representative samples for drawing inferences and the impact of bias.

Critical Skills from 6th Grade that Connect to 7th grade

ODE Progressions

6th Grade

- Develop understanding of statistical problem solving. (6.SP.1,2,3)
- Summarize and describe distributions. (6.SP.5)

7th Grade

- Use sampling to draw conclusions about a population. (7.SP.1)
- Broaden understanding of statistical problem solving. (7.SP.2)
- Summarize and describe distributions representing one population and draw informal comparisons between two populations. (7.SP.3)

Critical Area 5: Investigating chance

Students build upon previous understandings as they develop concepts of probability. They investigate relevant chance events and develop models to determine and compare probabilities. They analyze the frequencies of the experimental results against their predictions, justifying any discrepancies. Students extend their investigations with compound events representing the possible outcomes in tree diagrams, tables, lists, and ultimately through designing and using simulations.

Critical Skills from 6th Grade that Connect to 7th grade

ODE Progressions

encouraged to answer questions such as “What are some ways to represent the quantities?” or “How might it help to create a table, chart, or graph?”

MP.5 Use appropriate tools strategically. Students consider available tools (including estimation and technology) when solving a mathematical problem and decide when certain tools might be helpful. For instance, students in grade 7 may decide to represent similar data sets using dot plots with the same scale to visually compare the center and variability of the data. Students might use physical objects or applets to generate probability data and use graphing calculators or spreadsheets to manage and represent data in different forms. Teachers might ask, “What approach are you considering?” or “Why was it helpful to use ___?”

MP.6 Attend to precision. In grade 7, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students define variables, specify units of measure, and label axes accurately. Students use appropriate terminology when referring to rates, ratios, probability models, geometric figures, data displays, and components of expressions, equations or inequalities. Teachers might ask, “What mathematical language, definitions, or properties can you use to explain ___?”

MP.7 Look for and make use of structure. Students routinely seek patterns or structures to model and solve problems. For instance, students recognize patterns that exist in ratio tables making connections between the constant of proportionality in a table with the slope of a graph. Students apply properties to generate equivalent expressions (i.e. $6 + 2nm = 2(3 + nm)$ by distributive property) and solve equations (i.e. $2cc + 3 = 15$, $2cc = 12$ by subtraction property of equality; $c = 6$ by division property of equality). Students compose and decompose two- and three-dimensional figures to solve real world problems involving scale drawings, surface area, and volume. Students examine tree diagrams or systematic lists to determine the sample space for compound events and verify that they have listed all possibilities. Solving an equation such as $8 = 4(nm - 12)$ is easier if students can see and make use of structure, temporarily viewing $(nm - 12)$ as a single entity.

MP.8 Look for and express regularity in repeated

Grade 7 Continued

6th Grade

- None listed

7th Grade

- Investigate chance processes and develop, use, and evaluate probability models. (7.SP.5-8)

reasoning. In grade 7, students use repeated reasoning to understand algorithms and make generalizations about patterns. During multiple opportunities to solve and model problems, they may notice that $aa\ bb = cc\ dd$ if and only if $aaaa = bbbb$ and construct other examples and models that confirm their generalization. Students should be encouraged to answer questions such as “How would we prove that ___?” or “How is this situation both similar to and different from other situations using these operations?”

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Grade 7 Continued

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Grade 7 Continued

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Grade 8

What Students Learn (Critical Areas/Big Ideas)

ODE Critical Areas of Focus

Critical Area 1: Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations.

Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ($y/x = m$ or $y = mx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x -coordinate changes by an amount A , the output or y -coordinate changes by the amount $m \cdot A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y -intercept) in terms of the situation. Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables graphically or by simple inspection; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

Critical Skills from 7th Grade that Connect to 8th grade

ODE Progressions

7th Grade

- Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (7.EE.4)
- Analyze proportional relationships and use them to solve real-world and mathematical problems. (7.RP.2)

8th Grade

- Understand the connections between proportional relationships, lines, and linear equations. (8.EE.5,6)
- Analyze and solve linear equations and pairs of simultaneous linear equations. (8.EE.7)
- Analyze and solve linear equations and pairs of simultaneous linear equations. (8.EE.8)
- Investigate patterns of association in bivariate data. (8.SP.1-4)

How to Facilitate Learning

(We believe students should be doing the thinking)

[PDF Executive Summary of NCTM's Principles to Actions](#)

(The big picture of what our students deserve)

Grade 8 Model Curriculum

Instructional Supports for...

