Edgenuity®

How Edgenuity Intervention Solutions Align with Research on Effective Instruction

A SUMMARY OF INDEPENDENT RESEARCH

Contents

Introduction

THE CHALLENGE

Research confirms that strong mathematics and reading skills are critical to academic and career success (Graham & Perin, 2007; Lesnick, Goerge, Smithgall, & Gwynne, 2010; Duncan & Magnuson, 2011; Hernandez, 2011). Students who cannot read proficiently by third grade are four times less likely to graduate by age 19 than students who read proficiently by third grade (Hernandez, 2011). Similarly, students who complete Algebra 1 in eighth grade more than double their chances of attending a two- or four-year college and have greater earnings growth than those who do not (Murnane, Willett, & Levy, 1995; Rose & Betts, 2004; Adelman, 2006; National Mathematics Advisory Panel, 2008; Duncan & Magnuson, 2011).

Unfortunately, data indicate that many students are not receiving the targeted support they need to master basic mathematics and reading skills. According to the 2017 National Assessment of Education Progress (NAEP), 65 percent of fourth grade and eighth grade students scored below the proficient level in reading. Sixty percent of fourth grade students and 67 percent of eighth grade students scored at or below the proficient level in mathematics (National Center for Education Statistics, 2018a). Results from the 2015 Programme for International Student Assessment (PISA) indicate that U.S. high school students ranked 40th in math, 25th in science, and 24th in reading in a comparison with students from 73 countries (Kastberg, Chan, & Murray, 2016). These findings show not only that American students struggle to recall rote procedures and facts, but also that they are not able to analyze, reason, or communicate effectively.

Students who struggle academically do so for a variety of reasons. While some students lack critical background knowledge or have cognitive processing issues, others may have reading, mathematics, or language deficits (Vaughn, Wanzek, Murray, & Roberts, 2012; Saunders, Browder, & Root, 2017). More than four decades of research suggest that reading and mathematics interventions are most effective when they take into account students' unique learning needs (Subban, 2006; McRel, 2010; Tomlinson & Moon, 2013).

Educators recognize the importance of providing targeted interventions to ensure struggling learners get the individualized instruction they need to succeed academically. The challenge, however, is that these students' needs may vary dramatically.

A growing number of educators are turning to technology to offer personalized interventions that address students in the same class who have different abilities. Personalized learning is an approach to teaching that organizes learning around individual student needs rather than grade-level content. The objective is to facilitate and optimize student learning by meeting each student where he or she is. Research shows that blending technology with teacher-led instruction may be particularly effective in helping struggling students succeed academically (Stanford, Crowe, & Flice, 2010; Cavanaugh, 2013; Means, Toyama, Murphy, & Bakia, 2013; Pane, Steiner, Baird, & Hamilton, 2015).

INTERVENTION OVERVIEW

Edgenuity's online intervention programs, MyPath® and Pathblazer®, are laser-focused on helping students catch up, keep up, and get ahead. In both programs, initial assessments are used to determine Individualized Learning Paths (ILPs) for students. Students may take assessments built into the programs, or schools can import student data from MAP® Growth™, Scantron® Performance Series®, and Renaissance STAR 360® assessments. Results are used to recommend a customized sequence of engaging, interactive lessons that review skills and build conceptual understanding. Edgenuity's Pathblazer targets instruction for students in grades K–6, and MyPath supports middle and high school students with personalized intervention content. Through assessments, personalized instruction, and detailed reports, MyPath and Pathblazer recommend ILPs based on skill level, not grade level, to ensure students receive age-appropriate instruction in the skills they need to master academic content.

Research-Based Solutions

Education researchers have documented five well-established principles of effective interventions that contribute to student achievement. These principles are incorporated into Edgenuity's MyPath and Pathblazer programs.

1. Capitalize on initial screening and ongoing assessments to inform instruction.
2. Deliver explicit instruction.
3. Strengthen foundational skills and provide access to grade-level content.
4. Build confidence through error correction procedures, regular feedback, and positive attitudes.
5. Prime students to learn and make instruction accessible.

1. CAPITALIZE ON INITIAL SCREENING AND ONGOING ASSESSMENTS TO INFORM INSTRUCTION

There is widespread agreement that successful interventions are "guided by and are responsive to data on student progress" (Torgesen, 2006, p. 2). Empirical evidence supports the use of universal screeners to assess students' specific math and reading difficulties (Fuchs et al., 2007; Jenkins, Hudson, & Johnson, 2007; Gersten et al., 2008; Gersten et al., 2009). Multiple meta-analyses show that formative assessment—the process of using ongoing assessment to inform instruction—can be particularly useful in improving struggling students' achievement (Black & William, 1998; Kingston & Nash, 2011; Lai & Schildkamp, 2012). Research indicates that formative assessment is most effective for students when assessment data is used to 1) pinpoint students' specific abilities; 2) make learning goals clear to students; 3) continuously monitor student performance; 4) provide feedback; and 5) calibrate and intensify instruction to meet students' needs (National Center for Response to Intervention, 2010; Lai & Schildkamp, 2012; National Research Council, 2012). By revealing students' strengths and uncovering opportunities for improvement, formative assessments can help teachers harness and allocate resources to struggling students more efficiently and effectively. When educators can make sense of what data means, they can more effectively "set appropriate student learning goals; monitor and check to see if students are reaching their goals; and support students in developing the ability to monitor and check their own goal attainment" (Lai & Schildkamp, 2012, p. 15).

Our solution: Capitalize on initial screening and ongoing assessments to inform instruction

Edgenuity's intervention solutions capitalize on a wide array of assessments to customize instruction to meet each student's unique needs.

- **Screener assessments:** In MyPath, the Edgenuity Placement Exam (EPE) determines placement into the program. The EPE contains 44 questions in mathematics and 40 questions in reading. In Pathblazer, students complete an initial adaptive screener to determine approximate grade level. They are then assigned additional, more detailed diagnostic assessments to pinpoint specific skill strengths and gaps and to generate a sequence of learning activities. In both programs, however, schools can instead choose to import data from Renaissance STAR 360, NWEA MAP Growth, or Scantron Performance Series assessments to create individualized learning paths with no additional testing.
- **Formative assessments:** As students progress through MyPath and Pathblazer, they engage in scored learning activities and complete curriculum-based quizzes to evaluate their mastery of the lesson objectives. Using Webb's Depth of Knowledge and Bloom's Taxonomy, assessment items are classified based on their level of difficulty. In Pathblazer, automatic decision points are built into the system so that teachers can evaluate whether students are ready to move forward or if they need additional interventions, such as student conferencing. Decision points allow the sequence of an assignment to be based on student performance; programmatic flags trigger an additional specified action when the established mastery score in an activity is not met. The flags are embedded in the individualized learning paths, but can also be inserted by the teacher as needed to provide more control and immediate transparency into student progression. In both Pathblazer and MyPath, users can set custom mastery levels on assessments and/or insert their own content to customize instruction based on student performance.
- **Summative assessments:** In both intervention solutions, post-tests are provided at the end of each learning path to evaluate students' overall performance. Like formative assessments, summative assessments also classify items using Webb's Depth of Knowledge and Bloom's Taxonomy.

MyPath and Pathblazer reports make it easy for teachers to review each student's achievement, engagement, and progress, as well as determine appropriate follow-up steps, including individual conferences and small-group instruction.

Key MyPath progress monitoring reports include:

- **Lesson Mastery Report:** This report gives educators a customizable, at-a-glance view of student and class progress and achievement data across an entire ILP. Educators can view average and individual student assessment scores by lesson, to group students for reteaching and intervention. The report can be customized with filter options to view how many students are struggling with the lesson, average quiz score, average number of quiz attempts, and average time. The report can also be filtered by educational standard.
- **Course Map:** The interactive Course Map helps students view and track the assignments they should be completing each day. This tool aids in goal setting and encourages students to take ownership of their learning.
- **Course Report:** This downloadable PDF, available to both students and educators, shows details for all activities in the ILP, including time spent and scores.
- **Session Log:** The Session Log not only tracks student time on task, but also enables teachers to view a student's idle time, which could indicate time not spent on task. Students can view this report as well.
- **Individual Student Progress Report:** This report tracks a student's grades, percentage of the ILP completed, and percentage of the ILP the student should have completed based on the start and target dates set by the teacher. Like the Session Log and Course Report, this report is available to both students and educators.
- **Dashboard:** The Dashboard displays all students' progress, achievement, and engagement data, as well as alerts when students are stuck or need an assessment unlocked.
- **Gradebook:** The Gradebook enables teachers to view test, quiz, and activity scores for an entire class, or for a defined group. Alerts are displayed when a student is out of retakes or has reached an assessment that must be unlocked by a teacher. The Gradebook enables teachers to easily view assignments, change a score, and reset or bypass an assignment as needed.

Key Pathblazer progress monitoring reports include:

- **Utilization Report:** This report summarizes the total number of students enrolled, total number of students who have completed an activity, total session time, total active time, average activity score, and number of activities completed for a school or a district.
- **Attendance Report:** This report displays last login time, total logins, and total time for students, parents, or teachers.
- **Screener Results Report:** This report displays results from students' Pathblazer adaptive screener tests. Knowing how students scored on the Pathblazer screener shows teachers each student's proficiency level, which can help teachers determine what level of work the student should be assigned.
- **Student Progress Report:** Here, teachers can track student performance by educational standard to identify areas that need extra attention. The report includes summaries by activity type or by assignment, and enables educators to check that the current intensity and pace of the intervention is working by tracking weekly student performance against the overall proficiency level goal.
- **Completion Report:** This report displays a snapshot of student work on one or multiple assignments, and includes the percentage of the assignment that is completed, along with a cumulative score.
- **Test Summary Objective Report:** This report displays individual student performance on learning objectives or standards for an entire class, and allows educators to review what standards or objectives students have mastered on the pretest. Data can be used to identify small groups for reteaching difficult-to-master standards by finding the objectives students most often failed.
- **Learning Path Summary Report:** This report summarizes student progress in learning paths in the context of a class. Teachers are armed with a quick summary of pretest verses activity/quiz scores. It identifies students who need to be accelerated or adjusted downward in their learning path.
- **Learning Path Status Report:** This report displays the status of activities in a learning path, including information on objectives associated with each activity. Teachers can view details for individual objectives or a summary of the entire learning path.

2. DELIVER EXPLICIT INSTRUCTION

More than 20 years of research confirms that struggling students benefit more from focused explicit instruction than implicit, discovery-oriented approaches to teaching (Rosenshine, 1995; Kozioff, LaNunziata, Cowardin, & Bessellieu, 2000; Baker, Gersten, & Lee, 2002; Torgesen, 2002; Gersten et al., 2008; Archer & Hughes, 2011; Fisher, Frey, & Lapp, 2011; Vaughn et al., 2012). Educational experts agree that there are six components of explicit instruction that help improve struggling students' achievement (Archer & Hughes, 2011; Fisher et al., 2011). These are:

