Orchard Now and the Common Core Standards for Mathematics

A Position Paper

Executive Summary

In 2010, the Common Core State Standards Initiative, a state-led movement headed by the Council of Chief State School Officers (CCSSO) and the National Governors Association for Best Practices (NGA Center), was developed to create a common set of expectations for educational goals for prekindergarten through grade 12 curriculum, all designed to adequately prepare children for higher education and future employment. Orchard Now provides individualized learning paths that fully adhere to the Common Core Standards for Mathematics through the use of targeted instructional activities, assessments and practice questions.

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Introduction

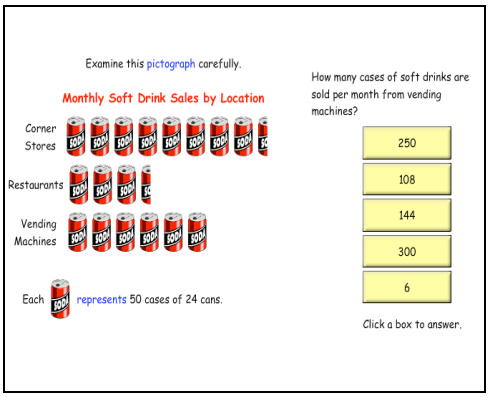
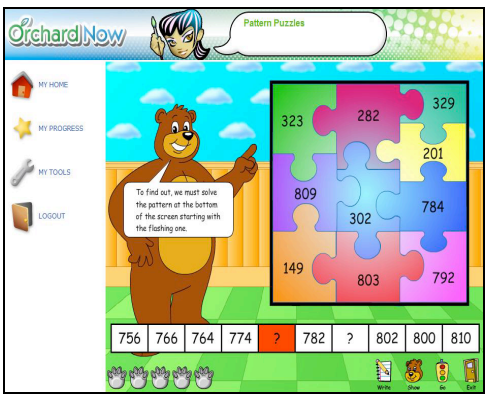
The Common Core State Standards Initiative, a state-led movement headed by the Council of Chief State School Officers (CCSSO) and the National Governors Association for Best Practices (NGA Center), was developed to create a common set of expectations for educational goals for prekindergarten through grade 12 curriculum, all designed to adequately prepare children for higher education and future employment (About the Standards, 2011). Developed in partnership with teachers, parents, educational experts and school administrators, the standards outline skill sets, currently in English Language Arts and Mathematics, which educators should seek to develop in their students. The Mathematics section of the Common Core State Standards Initiative focuses on two important longstanding mathematical "processes and proficiencies" (Common Core State Standards for Mathematics, p. 6):

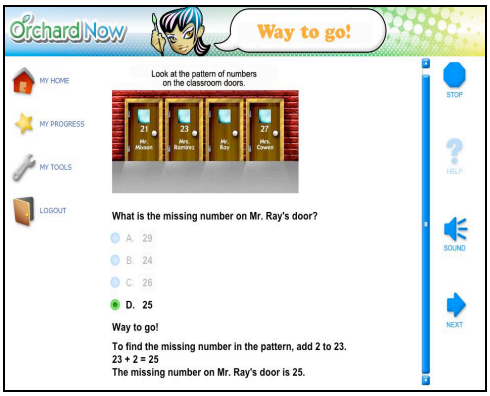
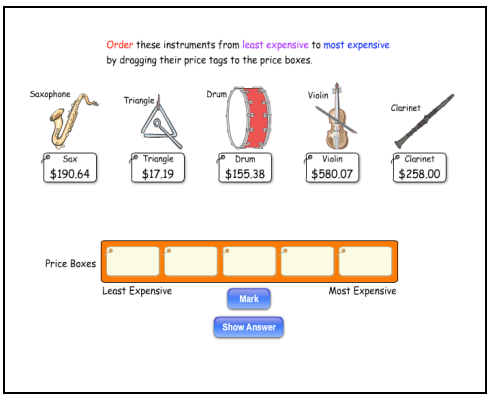
- "NCTM process standards of problem solving, reasoning and proof, communication, representation and connections; and
- "The strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately) and productive disposition (habitual inclination to see mathematics as sensible, useful and worthwhile, coupled with a belief in diligence and one's own efficacy)" (Common Core State Standards for Mathematics, p. 6).