[Critical Area 1: Expressions and Equations, Statistics and Probability](#)

[Critical Area 2: Functions](#)

[Critical Area 3: Expressions and Equations, Geometry](#)

[Critical Area 4: The Number System, Expressions and Equations](#)

(The links shown above direct teachers to GREAT resources for each critical area! Many examples are shown to give more meaning to standards. And, many links are provided to other resources that can support each standard cluster.)

[Teaching for Robust Learning \(Tru\) Framework](#)
(Explore the five dimensions of powerful classrooms)

[Restarting School: Planning for Acceleration in 20/21](#)
(Embedding missed content into current grade level material)

[Nix the Tricks](#)
(Ideas for teaching concepts mathematically to help students learn)

[8th Grade Standards for Mathematical Practice](#)
(Imagine these are your instructional goals; the content standards are the vehicle you use to get students behaving mathematically)

MP.1 Make sense of problems and persevere in solving them. In grade 8, students solve real-world problems through the application of algebraic and geometric concepts. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check

Grade 8 Continued

Critical Area 2: Grasping the concept of a function and using functions to describe quantitative relationships.

Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

Critical Skills from 7th Grade that Connect to 8th grade

[ODE Progressions](#)

7th Grade

- Analyze proportional relationships and use them to solve real-world and mathematical problems. (7.RP.2)
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (7.EE.4)

8th Grade

- Define, evaluate, and compare functions. (8.F.1,2,3)
- Use functions to model relationships between quantities. (8.F.4,5)

Critical Area 3: Analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

Critical Skills from 7th Grade that Connect to 8th grade

[ODE Progressions](#)

their thinking by asking themselves, “What is the most efficient way to solve the problem?”, “Does this make sense?”, and “Can I solve the problem in a different way?”

MP.2 Reason abstractly and quantitatively. In grade 8, students represent a wide variety of real-world contexts through the use of real numbers and variables in mathematical expressions, equations, and inequalities. They examine patterns in data and assess the degree of linearity of functions. Students contextualize to understand the meaning of the number(s) or variable(s) as related to the problem and decontextualize to manipulate symbolic representations by applying properties of operations.

MP.3 Construct viable arguments and critique the reasoning of others. In grade 8, students construct arguments using verbal or written explanations accompanied by expressions, equations, inequalities, models, and graphs, tables, and other data displays (i.e. box plots, dot plots, histograms, etc.). They further refine their mathematical communication skills through mathematical discussions in which they critically evaluate their own thinking and the thinking of other students. They pose questions like “How did you get that?”, “Why is that true?” “Does that always work?” They explain their thinking to others and respond to others’ thinking.

MP.4 Model with mathematics. In grade 8, students model problem situations symbolically, graphically, in tables, and contextually. Working with the new concept of a function, students learn that relationships between variable quantities in the real-world often satisfy a dependent relationship, in that one quantity determines the value of another. Students form expressions, equations, or inequalities from real-world contexts and connect symbolic and graphical representations. Students use scatterplots to represent data and describe associations between variables. Students need many opportunities to connect and explain the connections between the different representations. They should be able to use all of these representations as appropriate to a problem context. Students should be encouraged to answer questions such as “What are some ways to represent the quantities?” or “How might it help to create a table, chart, graph, or ___?”

MP.5 Use appropriate tools strategically. Students consider available tools (including estimation and technology) when solving a mathematical problem and

Grade 8 Continued

7th Grade

- Analyze proportional relationships and use them to solve real-world and mathematical problems. (7.RP.2)
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (7.EE.4)
- Draw, construct, and describe geometrical figures and describe the relationships between them. (7.G.1-2)
- Solve real-life and mathematical problems involving angle measure, circles, area, surface area, and volume. (7.G.5-6)

8th Grade

- Understand the connections between proportional relationships, lines, and linear equations. (8.EE.6)
- Understand congruence and similarity using physical models, transparencies, or geometry software. (8.G.1,2,3,4,5)
- Understand and apply the Pythagorean Theorem. (8.G.6,7,8)
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. (8.G.9)

Critical Area 4 : Working with irrational numbers, integer exponents, and scientific notation

Students explore irrational numbers and their approximations. They extend work with expressions and equations with integer exponents, square and cube roots. Understandings of very large and very small numbers, the place value system, and exponents are combined in representations and computations with scientific notation.