- **Clearly defined lesson goals and expectations:** A large body of research suggests that clearly articulated lesson goals can enhance struggling students' learning (Rosenshine, 1995; Marzano, 2007; Archer & Hughes, 2011; Fisher et al., 2011; National Research Council, 2012). Karen Swan's review of 73 online courses "found significant correlations between the clarity, consistency, and simplicity of course designs and students' perceived learning. Such findings support the prescription for clear goals and expectations for learners" (K. Swan, 2003, p. 19).
- **Prior knowledge activation:** To process information, students need to connect new information and skills with preexisting experience and knowledge (National Research Council, 2012). However, as Fisher et al. (2011, p. 370) point out, struggling students are often unable to figure out what is "known to solve the unknown. Therefore, it is important to activate useful background knowledge when figuring out how to do something less familiar."
- **Small, manageable chunks of instruction:** Neuroscientists have identified two main cognitive structures that facilitate learning: working memory and long-term memory. Working memory is where we process new information, and long-term memory is where we store facts, ideas, and procedural knowledge (Sweller, 2008). Research indicates that because of the limited size of human working memory, instruction is most effective when new information and new procedures are taught in small chunks (Rosenshine, 1995; Archer & Hughes, 2011).
- **A wide array of models and demonstrations:** Research supports using models and demonstrations to teach students new concepts (Gersten et al., 2008; Gersten et al., 2009; Archer & Hughes, 2011). Research confirms that models are most effective when they:
  - Use think-alouds to verbalize the thought process and make transparent strategies to approaching new texts and problems (Rosenshine, 1995; Archer & Hughes, 2011).
  - Use precise language to describe complex skills or concepts, involve students in interactive demonstrations, and are selected thoughtfully (Stein, Kindler, Silbert, & Carnine, 2006; Archer & Hughes, 2011; Doabler & Fien, 2013).
  - Show different ways of approaching problems and include rationales for why one approach may be better than another, or explain when it does not matter (Sowder & Kelin, 1993).
  - Capitalize on worked examples that show worked-out solution steps for problems, to elucidate why some solutions to problems are better than others and to illuminate how to apply concepts in new settings (Clark, 2005; Sweller, 2008). As student expertise increases, fully worked examples should be replaced by partially worked examples, and eventually by problems students complete without support (Sweller, 2008).
- **Scaffolded practice with prompts:** Struggling students may suffer from "working-memory deficits, attention deficits, language processing and comprehension deficits, weak early numeracy skills, and difficulty with self-regulation" that require supports to make learning accessible (Saunders et al., 2017, p. 690, citing Donlan, 2007). Instructional scaffolding refers to temporary supports (i.e., prompts, cues, interactive tools, worked examples, graphic organizers, and other visual aids) designed to help students carry out tasks until they are able to do so independently (Rosenshine & Stevens, 1986; Rosenshine, 1995; Sweller, 2008; Archer & Hughes, 2011; Fisher et al., 2011; National Research Council, 2012).
- **Checks for understanding:** Research confirms that asking strategic questions to check for understanding is critical to helping students master academic material (M.B. Swan, 2003; Stein et al., 2006; Archer & Hughes, 2011). The types of questions asked are crucial because they reveal misconceptions, gaps in understanding, or overall confusion. Researchers agree that strategic questions should not only elicit factual knowledge, comprehension, application, and analysis, but should also require students to synthesize and evaluate faulty reasoning. Questions should ask students to explain their answers in different ways and describe patterns that they notice (Fisher et al., 2011; Dougherty, Bryant, Bryant, & Shin, 2017). To effectively check for understanding, students must receive "explanatory feedback that helps learners correct errors and practice correct procedures" (National Research Council, 2012, p. 4-12).

Our solution: Deliver explicit instruction

Explicit instruction is the cornerstone of Edgenuity's intervention solutions. Both Pathblazer and MyPath include:

Clearly defined lesson goals and expectations: Each ILP begins by presenting clearly defined instructional objectives and spelling out what students will be expected to learn and do as part of the lesson. Lesson goals are written in student-friendly language and are directly connected to assignments and tasks. Graphic organizers and tables make relationships between concepts and skills apparent to students. For instance, at the start of a mathematics lesson, an on-screen teacher states that students can successfully achieve the lesson goal of solving real-world problems with decimals by using a number line, by using properties of operations to add and subtract decimals, and by estimating sums and differences of decimals (Figure 1). Similarly a Pathblazer English language arts lesson explains that informational text, such as articles, have both words and images, and that the goal of the lesson is to teach students how to use words and images to interpret a text (Figure 2.).

Figure 1

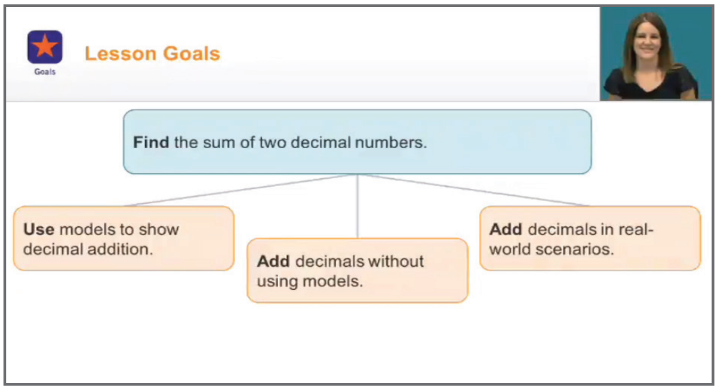


Figure 2

Prior knowledge activation: At the start of each lesson, Pathblazer and MyPath instruction engages students in a brief task that connects new knowledge to known knowledge. This task may help students recall and verify prior learning, prompt thinking about a subject, connect a topic to students' own lives, challenge students to reflect on a new idea, or pose a compelling problem. For example:

- In a MyPath reading lesson (Figure 3), an on-screen instructor uses students' understanding of how houses are built to activate what they already know about affixes (even though students may not have used the word affix before). The instructor first explains that it takes a lot of different parts (e.g., roof, windows, doors) to build a house. She then explains that words are similar to houses in that they are also made of different parts called root words (standalone words with their own meaning), prefixes (a group of letters placed before the root of a word), and suffixes (a group of letters placed at the end of the word).
- A Pathblazer activity relates writing to a connect-the-dots picture (Figure 4). Video instruction explains that in a connect-the-dots picture, the task is to connect the dots in the right order to make a recognizable picture. If you do not connect the dots in the right order, you end up with a picture that makes no sense. Like a connect-the-dots picture, writers must connect sentences and ideas in the right order so that their paragraphs make sense.

Figure 3

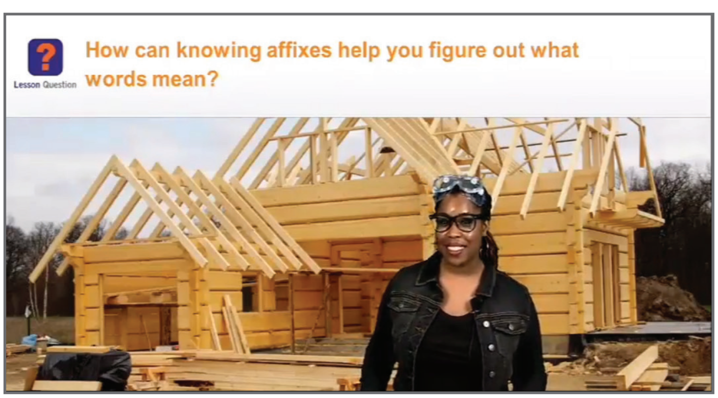
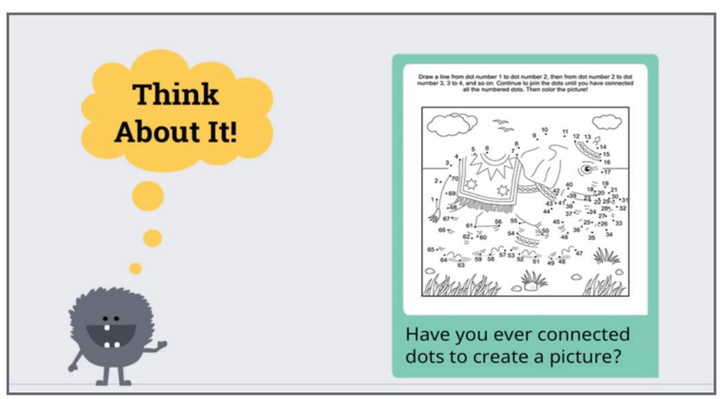


Figure 4



Small, manageable chunks of instruction: In Pathblazer and MyPath, lessons, skills, and concepts are introduced to students in small, three- to five-minute segments. When students learn a complex skill, they practice key steps separately, then put all the steps together to synthesize learning. For example:

In a MyPath mathematics lesson (Figure 5), an on-screen teacher explains that the distributive property means the sum of two numbers is the same as its parts. This means you get the same answer if you multiply a number by a group of numbers added together, or if you multiply each separately and then add them. In the first segment of instruction, students use an area model where they see that 2 squares of (3 + 5) is the same as 2 squares of 3 plus 2 squares of 5, and is equivalent to the total area (16). An on-screen instructor explains why 2 can be distributed across the 3 + 5, into 2 × 3 and 2 × 5. Students then practice applying the distributive property to expressions and equations in a wide array of contexts. Eventually, students synthesize the information while solving specific word problems.

In a Pathblazer reading lesson (Figure 6), students learn how to interpret steps in a process. An on-screen instructor first defines a process as a series of steps in sequential order. She then explains that words and phrases that are embedded in the text (e.g., first, next, then, last, now, after five minutes, so that, because) may signal an author's central ideas and intentions. Students then practice identifying words related to sequence, time, and cause and effect to better understand a technical procedure about robots.

Figure 5

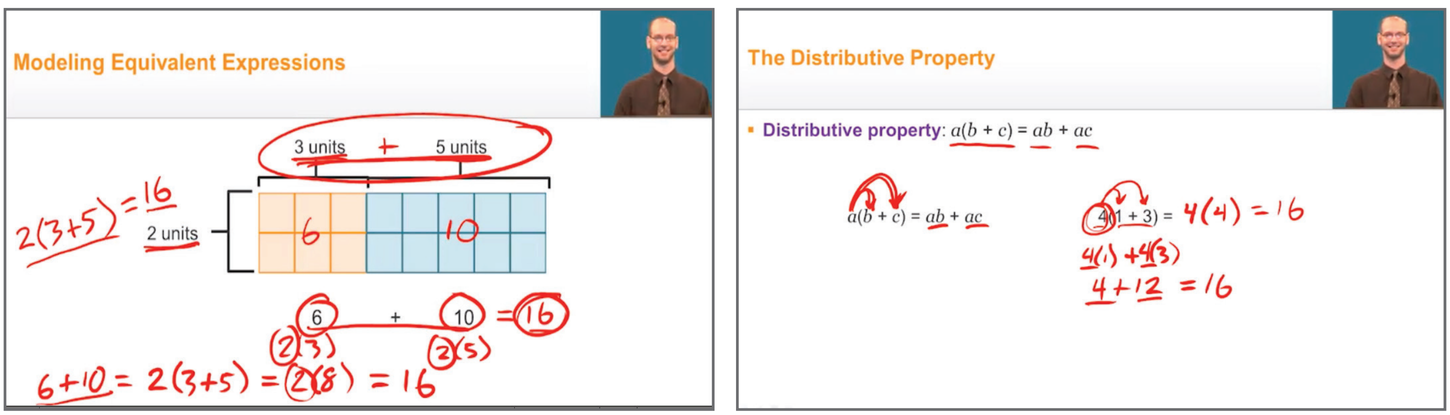
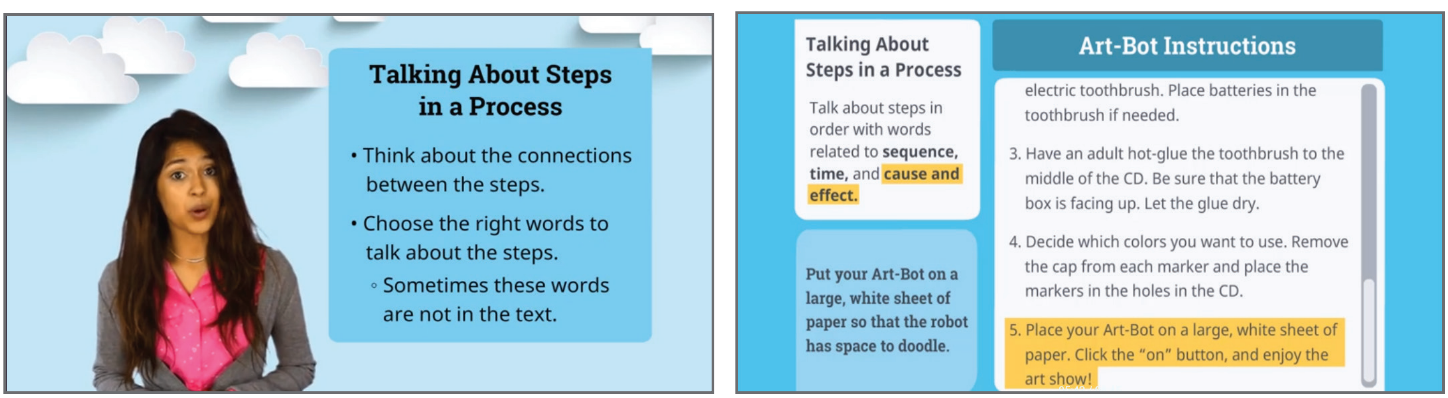