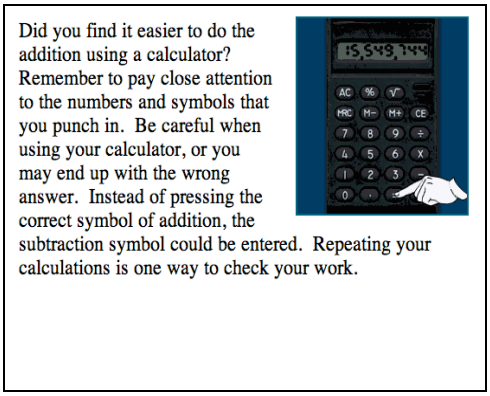
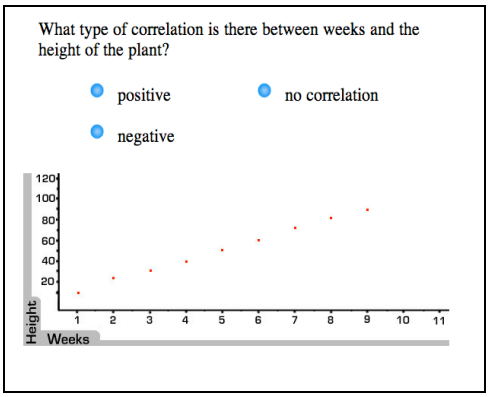
Designed to foster a positive relationship between students and mathematics, the two points clearly illustrate that the Common Core State Standard Initiative focuses on students' abilities to understand the reasons behind mathematical practices rather than strictly on computation. This position paper addresses the ways that Orchard Now successfully complies with the Common Core Standards for Mathematics from prekindergarten through grade 8 and encourages positive, engaging and effective educational technology methods for teaching students about the discipline. The core areas of Mathematical Practice and Content Standards are explored in this paper, and each section examines and demonstrates how Orchard Now consistently aligns to Common Core State Standards for Mathematics based on individualized and interactive instruction.

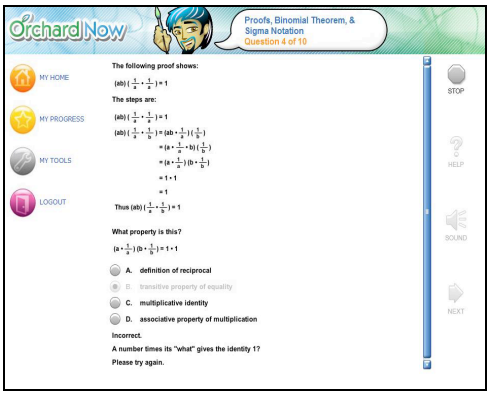
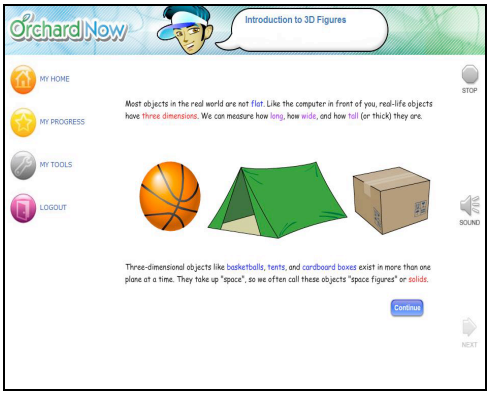
Standards for Mathematical Practice

Currently, the Common Core State Standard Initiative has a set of eight standards for mathematical practice, the purpose of which are to ensure effective competency in mathematical skills. The eight concepts are listed below followed by a description of the ways that Orchard Now demonstrates and fully adheres to the standards through individualized learning paths utilizing targeted instructional activities, assessments and practice questions.