Critical Skills from 7th Grade that Connect to 8th grade ODE Progressions

7th Grade

- Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. (7.NS.2-3)
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (7.EE.3)

8th Grade

- Know that there are numbers that are not rational, and approximate them by rational numbers. (8.NS.1,2)
- Work with radicals and integer exponents. (8.EE.1,2,3,4)

decide when certain tools might be helpful. For instance, students in grade 8 may translate a set of data given in tabular form to a graphical representation to compare it to another data set. Students might draw pictures, use applets, or write equations to show the between the angles created by a transversal that intersects parallel lines. Teachers might ask, “What approach are you considering?” or “Why was it helpful to use ___?” MP.6 Attend to precision. In grade 8, students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to the number system, functions, geometric figures, and data displays. Teachers might ask, “What mathematical language, definitions, or properties can you use to explain ___?”

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MP.7 Look for and make use of structure. Students routinely seek patterns or structures to model and solve problems. In grade 8, students apply properties to generate equivalent expressions and solve equations. Students examine patterns in tables and graphs to generate equations and describe relationships. Additionally, students experimentally verify the effects of transformations and describe them in terms of congruence and similarity.

MP.8 Look for and express regularity in repeated reasoning. In grade eight, students use repeated reasoning to understand the slope formula and to make sense of rational and irrational numbers. Through multiple opportunities to model linear relationships, they notice that the slope of the graph of the linear relationship and the rate of change of the associated function are the same. For example, as students repeatedly check whether points are on the line with a slope of 3 that goes through the point (1, 2), they might abstract the equation of the line in the form $(y - 2)/(x - 1) = 3$. Students should be encouraged to answer questions such as “How would we prove that ___?” or “How is this situation like and different from other situations using these operations?”

Grade 8 Continued

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Algebra 2 Continued

effect regardless of the type of the underlying functions. They Identify appropriate types of functions to model a situation, they adjust parameters to improve the model, and they compare models by analyzing appropriateness of fit and making judgments about the domain over which model is a good fit. The description of modeling as “the process of choosing and using mathematics and statistics to analyze empirical situations, to understand them better, and to make decisions” is at the heart of this unit. The narrative discussion and diagram of the modeling cycle should be considered when knowledge of functions, statistics, and geometry is applied in a modeling context.

$$\begin{array}{ll} i^2 = -1 & i^6 = -1 \\ i^3 = -i & i^7 = -i \\ i^4 = 1 & i^8 = 1 \end{array}$$

students use this observation to make a conjecture about any power of i .

Nix the Tricks

(Ideas for teaching concepts mathematically to help students learn)

Resources for High School Instruction

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** Referenced in the Model Curriculum with Instructional Supports

- 3-Act Math Tasks
 - [Dan Meyer](#)** - blog contains lots of thought-provoking information as well as 3-act tasks by topic
 - [Robert Kaplinsky](#)** - lessons easily identified by course
 - [Tap Into Teen Minds](#)** - search for lessons by standard or topic
 - [When Math Happens](#)** - tasks by course up through Calculus
 - [Yummy Math](#)** - tasks by conceptual category
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- [Achieve the Core Assessments](#) contains mini assessments to gauge student understanding of specific standards.
- [Depth of Knowledge Sample Problems](#) by Conceptual Category for High School
- [Mathematics Assessment Project](#) provides resources for both formative and summative assessment
- [ODE Testing Resources](#)
- [ODE Instructional Strategies for Mathematics](#) supports assessment using Depth of Knowledge

Closing Thoughts

This document offers many amazing resources for understanding content and how to deliver content in a mathematics classroom. We are encouraged and hopeful by the progress our state has made in mathematics instruction, but our work is far from complete! We need to move from knowledge to deep understanding of the Ohio Learning Standards and how they interact with each other to create a wonderful connected web of learning. We need to learn and reflect on how students learn mathematics developmentally and how building agency and identity are just as important as content. Please consider avenues to “sharpen your saw” and grow in your craft. No one person has all the answers or has reached the pinnacle of understanding on how to deliver the content from their discipline. This work is hard, and is a slow metamorphosis. We encourage a process of building beliefs and visions of what students deserve and learning how to align practices with those beliefs. It ensures we are doing what the research suggests is best for students, not what is easiest for adults. Although we are proud and pleased to be embedded in Ohio’s math community, we also know we have lots of understanding and growth to do as a professional community. This document was prepared to help educators post Covid-19, but we view it also as a document and calling to continue improving our discipline. This document and appropriate professional development will be an impetus for both. Please remember when planning instruction to focus on Mathematical Practices and work diligently to ensure the students are doing the thinking.

“What we learn today does not make yesterday wrong; it only makes tomorrow better.” Unknown

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