Figure 6



A wide array of models and demonstrations: Pathblazer and MyPath lessons use think-alouds, worked examples, demonstrations, and models to teach struggling learners the step-by-step thought processes and systematic strategies needed to read complex texts and solve problems. Models typically present the big idea or generalize an underlying concept or skill before presenting procedural knowledge. To make learning more meaningful for struggling students, video instruction always explains why that concept or skill has academic and/or real-life importance. Clear-cut language, as well as examples and nonexamples, draw students' attention to the critical, noncritical, and shared attributes of terms or concepts. Think-alouds not only verbalize the concepts, factual information, step-by-step procedures, and strategies needed, but also model when students might apply the strategy. At the end of each model, on-screen instructors ask themselves strategic questions such as, "What was I thinking when I . . ." or "How did I know to . . ." or "How did I remember . . ." or "How did I decide to . . ." or "Why did I . . ." to help summarize the cognitive strategies that were used. For example:

- In a MyPath reading lesson, students learn that paraphrasing and summarizing can be effective strategies for distilling and remembering essential information from a text (Figure 7). While reading out loud a nonfiction passage about the history of musical recordings, the on-screen instructor verbalizes how he discriminates between important ideas and unimportant facts. He states, "Since the text is talking about how recordings got better over time, I think that is the big idea." The on-screen instructor adds, "Notice how there were some words, like 'early 1900s' and 'sound recordings,' that I kept from the paraphrased sentence, since sound recordings was the topic and early 1900s was a date used in the text. I kept these words to stay true to the original meaning of the text."
- In a MyPath mathematics lesson about linear equations, students learn that equivalent fractions are fractions that describe the same amount. The lesson provides examples and nonexamples of fraction equivalence using area models. For example, 1/2 and 2/4 are equivalent, 1/2 and 3/4 are not equivalent. Students learn that 3/4 is a bigger amount than 1/2 (Figure 8).
- In a Pathblazer mathematics lesson, students are asked to estimate whether a teacup or a soup pot could hold six liters (Figure 9). To explore this question, students are first taught the conceptual underpinnings of volume. They learn that volume is the amount of space a solid, gas, or liquid takes up. Video instruction teaches students to estimate liquid benchmarks such as one milliliter and one liter to estimate volume. The on-screen instruction shows how a water bottle is equivalent to about one liter of water. Since a teacup is smaller than a water bottle, the on-screen instructor infers that it could not hold six liters of water. A soup pot, on the other hand, could.
- In a Pathblazer reading lesson (Figure 10), students are taught that reporters ask six critical questions—who, what, where, when, why, and how—to tell and make sense of a story. Students learn that proficient readers can use these exact same questions to clarify meaning. An on-screen instructor then verbalizes how to ask and answer these questions while reading the fable "The Lion and the Mouse." For instance, after reading the sentence, "Forgive me just this once and I will always be in your debt," the instructor explains how she can answer the question WHY the mouse would save the lion: The mouse wants to keep his word to repay the lion for letting him go.

Figure 7

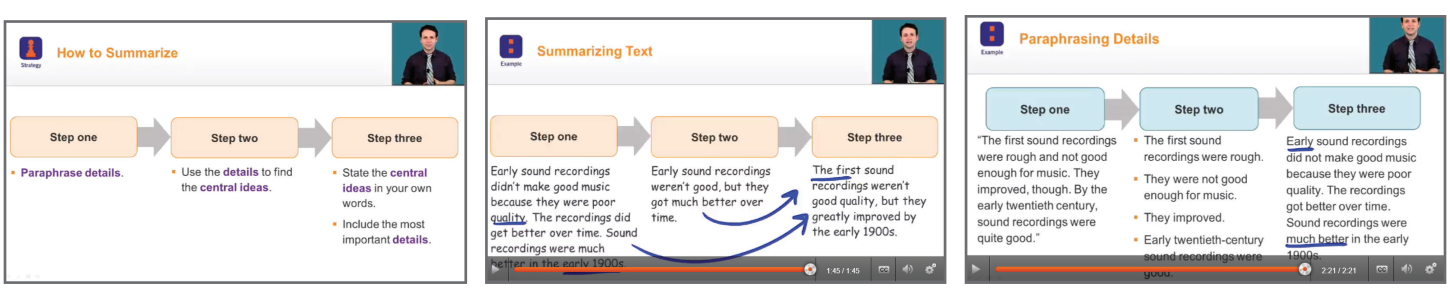


Figure 8

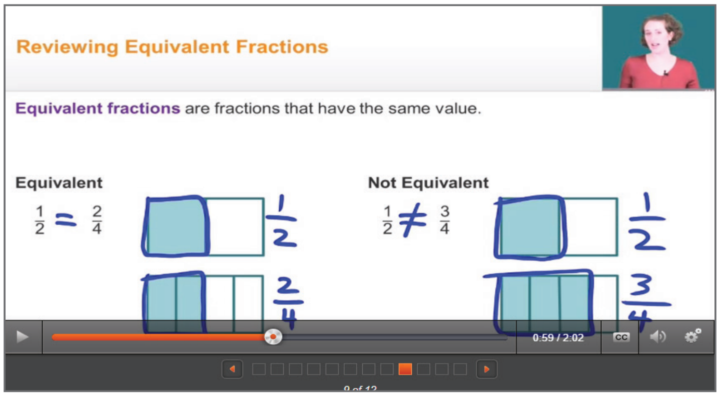


Figure 9

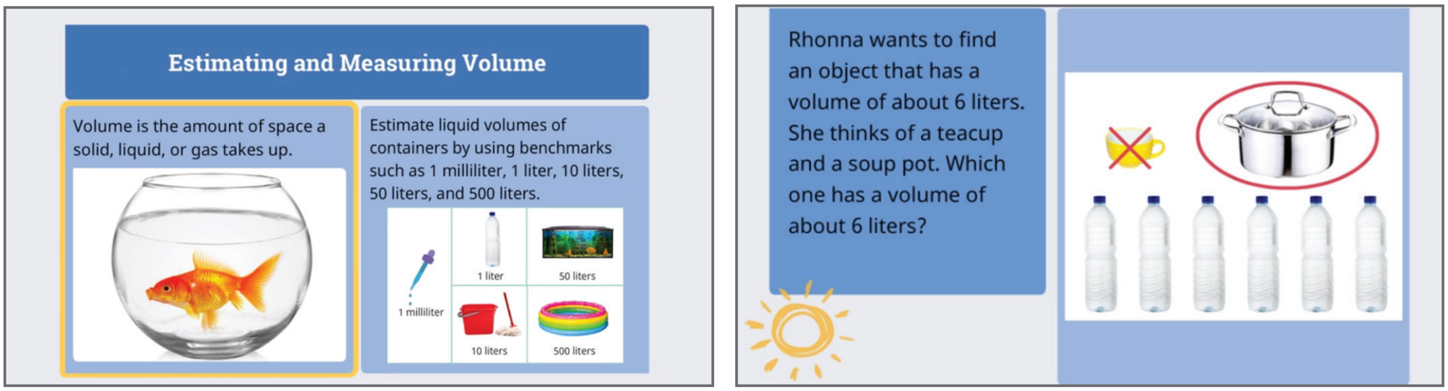
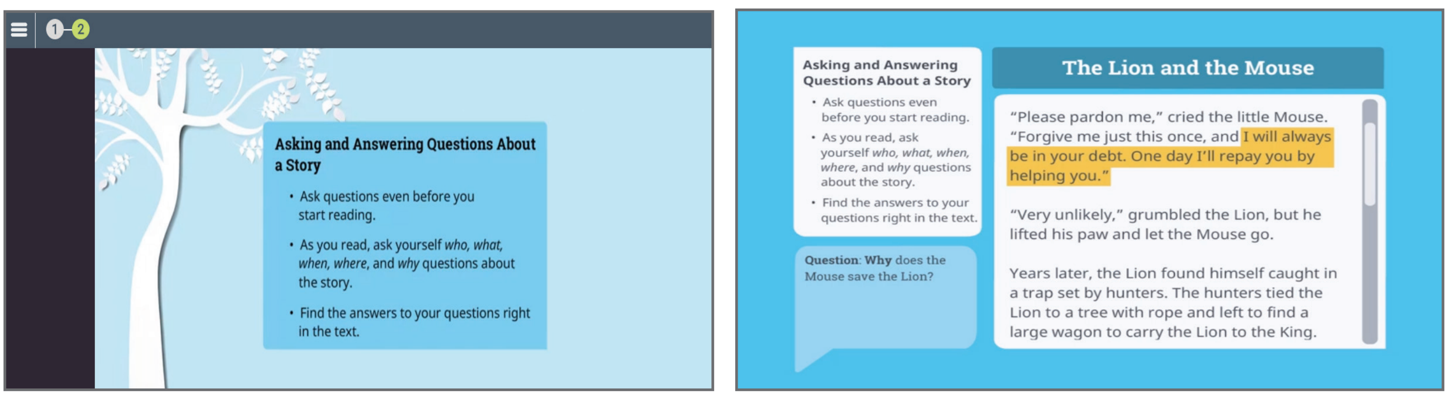


Figure 10



Scaffolded practice with prompts: Edgenuity content helps struggling students build mastery by providing scaffolded practice that is reduced over time. During scaffolded practice, prompts help students carry out their tasks. Visual and verbal cues are designed to focus students' attention and help them check their own understanding. Think-alouds and multiple worked examples and models show how to complete tasks in a variety of ways. Immediate, corrective feedback reinforces correct performance and helps students make adjustments as needed. As students demonstrate understanding, lessons increase the complexity of tasks and decrease the level of prompts and support.

Edgenuity provides a wide array of scaffolded support. In MyPath, for example:

- Students with visual impairments, aural learners, and those who need additional reading support can use the text-to-speech read-aloud feature to hear on-screen text read to them. Students can either select specific text to be read or have an entire page read aloud. Students can pause, stop, or adjust the speed at which the text is read aloud.
- Video captions and transcripts ensure a wide range of students can access and decode textual information.
- A dynamic glossary offers a way for students to review the key vocabulary words from each lesson.
- Students can pause and rewind instruction to ensure content mastery.
- Digital highlighters and sticky notes help students organize information, ask questions, and record observations.
- A digital notebook, called eNotes, enables students to take notes, record, synthesize, and organize their thinking.
- Hints and feedback clarify content.
- Students can adjust the size of text and audio volume.
- MyPath content supports the translation of text into more than 60 languages, including Spanish, French, German, Italian, Chinese, Japanese, Hindi, Russian, and Korean.
- MyPath also includes Edgenuity's CloseReader™, which provides contextual definitions for key vocabulary, text-based teacher's notes, audio commentary, and embedded comprehension questions (Figure 11).
- A dynamic glossary and word look-up tool helps students build their academic vocabulary. Calculators, graphic organizers, and other tools help students complete assignments and promote the deep transfer of knowledge and skills.

In Pathblazer:

- Visuals, including graphic organizers, graphics, images, videos, manipulatives (an object designed so that a learner can perceive some mathematical concept by manipulating it), and timelines provide visual and conceptual support.
- Texts can be heard read aloud by clicking on the radio or speaker button.
- Audio and conversational support is included throughout lessons.
- Vocabulary words are hyperlinked so students can click on them while they are reading to discover meanings and pronunciations.
- Hint buttons provide multiple examples of content material.
- Metacognitive "bubbles" provide scaffolding to students who need help learning to "think aloud," promote self-questioning and self-monitoring, and aid students in making predictions.
- Video lectures allow students to replay content to help review essential concepts.
- Printable transcripts are included for instructional and practice activities.
- An embedded toolbar enables students to communicate directly with teachers.
- A Student Toolkit is available, which includes an interactive glossary and writing templates.
- A Math Toolkit is available in mathematics content that contains virtual manipulatives (e.g., algebra tiles, base ten blocks, counters) that students can use to visualize and solve problems, create models of mathematical concepts, or apply a hands-on approach to learning (Figure 12).