Standards for Mathematical Practice	Orchard Now Alignment
• ***Make sense of problems and persevere in solving them.*** Students are able to understand and analyze all aspects of a problem, plan a pathway for a solution, consider similar problems in the process of solving, make connections between descriptions, graphs and verbal directions, check their answers using different methods and have the ability to understand multiple approaches in solving a single problem (Common Core State Standards for Mathematics, p. 6).	• Orchard Now employs the use of tutorials and interactive activities to give students hands-on experience with problem solving. Guided instruction and voiced explanations assist students in mastering problem solving strategies, enabling students to understand how problems are structured, how to appropriately solve them and to create connections between similar problems.  *Examining Pictographs/grade 6*
• ***Reason abstractly and quantitatively.*** Students are able to decontextualize a problem by abstracting it, and utilizing or manipulating symbols, while also being able to contextualize the same symbols within the proposed problem. They are able to reason quantitatively by knowing and being able to use different properties of operations, consider all units involved and understand the meaning of quantities (Common Core State Standards for Mathematics, p. 6).	• The interactive nature of Orchard Now allows students to decontextualize problems by allowing them to see each aspect of a problem separately through visual representations. Practice activities promote abstract reasoning and encourage quantitative thought processes by learning beyond sole computation practice—students develop long-term and transferable problem solving skills by becoming active participants in the learning process.  *Pattern Puzzles/grade 3*

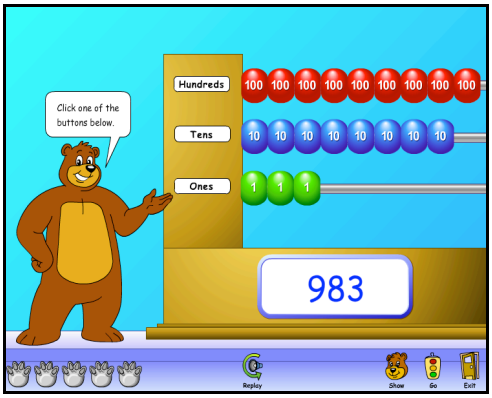
• ***Construct viable arguments and critique the reasoning of others.*** Students can make conjectures, analyze statements by separating them into cases, justify conclusions and communicate those answers to others. Students read or listen to arguments made by others and have the ability to decide whether the conclusions make sense (Common Core State Standards for Mathematics, p. 6-7).	• Orchard Now promotes critical thinking and logical reasoning by offering opportunities for students to apply their knowledge and skill in interactive practice activities. Students synthesize data, apply understanding to given contexts, and reason logically to solve problems. Animated lessons guide students in assessing conclusions and enable them to communicate reasoning in follow-up activities and practice questions. Orchard Now also incorporates oral instruction to promote skills in listening, critical thought and analysis during the problem solving process.  *Skip Counting/grade 3*
• ***Model with mathematics.*** Students are able to use the mathematical skills they know in practical situations to solve problems in society, the workplace and everyday life. They are able to apply their skills to analyze problems in the community or plan a school event; students also have the ability to use diagrams, graphs, formulas, flowcharts and two-way tables (Common Core State Standards for Mathematics, p. 7).	• Featuring skills that can be applied in real-world settings such as estimation, probability and knowledge of how to count and manipulate money, Orchard Now successfully prepares students to utilize mathematical skills both inside and outside the classroom setting. Guided instruction and activities that challenge students to apply critical thinking establishes Orchard Now as a tool for developing positive mathematical habits transferable to real-world problem solving situations.  *Order Price From Least Expensive to Most Expensive/grade 4*