Figure 11

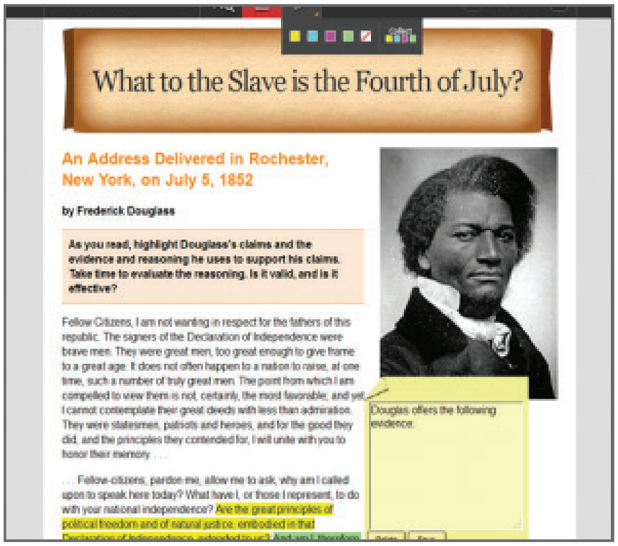
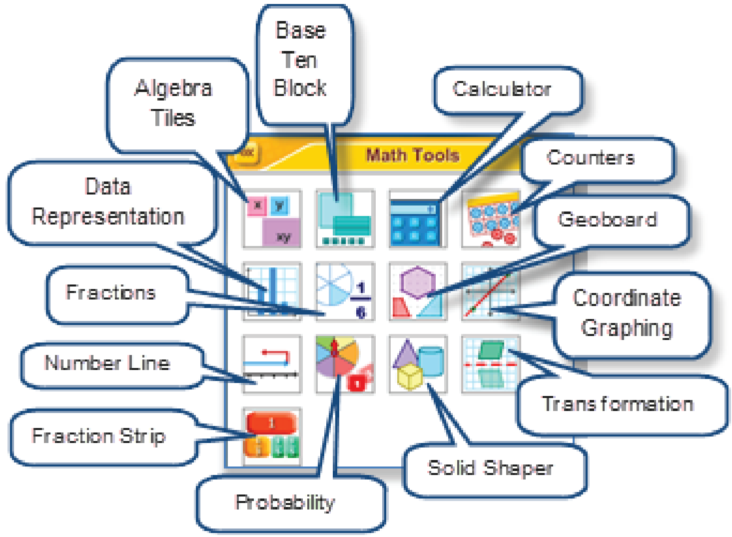


Figure 12



Checks for understanding: After each instructional sequence in Pathblazer and MyPath, students answer questions and complete tasks to check what they have learned and apply new skills. For example:

- In Pathblazer, activity-level and lesson-level quizzes provide valuable feedback for students and teachers on student mastery of the skills presented. The program also includes chapter tests, as appropriate. In addition to multiple choice, fill in the blank, and performance tasks, many of the questions during independent practice mirror the format of new assessments, so students can practice with technology-enhanced item types.
- Within instruction in MyPath, the on-screen teacher pauses to engage students in quick-check tasks. Students receive corrective feedback if they answer questions incorrectly, allowing them to refine misconceptions early on in instruction. These assessments include a range of system-scorable task types—including drag-and-drop, multi-select checkbox, fill-in-the-blank, number entry, and multiple choice. Within assignments, students compose short responses in which they explain their thinking, evaluate an argument, etc. They compare their answers to model responses and self-assess using a checklist of criteria. Within reading assignments in Edgenuity's CloseReader, students respond to comprehension questions that provide feedback explaining correct or incorrect answers, to guide reading comprehension.

3. STRENGTHEN FOUNDATIONAL SKILLS AND PROVIDE ACCESS TO GRADE-LEVEL CONTENT

Experts, researchers, and practitioners agree that struggling students need instruction that simultaneously promotes foundational skills and provides access to rigorous grade-level content (Gersten et al., 2008; Gersten et al., 2009; Copeland & Keefe, 2017; Foorman et al., 2017; Saunders et al., 2017).

Foundational Reading Instruction

Research shows that explicit instruction in print awareness and alphabet knowledge, phonological and phonemic awareness, phonics and decoding, fluency, word analysis, vocabulary, and comprehension is an effective way of bolstering struggling students' literacy skills (National Institute of Child Health and Human Development [NICHD], 2000).

- **Print awareness and alphabet knowledge:** Research indicates that print awareness—having a basic understanding of how letters, words, sentences, and books function—is highly predictive of reading achievement (Teale & Sulzby, 1986; Adams, 1990; Wagner et al., 1997; Scarborough, 1998; Clay, 2005; National Early Literacy Panel, 2008). However, many students don't come to school with an understanding of basic print concepts (Clay, 1985). As such, experts recommend explicitly teaching struggling students the conventions of printed language, such as how to locate the front and back of a book, identify letters and words, notice when words and letters are out of order, and recognize sentence punctuation (NICHD, 2000). Becoming literate also depends on a student's ability to recognize, produce, and write letter names and their corresponding sounds. A large body of research confirms that letter name knowledge is one of the best indicators of reading and spelling abilities (Piasta & Wagner, 2010). Three seminal studies by Stanovich (1986), Torgesen (2002), and Piasta & Wagner (2010), indicate that students with poor knowledge of letter names and sounds are more likely to struggle with spelling, reading fluency, vocabulary, and reading comprehension. The National Reading Panel (NICHD, 2000) confirms that providing struggling students with explicit instruction, practice, and opportunities to apply knowledge of letter-sound relationships to phonetically spelled words enhances alphabet knowledge.
- **Phonemic and phonological awareness:** Phonemic awareness is the ability to hear, identify, and manipulate the individual sounds in words. Research shows that phonemic awareness is an important predictor of early reading success (Moats & Tolman, 2009). Phonological awareness is the ability to break down spoken words into smaller parts, such as syllables, onsets (the consonant that precedes a vowel), rimes (the vowel and following consonants in the syllable), and individual speech sounds called phonemes (Gillon, 2018). Phonological awareness is important because it helps readers decode words (Ehri, 1992; Yopp, 1992; Ehri, 2005) and has a causal impact on word recognition, reading comprehension, and spelling performance (Bradley & Bryant, 1983; Gillon, 2018). Data indicate that the large majority of struggling readers have phonological awareness deficits (Gillon, 2018). As such, educational experts recommend providing these students with explicit, phonological instruction that is 1) aligned to their level of development (NICHD, 2000); 2) connected to written language (Cunningham, 1990); and 3) targeted at the phoneme level (Gillon, 2018). More specifically, students should practice isolating or categorizing phonemes in words, segmenting words into phonemes, blending phonemes to form words, adding or deleting phonemes from words, and manipulating onsets and rimes (Adams, 1990; NICHD, 2000).
- **Phonics and decoding:** Effective phonics instruction "teaches students to use the relationship between letters and sounds to translate printed text into pronunciation" (Shanahan, 2005, p. 11). Decoding is the process of reading letters or letter patterns in a word to determine the meaning of the word. As the National Reading Panel notes, more than a century of research confirms that systematic phonics instruction (teaching phonics elements in a carefully planned sequence) and explicit decoding instruction leads to better spelling and reading achievement than unsystematic instruction or no phonics instruction at all (NICHD, 2000). Experts agree, however, that there is no one "effective" sequence for phonics instruction. For example, converting letters to sounds and blending the sounds to form words is as effective as identifying words before pronouncing sounds (NICHD, 2000). Educators must "ensure that children understand the purpose of learning letter-sounds and are able to apply their skills accurately and fluently in their daily reading and writing activities" (NICHD, 2000, p. 2-135).
- **Fluency:** Fluency is the ability to read accurately, quickly, expressively, with good phrasing, and with good comprehension. Fluency is important because it is a strong predictor of reading comprehension (Kuhn & Stahl, 2000; NICHD, 2000; Rasinski & Hoffman, 2003). As Roxanne Hudson, Holly Lane, and Paige Pullen point out, "Inaccurate word reading can lead to misinterpretations of the text. Poor automaticity in word reading or slow, laborious movement through the text taxes the reader's

capacity to construct an ongoing interpretation of the text. Poor prosody can lead to confusion through inappropriate or meaningless groupings of words or through inappropriate applications of expression" (Hudson, Lane, & Pullen, 2005, p. 702).

Research suggests that teachers can improve struggling students' reading fluency by:

- Teaching word-identification strategies such as decoding and analogy (Ehri, 2002).
- Teaching students to (1) identify the sounds represented by the letters or letter combinations; (2) blend phonemes; (3) read phonograms (common patterns across words); and (4) use both letter-sound and meaning cues to determine exactly the pronunciation and meaning of the word that is in the text (Hudson et al., 2005).
- Modeling expressive, fluent oral reading (NICHD, 2000; Rasinski, 2003).
- Facilitating guided repeated oral readings (NICHD, 2000; Chard, Vaughn, & Tyler, 2002).
- Using assisted reading, choral reading, paired reading, audiotapes, and computer programs (Rasinski, 2003).
- Offering opportunities for practice using repeated readings with models (NICHD, 2000; Chard et al., 2002; Rasinski, 2003).

- **Word analysis:** Successful readers understand that letters are associated with sounds and that these sounds combine to make words (NICHD, 2000). When children learn to read, they sound out words and use visual cues, syntactic cues (how the words are ordered), or semantic cues (how the word fits into a sentence) to make meaning from text (Tankersley, 2003). This process, called decoding, enables students to figure out words they have never seen. While some words are highly decodable, other have irregular spellings that make decoding difficult (NICHD, 2000). Because these sight words appear frequently in the English language, students must learn to recognize them automatically if they want to read fluently. Indeed, research shows that explicit sight word instruction accelerates struggling students' reading comprehension (Combs, 2012). More specifically, teaching students to break words into syllables is particularly beneficial in building students' sight word vocabulary and improving their comprehension of longer words (NICHD, 2000). In addition, explicitly teaching students morphological awareness—how word bases, prefixes, and suffixes can be combined to form words—improves students' word identification, spelling, vocabulary, and reading comprehension (Bowers, Kirby, & Deacon, 2010). As Copeland and Keefe (2017, p. 645) point out, struggling students need to have opportunities to apply word strategies and "learn target words in different types of contexts to have maximum benefit from instruction (e.g., reading target words in books, digital texts, and handwritten letters)."
- **Vocabulary:** Numerous studies show that there is a strong and reciprocal relationship between vocabulary and reading comprehension (Stanovich, 2000; Beck, McKeown, & Kucan, 2002). That is, increased vocabulary exposure leads to improved reading comprehension, and increased reading exposure leads to vocabulary growth. Isabel L. Beck, Margaret G. McKeown, and Linda Kucan's research (2002) supports focusing on 1) high-utility basic words; 2) high-frequency words or words with multiple meanings; and 3) specialized content words that are domain-specific. Effective vocabulary instruction includes:
  - Direct and systematic instruction (NICHD, 2000; Copeland & Keefe, 2017)
  - Word consciousness through wide reading (Cunningham & Stanovich, 1998)
  - Clear definitions of word meanings in context (Stahl & Fairbanks, 1986; Nash & Snowling, 2006; Graves, 2016)
  - Repetition and multiple exposures to words (NICHD, 2000)
  - Connections between new and prior knowledge (Baumann, Edwards, Boland, Olejnick, & Kame'enui, 2003)
  - Word-learning strategies (Graves, Schneider, & Ringstaff, 2018)
  - Teaching about word parts (Graves, 2016)
  - Graphic organizers that provide a definition, list characteristics, use semantic features, and present examples and nonexamples of concepts can also aid learning (Archer & Hughes, 2011; Frayer, Frederick, & Klausmeier, 1969).
- **Reading comprehension**: The RAND Reading Study Group (RRSG, 2002, p. 11) defines comprehension as "The process of simultaneously extracting and constructing meaning through interaction and involvement with written language." To comprehend the meaning of a text, a reader must not only decode words on a page, but also draw on his or her own background knowledge, make sense of language structure, use verbal reasoning, and apply literacy concepts to make meaning of the author's purpose (Scarborough, 2001). This entails using reading strategies such as identifying the main idea of a passage, monitoring comprehension, visualizing, making inferences, summarizing, and generating and answering questions

about the text (Johnson-Glenberg, 2000; NICHD, 2000; Keene & Zimmerman, 2007; McNamara, 2007; Duke, Pearson, Strachan, & Billman, 2011; Marchand-Martella, Martella, Modderman, Petersen, & Pan, 2013). An understanding of the structures that undergird narrative texts (e.g., characters, setting, conflict, plot, and theme) and expository texts (e.g., compare and contrast, problem and solution, and cause and effect) is also essential to reading comprehension and writing skills (Duke et al., 2011; Marchand-Martella et al., 2013). Research shows that comprehension strategy instruction is most effective when it uses a gradual approach that first provides high support and then decreases support as students are able to carry out tasks independently (Raphael, George, Weber, & Nies, 2009).