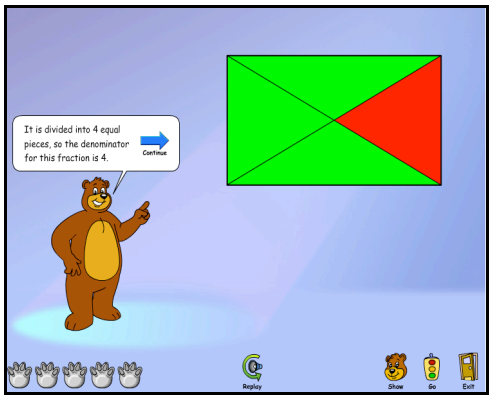
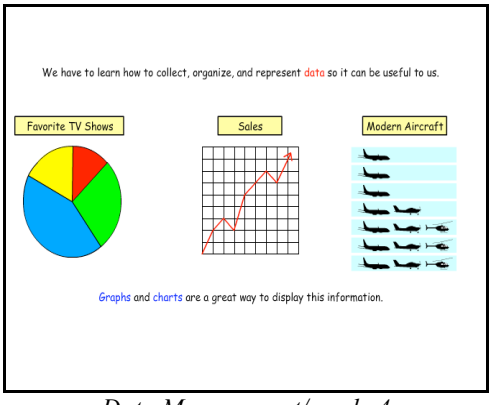
• ***Use appropriate tools strategically.*** Students are able to successfully identify and utilize tools at their disposal for solving mathematical problems, such as rulers, protractors, pencil and paper, and calculators. They are able to utilize technology as a tool to deepen and continue exploring their understanding of concepts (Common Core State Standards for Mathematics, p. 7).	• Orchard Now provides innovative educational technology in each activity so students have at their disposal the tools needed to deepen understanding of mathematical skills. Activities encourage students to utilize interactive resources built into the program, such as rulers and calculators, to augment comprehension of presented problems while learning fundamental problem solving principles.  Did you find it easier to do the addition using a calculator? Remember to pay close attention to the numbers and symbols that you punch in. Be careful when using your calculator, or you may end up with the wrong answer. Instead of pressing the correct symbol of addition, the subtraction symbol could be entered. Repeating your calculations is one way to check your work. *Adding With A Calculator/grade 7*
• ***Attend to precision.*** Students proficient in mathematics communicate with precision to others and are able to clearly define their strategies and reasoning. They understand and are able to state the meaning of the symbols they use, carefully label charts and graphs, and calculate accurately and consistently (Common Core State Standards for Mathematics, p. 7).	• In Orchard Now's customized learning paths, students interactively learn how to solve problems, present solutions with precision, and master the ability to understand and trace their reasons and strategies. The employment of animated activities allows students to be fully engaged in the learning process and enables them to command ownership in establishing precision while problem solving. Students are designed to be attentive participants in Orchard Now activities, situating opportunities to develop maximum precision skills by actively partaking in and communicating their understanding of mathematical concepts in each phase of the learning process.  *Scattergrams/grade 8*

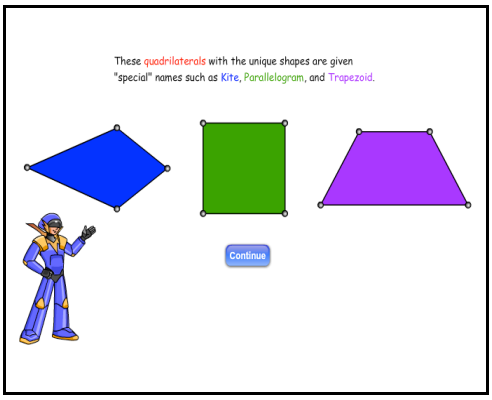
• ***Look for and make use of structure.*** Students should be able to determine a pattern or structure to a proposed problem. In younger students this can manifest in sorting shapes according to size, whereas older students can see more complex concepts such as the distributive property, or algebraic problems as both single objects or being comprised of several objects (Common Core State Standards for Mathematics, p. 8).	• Orchard Now encourages the ability of students at all levels to see the structure of mathematics. Through activities involving sorting and labeling shapes, identifying patterns and the application of standard equations, students develop the ability to understand patterns and structures, and apply these skills to future mathematical problems. In early grades, Orchard Now activities promote foundational skills in pattern and structure while higher grades practice, refine and extend knowledge by introducing complex concepts of operational properties and algebraic problems.  *Proofs, Binomial Theorem, & Sigma Notation/grade 9*
• ***Look for and express regularity in repeated reasoning.*** Mathematically proficient students are continually aware of the process in solving problems and pay attention to the details in this process. They may be aware of repeated calculations and be able to create conclusions resulting from this by utilizing equations or mathematical rules as their guide. Students continue to address the reasonableness of approach and results (Common Core State Standards for Mathematics, p. 8).	• Through the usage of Orchard Now activities, students are exposed to consistency in thinking about and solving problems. The interactive activities encourage students to pay attention to small details and challenge them to continually utilize effective reasoning skills. Orchard Now prepares students for lifelong dexterity in reasoning by offering multiple scenarios to explore repeated reasoning at all skill levels. Through a powerful combination of real-life word problems, computation, and multi-step exercises delivered in interactive and engaging activities, students are challenged to draw reasoning across situations and develop awareness in methods of problem solving.  *Introduction to 3D Figures/grade 5*

Standards

Content Standards: Prekindergarten Through Grade 5

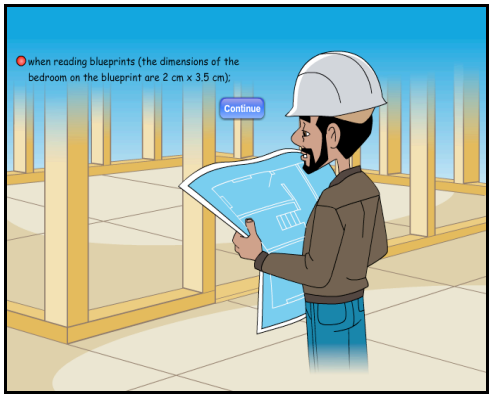
Content Standards	Orchard Now Alignment
• ***Operations and Algebraic Thinking.*** Instructional programs from prekindergarten through grade 5 should enable all students to: • Represent and solve problems involving addition, subtraction, multiplication and division. • Solve problems involving the four operations, and identify and explain patterns in arithmetic. • Gain familiarity with factors and multiples. • Generate and analyze patterns and relationships.	• From such activities as "Subtraction Soccer" in first grade to tutorials such as "Properties of Addition" in fifth grade, students learn how to utilize addition, subtraction, multiplication and division. Orchard Now activities introduce students to the four operations and encourages practice and participation, allowing them to garner in-depth information about fundamental mathematical operations in addition to understanding and generating patterns and relationships. Fundamental problem solving skills are presented and practiced as students master conceptual knowledge of operations and their relationships to one another.  *Subtraction Soccer/grade 1*
• ***Number and Operations in Base Ten.*** Instructional programs from kindergarten through grade 5 should enable all students to: • Understand place value. • Use place value understanding and properties of operations to add, subtract, and perform multi-digit arithmetic. • Perform operations with multi-digit whole numbers and with decimals to hundredths.	• Orchard Now offers extensive instruction and practice in place value at all skill levels. Activities such as "Abacus Fun" in second grade engages students in representing three-digit numbers using properties of place value. In higher grades, students refine place value understanding by recognizing place value with digits up to hundredths, thousands and millions. In fifth grade, students also explore place value charts in tutorials such as "Place Value and Large Numbers" and "Place Value and Decimals."  *Abacus Fun/grade 2*