Our solution: Foundational reading instruction

MyPath and Pathblazer are designed to move struggling students up to grade-level proficiency in reading. Pathblazer is focused on helping elementary school students who lack critical print awareness, phonemic awareness, phonics, fluency, vocabulary, and comprehension skills receive an explicit, accelerated path to support reading and literacy skills development. MyPath's foundational reading paths address comprehension strategies, while the basic and intermediate reading paths are more centered on literary analysis, grammar and mechanics, and writing as it relates to reading. Advanced paths expose students to great literature and help them develop critical thinking skills.

WHAT'S COVERED IN EDGENUITY'S READING INTERVENTION SOLUTIONS?		
Pathblazer K–2	**Pathblazer 3–5**	**MyPath 6–12**
Print awareness	Word study	Vocabulary
Letter recognition	Decoding skills	Reading comprehension
Sounds	Vocabulary	Literary analysis
Fluency	Idea synthesis	
Reading comprehension	Language structure	
Writing conventions	Study skills	

Pathblazer and MyPath address the five core areas that contribute to reading competency.

Print awareness and alphabet knowledge: Pathblazer explicitly teaches students how books and print work. For example, a reading lesson teaches students that a cover shows the name of the person who wrote the book, that books are read from left to right and top to bottom, that pages are numbered, and that the purpose of reading is to understand the text (Figure 13). Students learn that spoken words are made up of sounds represented by letters; words are composed of letters; words are separated by spaces; and sentences start with a capital letter and end with punctuation. Pathblazer provides many opportunities for students to hear text read with auditory support in levels, and to participate in read-aloud versions of the online passages. Pathblazer also includes digital activities to emphasize and recognize the names of letters, partner letters, and the shapes of letters and words associated with beginning and ending letters. The program teaches letter-sound correspondence explicitly, then provides multiple opportunities for students to practice this knowledge in reading and writing. For instance, a reading lesson asks students to identify the long A sound (Figure 14).

Figure 13

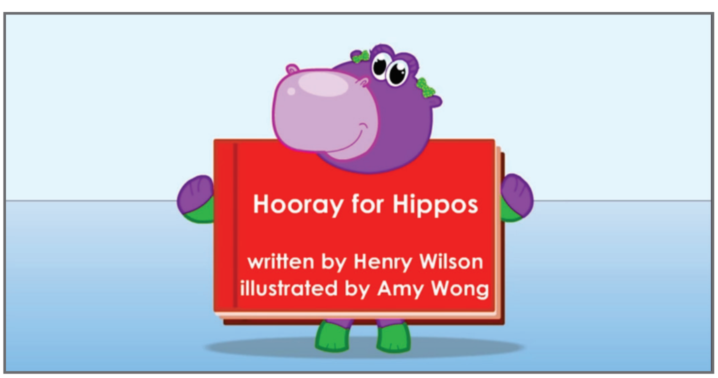
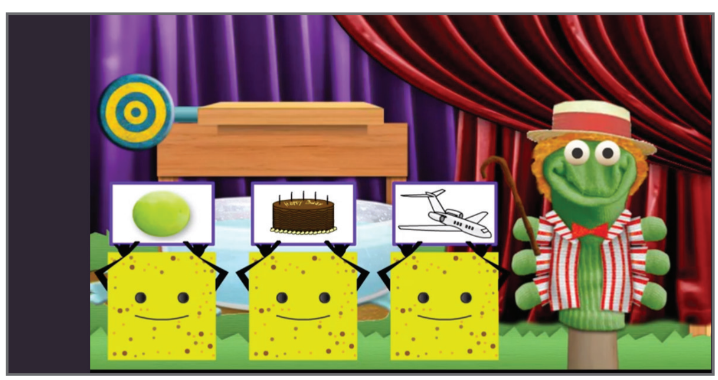


Figure 14



- **Phonemic and phonological awareness**: Pathblazer includes 105 phonemic awareness activities at the kindergarten and first grade levels. These activities provide students with opportunities to hear and work with spoken sounds in a variety of engaging ways. Students have the opportunity to isolate, identify, blend, segment, delete, and add sounds to develop an understanding of phonemic awareness. For example, in a reading lesson, students take away the letter c in cub and are asked to identify the new word when they add a t to the beginning (Figure 15). The program begins by explicitly teaching students one to two phonemic skills, and then adds additional skills to build on knowledge. Students then practice listening to poems, rhymes, and stories with repetitive refrains, rhymes, and language patterns. For instance, a reading lesson uses auditory cues to teach students to listen to spoken phonemes, orally blend the phonemes to make a word, identify phoneme segmentation in the word, identify sounds in the word, and identify the visual picture of the words read, real, and red (Figure 16).

Figure 15

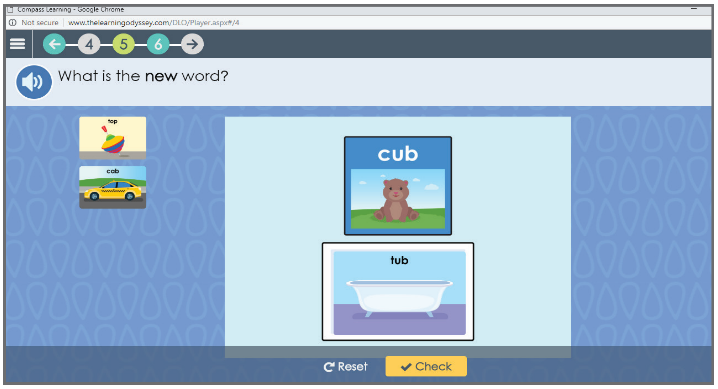


Figure 16

- **Phonics and decoding:** Pathblazer includes 104 phonics activities at the first and second grade levels using explicit and systematic direct instruction, guided practice, and scored independent practice. An additional 152 word analysis activities are included at the kindergarten level. The phonics curriculum is systematic and follows the developmental understanding of letter and sound principles. Students are first introduced to phonemes (Figure 17), shown the sound within words (Figure 18), and then the word within sentences using alliteration and rhyme (Figure 19). Activities are sequentially ordered to begin with initial sounds followed by ending sounds, then medial sounds. Students are taught to blend sounds together and use onsets and rimes effectively. Ultimately, larger chunks of sounds are taught, such as inflectional endings, prefixes (Figure 20), and suffixes. Students sing along, clap, and manipulate letters to build and spell words. After each activity, students apply their phonics skills to 15 different passages with predictable text structures, providing practice in decoding skills.

Figure 17

Figure 18

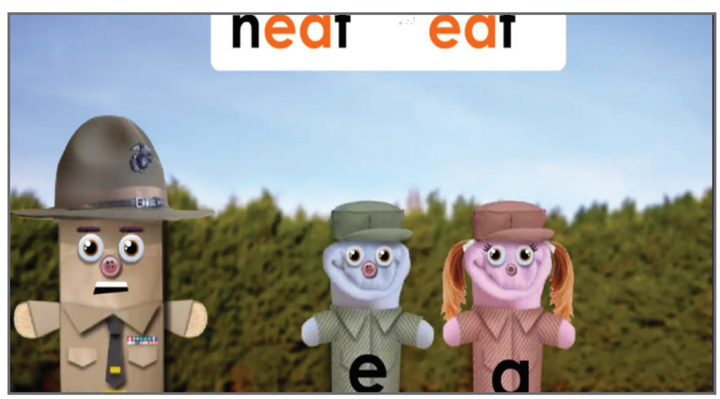


Figure 19

Figure 20

- **Fluency:** Pathblazer provides models for students to hear fluent reading, as well as the ability to have a single word read to them as they are reading. This modeling provides the support necessary to attain reading fluency. Students may also read and reread passages until an adequate fluency level is attained. For example, in a reading lesson, students practice stopping when they see a period. They also rehearse raising their voice when they see an exclamation mark or question (Figure 21). Pathblazer passages include a variety of literary genres, speeches, functional texts, paired readings, and novel studies to cover fiction and nonfiction. To accommodate a range of learners, these challenging passages are scaffolded with definitions, pronunciation, context, and reading strategies. Metacognitive thought bubbles are placed at strategic points in passages to model thinking strategies for readers (Figure 22).

Figure 21

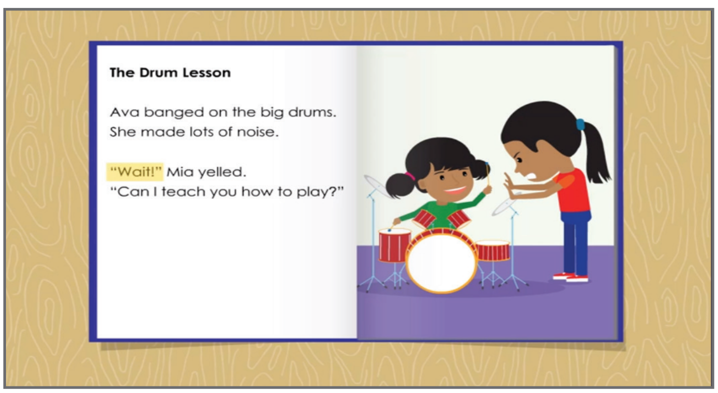
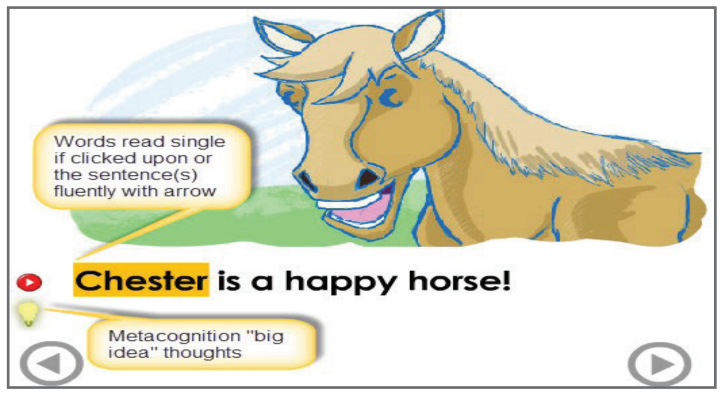


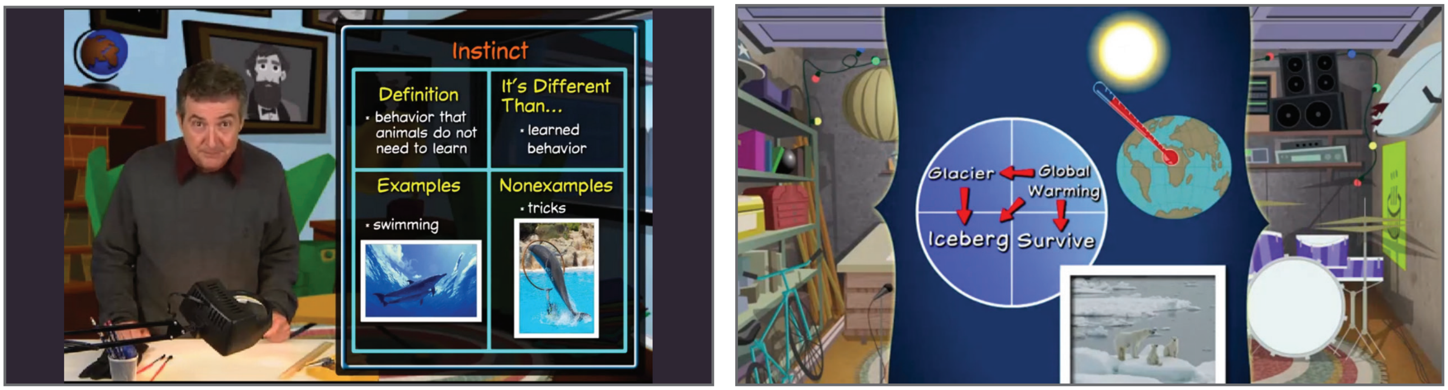
Figure 22



Word analysis: Students have a variety of opportunities to build sight word vocabulary through decodable stories and interactive games. For example, in a word analysis game, students use their space bar to identify high-frequency words and the video launches the astronaut at the word. Pathblazer provides word-attack skill instruction, such as syllabication, and helps struggling readers decode multisyllabic words and construct meaning from unfamiliar words they encounter (Figure 23).