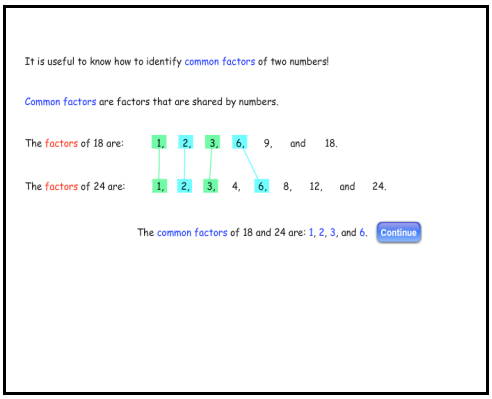
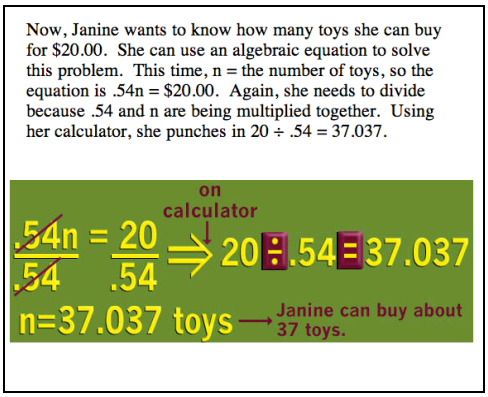
• ***Number and Operations—Fractions.*** Instructional programs from prekindergarten through grade 5 should enable all students to: • Develop understanding of fractions as numbers and extend understanding of fraction equivalence and ordering. • Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers. • Understand decimal notation for fractions, and compare decimal fractions. • Use equivalent fractions as a strategy to add and subtract fractions. • Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	• In Orchard Now, students gain a greater understanding of estimating fraction sizes, simplifying fractions, along with adding, subtracting, multiplying and dividing fractions. From activities such as "Fraction Flags" in first grade to tutorials such as "Fractions: Multiplication and Division" and "Fractions: Addition and Subtraction" in fourth grade, students are exposed to extensive fraction strategies at all skill levels. In early grades, students master basic concepts of fractions, while higher grades cover problem solving strategies for fraction conversions, equivalent fractions, least common denominator, and multiplication, division, addition and subtraction of proper and improper fractions.  *Fraction Flags/grade 1*
• ***Measurement and Data.*** Instructional programs from prekindergarten through grade 5 should enable all students to: • Classify objects and count the number of objects in categories. • Tell and write time. • Represent and interpret data. • Measure and estimate lengths in standard units. • Relate addition and subtraction to length. • Work with time and money. • Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects. • Geometric measurement: understand concepts of area and relate area to multiplication and to addition, recognize perimeter as an attribute of plane figures and distinguish between linear and area measures, understand concepts of angle and measure angles and volume. • Convert like measurement units within a given measurement system.	• Students solve real-life problems about time, money, temperature and measurement, allowing students to connect mathematical concepts to practical situations. Students also work extensively with measurement conversion, units of measures and word problems pertaining to mass, volume and distance. Data management is also presented extensively in activities such as "Data Management" in fourth grade, in which students are introduced to various ways of collecting, validating and interpreting data. Depiction of data is explored through activities involving pictographs, bar graphs, line graphs and circle graphs, and students refine skills such as labeling graphs, using many-to-one correspondence and assigning a scale.  *Data Management/grade 4*

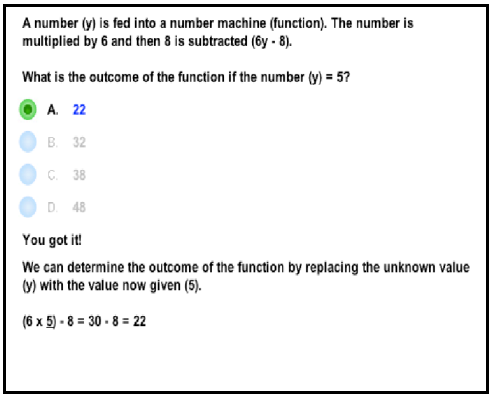
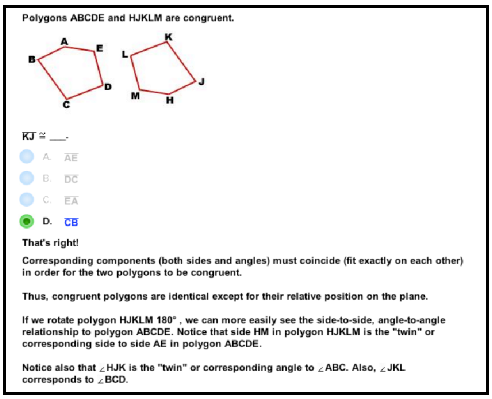
• ***Geometry.*** Instructional programs from prekindergarten through grade 5 should enable all students to: • Reason with shapes and their attributes. • Draw and identify lines and angles, and classify shapes by properties of their lines and angles. • Graph points on the coordinate plane to solve real-world and mathematical problems. • Classify two-dimensional figures into categories based on their properties.	• Geometry, with a special focus on two- and three-dimensional figures, is comprehensively integrated into Orchard Now across skill levels. In early grades, students identify basic shapes and attributes, while higher grades engage students in in-depth coverage of geometric attributes. Skill areas, such as "Quadrilaterals" in grade five, guide students in examining rules for classification of quadrilaterals, lengths of sides, number of parallel lines, interior angles and measuring diagonals. Students learn important geometric terms such as kite, parallelogram, trapezoid, rhombus, rectangle and square, while labeling quadrilaterals and classifying them through the application of rules.  *Quadrilaterals/grade 5*