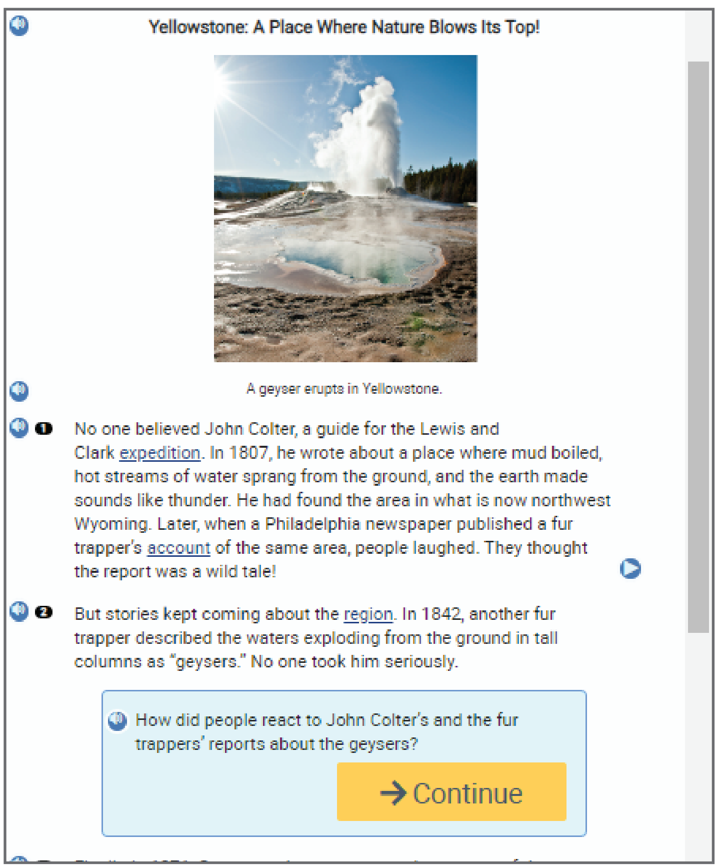
Figure 23

Figure 24



Vocabulary: Vocabulary development is a core component of reading lessons in both Pathblazer and MyPath. In Pathblazer, vocabulary instruction is embedded throughout meaningful stories and provides students with multiple opportunities to hear and use new words in engaging ways. High-utility (everyday), academic, and domain-specific words are introduced within the context of the story using everyday objects, auditory support, and music. Pathblazer teaches students how to recognize new words in various ways, such as context clues, synonyms, antonyms, picture representations, roots, suffixes, and affixes. The program also provides explicit word-recognition and word-attack skill instruction, such as syllabication, to help struggling readers decode multisyllabic words and construct meaning from unfamiliar words they encounter. Graphic organizers help identify and define key features of words (Figure 24). Within the text, students can access online glossaries to learn word meanings. For example, when reading a text about geysers in Yellowstone National Park, students can click on key vocabulary scaffolding to access pronunciations and additional definitions, with visuals that support the concept being presented (Figure 25). Included offline materials provide additional activities for teachers and students that introduce, emphasize, and provide practice for word-learning skills.

Figure 25



MyPath also explicitly teaches and spirals academic and domain-specific vocabulary throughout the curriculum. Academic vocabulary words are carefully selected from the Averil Coxhead Academic Wordlist (2000) and Magali Paquot Academic Keyword List (2010). In lesson warmups, students preview four to six academic and domain-specific vocabulary words in the Words to Know section (Figure 26). During instruction, on-screen teachers define and teach critical words. Explanations of vocabulary are clear, easy to understand, and illustrate not only what the words mean but also how they are used. For example, in a reading lesson, an on-screen instructor describes an affix using examples and nonexamples (Figure 27). The instructor also models the use of vocabulary for students—ensuring multiple exposures to high-frequency words (Figure 28). After instruction, students complete tasks that require them to identify examples of the words, explain phenomena using descriptive patterns, and complete concept definition maps. As students practice, they can take notes about words in the eNotes feature. A lesson glossary allows students to look up words and add them to their personal word lists. Within the CloseReader, students can look up unfamiliar words and can read the definitions themselves or hear them read aloud. They can also translate on-screen text into their home language.

Figure 26

Figure 27

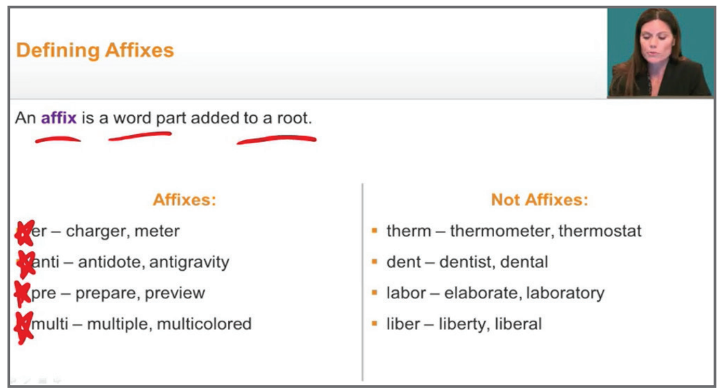
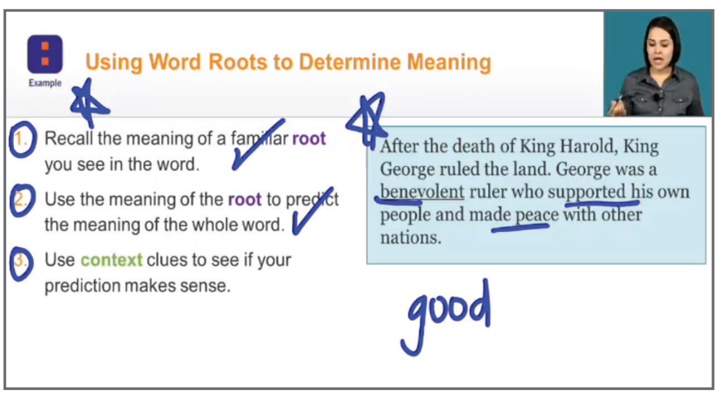


Figure 28



- **Reading comprehension**: In both MyPath and Pathblazer, comprehension instruction is explicit and text-driven. Skills are explicitly taught and practiced using authentic, engaging, content-related passages that range in difficulty. Instruction targets students' thinking as it occurs before, during, and after reading.

In MyPath, students read a wide variety of authentic texts. Approximately half the texts students read in MyPath are literary. The remaining half are nonfiction or informational. MyPath provides guided and independent practice in **pre-reading** strategies (previewing the text, accessing prior knowledge, formulating questions, clarifying understanding, setting a purpose, and making predictions), **during-reading** strategies (visualizing, making connections, monitoring understanding, making inferences, rereading, questioning, and summarizing), and **after-reading** strategies (comparing, synthesizing, and drawing conclusions). For example, throughout MyPath reading lessons, students learn that:

- Making predictions (educated guesses) can be a useful way of homing in on a text's meaning. For example, while reading a Greek myth and nonfiction articles about solenodon mammals, the Iditarod dogsled race, and climate change, students connect what they read in the text and recall what they have learned to make a prediction about what will happen next in the text (Figure 29). As students read, they check their predictions to see if they remain accurate.
- Visualizing can help a reader make sense of subject matter and "see" the characters, setting, and action taking place in the text. Students learn to visualize by identifying descriptive details and making text-to-self connections—that is, what the text has to do with the reader (Figure 30).
- Using background knowledge and clues from the text help a reader make sense of what an author implies rather than explicitly states. Students practice using text evidence to make inferences while reading poetry, fiction, and informational texts (Figure 31).
- Comparing and synthesizing different authors' experiences and literary style (word choice, figurative language, tone, sentence structure, and formality) can shed light on the author's viewpoint. After reading a graphic novel and a memoir, students learn about two different author's perspectives on wearing hijab. In the graphic novel, the author goes to a French school when she is young, but later attends an Islamic school for girls. The law requires her to wear hijab both in and outside of school, whether she wants to or not. As a result of this experience, the author views the veil negatively. This is in contrast to the memoir, where the primary character, Amal, goes to an Islamic high school, after having attended a Catholic school for much of her childhood. Amal has a more relaxed attitude about hijab and comes to admire and respect girls who choose to wear it outside of school (Figure 32).

Figure 29

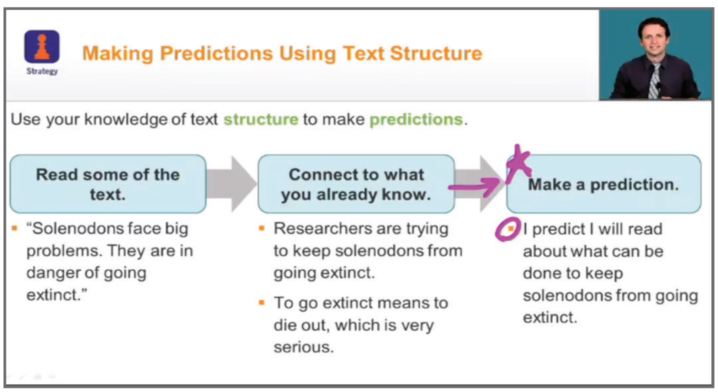


Figure 30

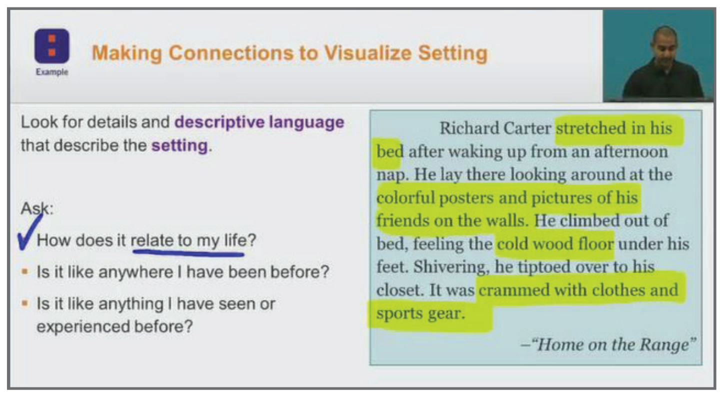


Figure 31

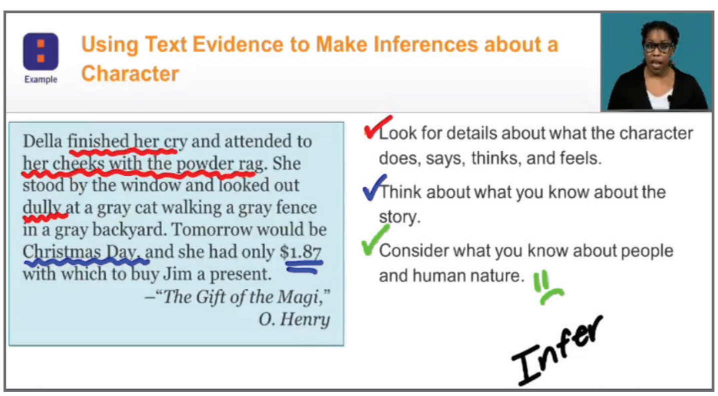
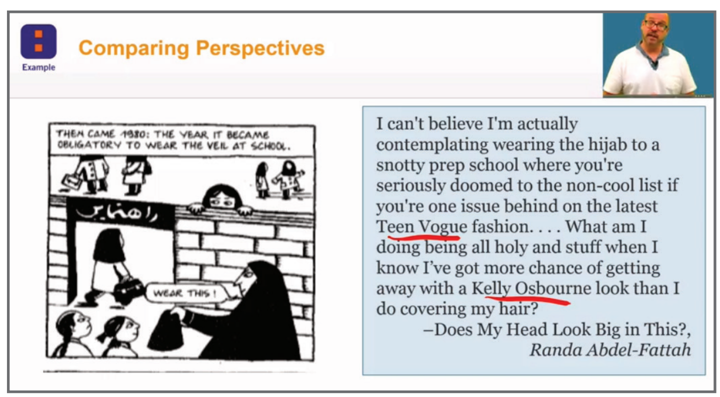
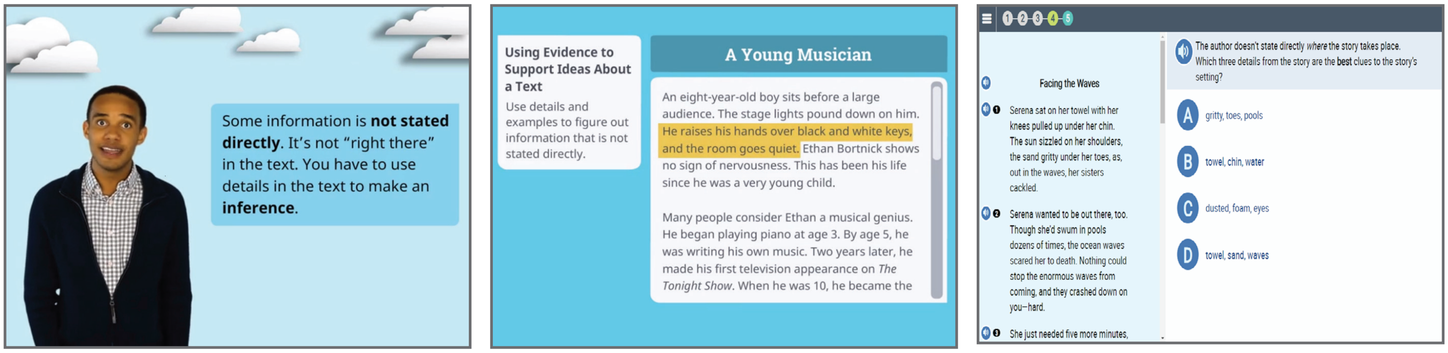


Figure 32



Pathblazer includes more than 60 leveled fiction and nonfiction selections that provide emergent readers with interesting and varied genres. Pathblazer teaches students to use comprehension strategies before, during, and after reading texts. For example, in a reading lesson, students learn that good readers combine relevant prior knowledge with clues from a text to come up with an idea that is not explicitly stated. **Before reading,** an on-screen teacher explains that explicit information is what is directly stated in a text. In contrast, inferences are what we figure out based on details or experience. **During reading,** the on-screen instructor models how to identify when information is implied, or not directly stated. **After reading,** students apply these skills independently while reading informational and literary texts (Figure 33). Students are encouraged to respond critically to what they have read through comprehension checks, comprehension reteaches, and responses to literature through writing.

Figure 33



Both MyPath and Pathblazer help students explore story elements, characterization, conflict, figurative language, voice, theme, and poetic structure in fictional texts. For example, a Pathblazer reading lesson teaches students that setting is where a story takes place. A think-aloud then models how to use details that describe what characters see, hear, and smell in a science fiction text to describe the setting (Figure 34). Students build on this knowledge by learning that a plot is the sequence of events, or the "why" for the things that happen in the story, and that the theme of a passage is the underlying message of the story. They then compare and contrast the setting, plot, and theme in two fictional stories about a lost dog and a baseball mitt (Figure 35).

Throughout MyPath, students learn how authors use metaphors, similes, personification, hyperbole, and symbolism to appeal to the senses and create mental images for a reader in literature and poetry. Edgenuity presents a schema of questions that can be used to help interpret the figurative language meanings. The digital sticky notes feature and graphic organizers help students concretely track and interpret how figurative language contributes to an author's message (Figure 36).

Figure 34

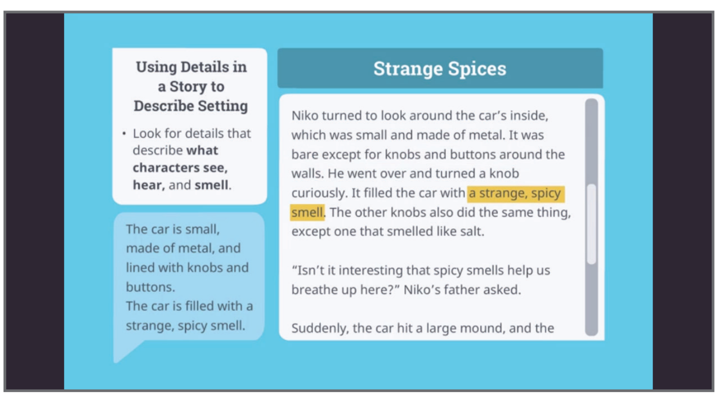


Figure 35

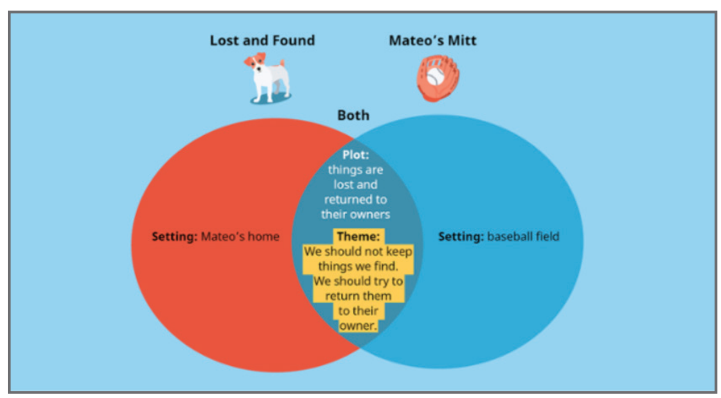
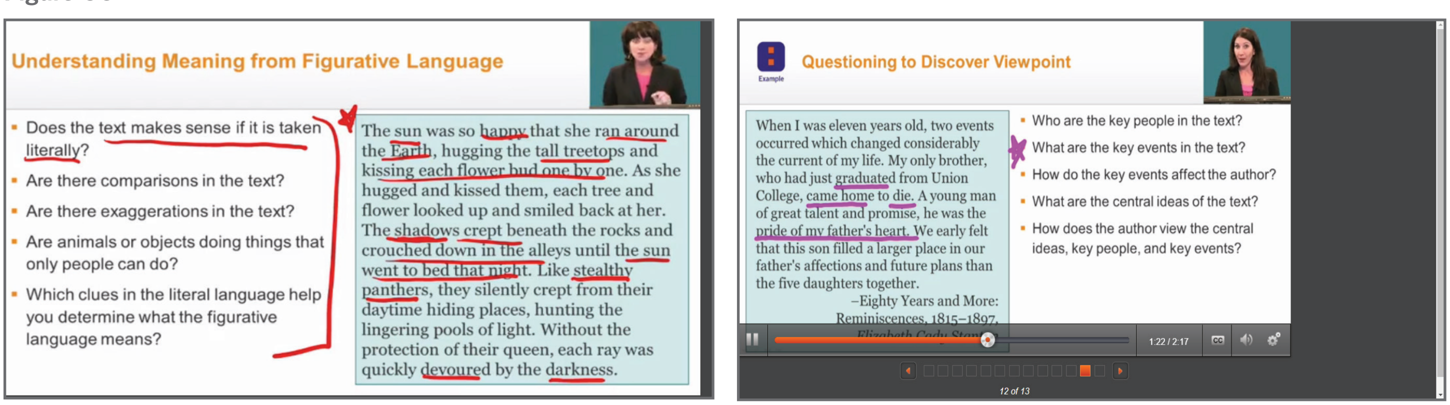


Figure 36



The intervention programs also teach students strategies for recognizing common organizational patterns of expository texts. In both programs, students are coached to look for words that signal chronological, comparison, cause and effect, or problem-solution text structures. For example, a Pathblazer reading lesson illustrates how the use of dates signals the chronological text structure of an article about the history of antibiotics (Figure 37). Students are then provided a series of comprehension question frames to help them make meaning of the text (Figure 38). In another example, from a MyPath lesson, after identifying a problem-solution text structure, video instruction prompts students to ask themselves what the problem in the text is, who has the problem, why it is a problem, what is causing the problem, and what the proposed solutions are. Ultimately, students use textual evidence and background knowledge to draw a conclusion that people need to start protecting animal habitats from climate change (Figure 39).

Figure 37

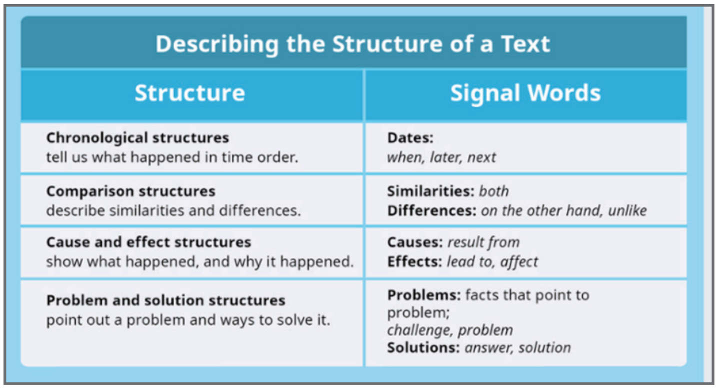


Figure 38

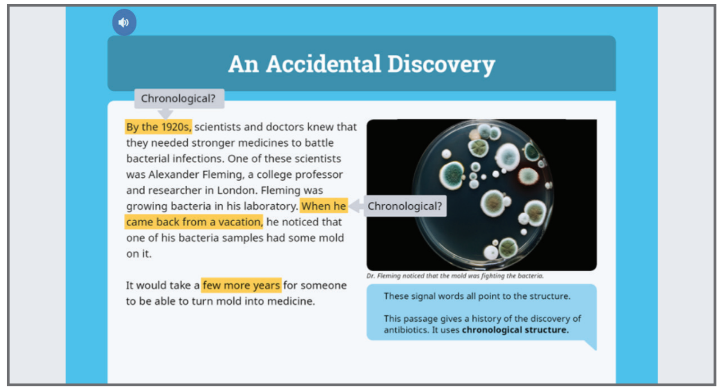
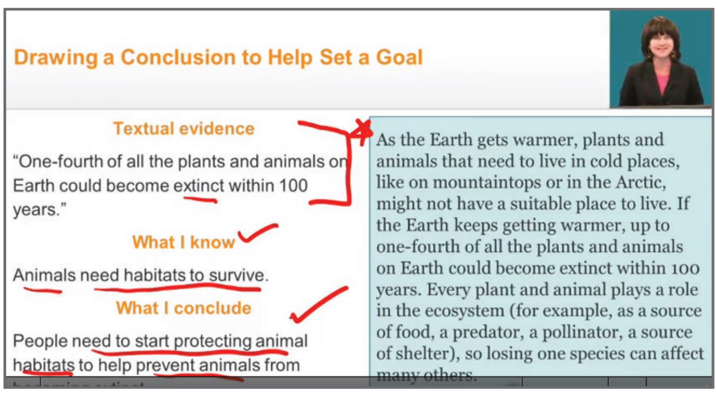


Figure 39



Close Reading of Complex Texts

As students progress through school, they are presented with texts that contain dense information, intricate text structures, abstract concepts, unfamiliar vocabulary, multiple meanings, and complicated sentence structures that make comprehension difficult. Research suggests that text-dependent questions—questions that require students to provide evidence from the text as part of their responses—can provide a predictable structure to help students better comprehend complex texts (Fisher & Frey, 2013; Fisher & Frey, 2014). As Buehl (2011, p. 225) states, "Helping students identify the reader moves that enable them to work complex texts is a significant step in their development as independent readers."

Our solution: Close reading of complex texts

MyPath and Pathblazer enable struggling students to access rigorous grade-level content. Both programs build conceptual understanding by requiring students to answer text-dependent questions based on short passages with varying degrees of complexity and scaffolding. The programs also create a "staircase" of increasing text complexity—a diverse array of classic and contemporary literature that gets progressively more difficult to comprehend (as determined by grade level, content, vocabulary, syntax, interest, coherence, standards, or Lexile level). Students are expected to explain and justify responses to questions in their own words by using specific evidence from the text (a word, phrase, or passage). Instructional scaffolding, hints, and reteaching are used to support struggling students.