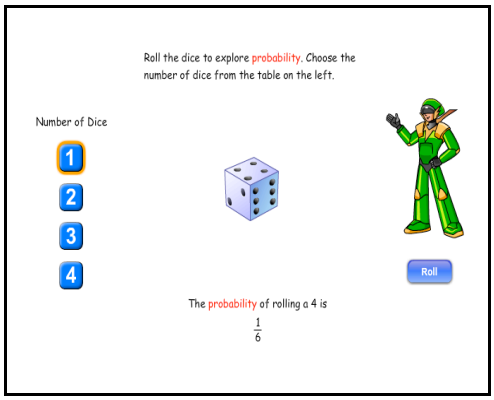
Standards

Content Standards: Grade 6 Through Grade 8

Content Standards	Orchard Now Alignment
• ***Ratios and Proportional Relationships.*** Instructional programs from grade 6 through grade 8 should enable all students to: • Understand ratio concepts and use ratio reasoning to solve problems. • Analyze proportional relationships and use them to solve real-world and mathematical problems.	• In "Welcome to Rate, Ratio and Proportion" students recognize proportions, rates and ratios in real-life applications and complete problems using context clues. "Using Proportions I" teaches students to use proportion to find the percent of a given number in multi-step word problems. An emphasis on reasoning and real-world applications is present in all Orchard Now ratio lessons across grade levels.  *Welcome to Rate, Ratio and Proportion/grade 6*

• ***The Number System.*** Instructional programs from grade 6 through grade 8 should enable all students to: • Apply and extend previous understandings of multiplication and division to divide fractions by fractions. • Compute fluently with multi-digit numbers and find common factors and multiples. • Apply and extend previous understandings of numbers to the system of rational numbers. • Apply and extend previous understandings of operations with fractions to add, subtract, multiply and divide rational numbers. • Know that there are numbers that are not rational, and approximate them by rational numbers.	• Orchard Now's individualized learning paths enables students to apply and extend previous knowledge and understanding of the number system as they progress through content customized to their needs. Activities, assessments and practice questions cover the skills found in the Common Core Standards for The Number System through numerous focused activities such as "Introduction to Number Patterns" in grade 6, in which students calculate factors, and "Compare and Order Rational Numbers" in grade 8, in which students compare and order positive and negative decimals using a number line or other models. Orchard Now content is designed to harness prior knowledge and engage students in ongoing learning of the number system as they acquire and master new skills.  *Introduction to Number Patterns/grade 6*
• ***Expressions and Equations.*** Instructional programs from grade 6 through grade 8 should enable all students to: • Reason about and solve one-variable equations and inequalities. • Represent and analyze quantitative relationships between dependent and independent variables. • Use properties of operations to generate equivalent expressions. • Solve real-life and mathematical problems using numerical and algebraic expressions and equations. • Work with radicals and integer exponents. • Understand the connections between proportional relationships, lines, and linear equations. • Analyze and solve linear equations and pairs of simultaneous linear equations.	• In "Exploring Algebraic Patterns" within the sixth grade skill category of Linear Equations, students demonstrate equivalence in simple numerical equations and determine the value of a missing term in equations involving addition, subtraction and multiplication. Equation skills continue through eighth grade with instructional tutorials such as "Solving Equations," in which students simplify and solve equation problems including operations, integers and fractions while emphasizing the order of operations.  *Simplifying Expressions/grade 8*

• ***Functions.*** Instructional programs from grade 6 through grade 8 should enable all students to: • Define, evaluate, and compare functions. • Use functions to model relationships between quantities.	• "Number Systems and Functions" offers focused practice questions on function knowledge with detailed explanations of correct and incorrect responses. Students are provided detailed feedback on answers, allowing them to fully engage in the material and correctly identify their mistakes and successes in function problem solving.  A number (y) is fed into a number machine (function). The number is multiplied by 6 and then 8 is subtracted (6y - 8). What is the outcome of the function if the number (y) = 5? A. 22 B. 32 C. 38 D. 48 You got it! We can determine the outcome of the function by replacing the unknown value (y) with the value now given (5). (6 x 5) - 8 = 30 - 8 = 22 *Number Systems and Functions/grade 8*
• ***Geometry.*** Instructional programs from grade 6 through grade 8 should enable all students to: • Solve real-world and mathematical problems involving area, surface area, and volume. • Draw, construct and describe geometrical figures and describe the relationships between them. • Solve real-life and mathematical problems involving angle measure, area, surface area, volume, cylinders, cones, and spheres. • Understand congruence and similarity using physical models, transparencies, or geometry software. • Understand and apply the Pythagorean Theorem	• Instructional activities ranging from "Similar Congruent Symmetrical Figures" in grade 7 to "Square Roots" in grade 8 provides foundational and remedial practice based on the needs of each student. Students practice identifying corresponding sides and angles in congruent and similar geometric shapes while refining understanding of geometric relationships. Assessment questions offer focused feedback enabling students to synthesize correct strategies for geometric problem solving.  Polygons ABCDE and HJKLM are congruent. A B C D E K L M H J $\overline{KJ} \cong$ ___. A. $\overline{AE}$ B. $\overline{DC}$ C. $\overline{EA}$ D. $\overline{CB}$ That's right! Corresponding components (both sides and angles) must coincide (fit exactly on each other) in order for the two polygons to be congruent. Thus, congruent polygons are identical except for their relative position on the plane. If we rotate polygon HJKLM 180° , we can more easily see the side-to-side, angle-to-angle relationship to polygon ABCDE. Notice that side HM in polygon HJKLM is the "twin" or corresponding side to side AE in polygon ABCDE. Notice also that ∠HJK is the "twin" or corresponding angle to ∠ABC. Also, ∠JKL corresponds to ∠BCD. *Similar Congruent Symmetrical Figures/grade 7*

• ***Statistics and Probability.*** Instructional programs from grade 6 through grade 8 should enable all students to: • Develop understanding of statistical variability. • Summarize and describe distributions. • Use random samplings to draw inferences about a population. • Draw informal comparative inferences about two populations. • Investigate chance processes and develop, use, and evaluate probability models. • Investigate patterns of association in bivariate data.	• In relevant contexts, students are introduced to the meaning of probability and various ways of expressing probability in instructional activities across grade levels. In grade 6 "Probability," critical probabilities are compared to actual results using several activities, while students also explore the concepts of certainty, possibility and impossibility. In grades 7 and 8, instructional activities encompass statistical outcomes and comparing events.  *Probability/grade 6*

Conclusion

As technology continues to become a vital part of classroom activities, Orchard Now is an indispensible tool for both students and teachers alike. In order to ensure that students receive the best education possible, the Common Core Standards are necessary fixtures to encourage reaching benchmarks for success in students' learning abilities. In accordance with the Common Core State Standards for Mathematics, Orchard Now provides engaging and innovative ways to intermingle the use of technology and mathematics in prekindergarten through grade 8 classrooms.

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