In MyPath, students are required to answer text-dependent questions that address:

- **What the text says:** These questions, often phrased as who, what, when, where, why, how much, or how, are designed to assess whether students understand the gist and explicit details of a text. For example, in a MyPath reading lesson, students read "Icarus and Daedalus," a Greek myth that retells the story of an inventor and his son who get trapped by King Minos on Crete. The inventor, Daedalus, creates wings for himself and his son, Icarus, to escape. But Icaraus gets carried away by his newfound freedom, flies too close to the sun, and his wings melt. After reading the text, students are asked text-based questions that address who the characters are, how the plot develops, what the conflict is, and how the characters react to the conflict. Ultimately they are asked about the overarching theme that obedience is important and that one should not overestimate one's abilities (Figure 40).
- **How the text works:** These questions ask students about how an author's choice of words, text structure, literary devices (foreshadowing, imagery, point of view, tone, and mood), poetic devices (alliteration, hyperbole, metaphor, personification, simile, and symbolism), text features (charts, diagrams, figures, illustrations, boldface, font), or narration (first person, second person, third person, limited, omniscient, or unreliable) contribute to a text's meaning. For example, a MyPath reading lesson asks students questions about how an author uses a problem-solution text structure, tone, and punctuation to create a sense of urgency in a case study about mad cow disease (Figure 41).
- **What the text means:** These questions concentrate on an author's purpose (stated or implied) and on synthesizing information. They also ask students to provide an opinion with evidence to argue for or against the theme of the text. In a MyPath lesson, students read a speech given by nine-year-old Severn Cullis-Suzuki at the United Nations Earth Summit in Rio de Janeiro in 1992. After reading the speech, students are asked to identify the type of appeal Cullis-Suzuki is trying to make, Cullis-Suzuki's central argument, persuasive techniques, and effective evidence (Figure 42).

Figure 40

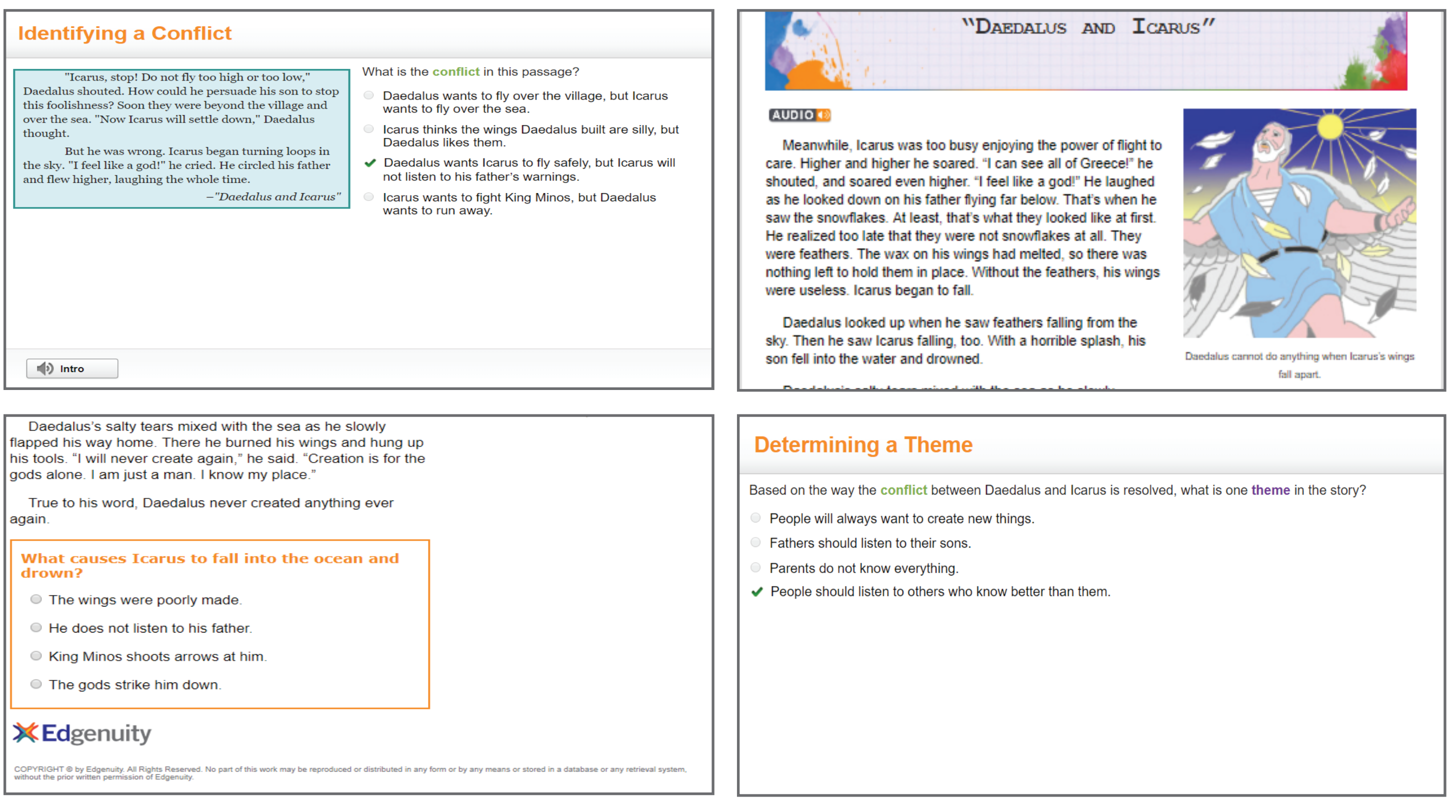


Figure 41

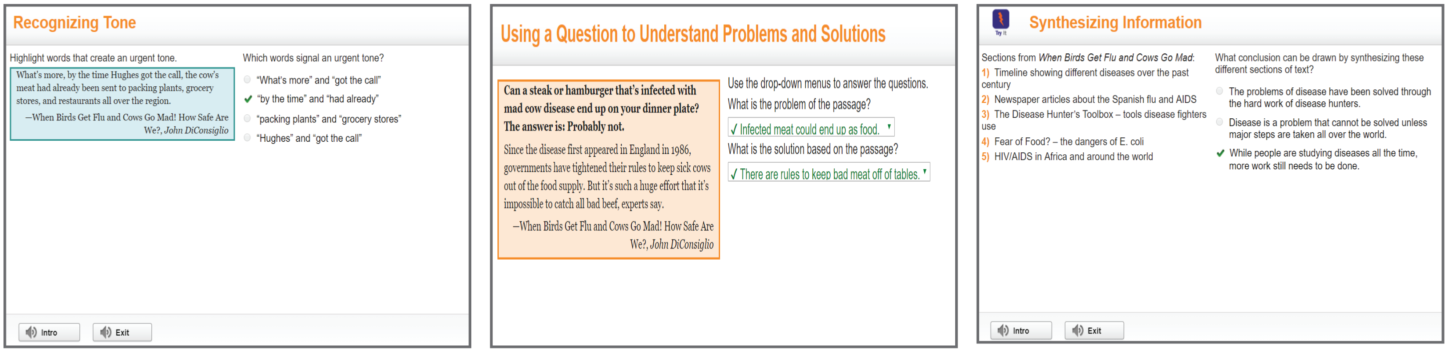
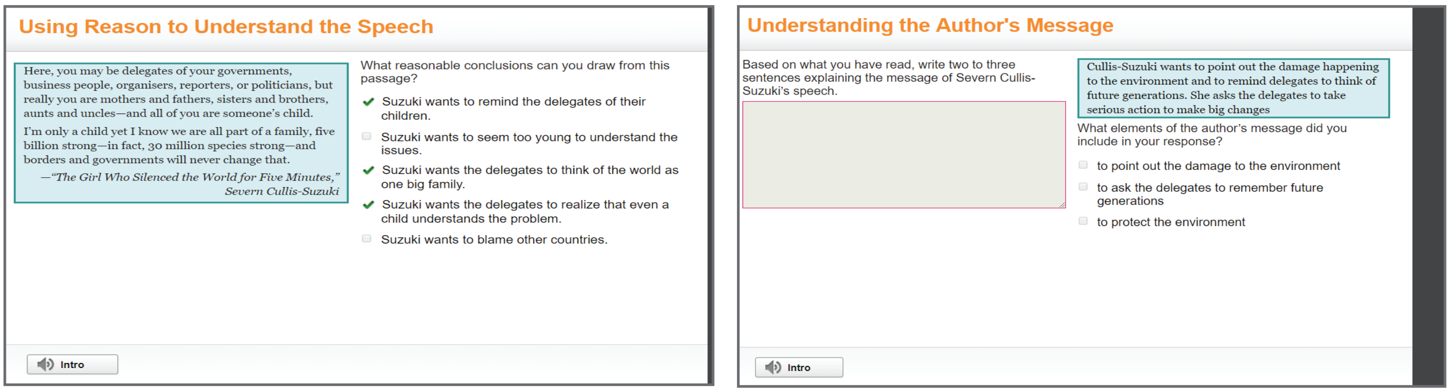


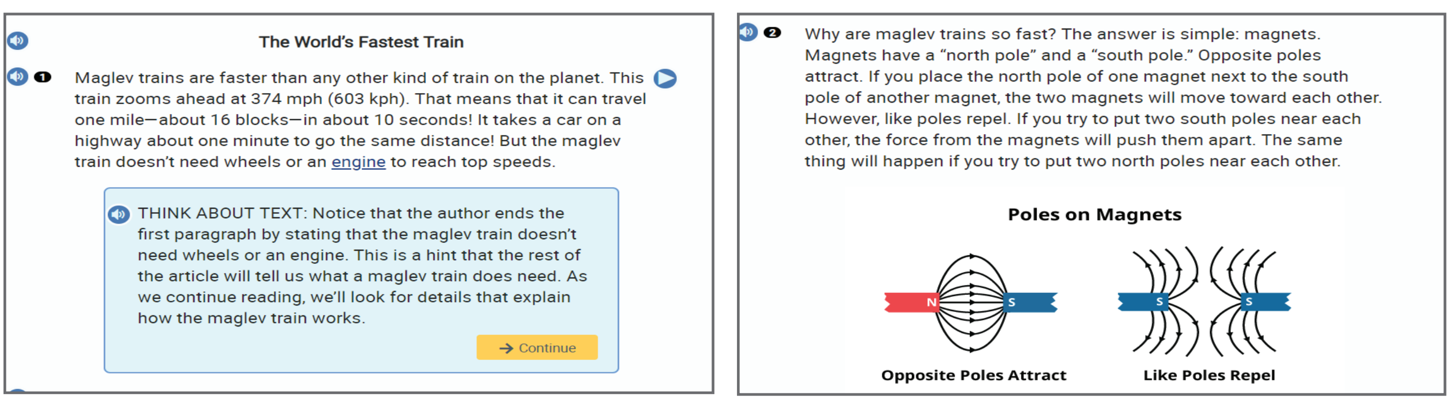
Figure 42



Pathblazer also engages students in a structured, close reading process that requires them to read passages three times (Figure 43):

- **First reading:** Students read the passage for the first time with audio support, focusing on what the text implicitly and explicitly says. A video guides students in reexamining the text and discussing how the skill was applied in the context of the text.
- **Second reading:** As students read for the second time with audio support, they focus on craft and structure, with an emphasis on the impact of text structure on meaning.
- **Third reading:** During the final reading, students read without the support of audio, having had two opportunities to gain familiarity with the text. This time the focus is on integrating knowledge and ideas, with an emphasis on integrating multimedia visual content. A teacher resource is available for guided questions, along with rubrics and short-answer questions in a blackline master for offline use.

Figure 43



Foundational and Content Area Math Instruction

In addition to exhibiting memory, attention, language processing, and comprehension deficits, students who struggle with mathematics often have weak early numeracy and executive function skills that make mastery of mathematics content difficult (Maccini & Gagnon, 2006).

For these students to succeed academically, they need to develop their foundational skills while also accessing grade-aligned content (Saunders et. al, 2017). Research supports the development of math intervention programs that explicitly teach foundational skills such as number sense, whole number operations, rational numbers, and problem solving, while also addressing algebra, measurement, and spatial reasoning (Payne & Huinker, 1993; Gersten et al., 2009; Sherman, Richardson, & Yard, 2013; Witzel & Little, 2016; Codding, Volpe, & Poncy, 2017; Gurganus, 2017; Saunders et al., 2017; Van de Walle, Bay-Williams, Lovin, & Karp, 2018a; Van de Walle, Bay-Williams, Lovin, & Karp, 2018b).

- **Number sense:** Research confirms that number sense—the ability to recognize number meaning, relationships, representations, magnitude, and reasonableness—is a strong predictor of future quantitative understanding and mathematical achievement (Sarama & Clemens, 2009). Yet, many students never develop solid number skills because they have difficulty conceptualizing numbers. While students often learn to calculate mechanically, they fail to grasp what the numbers actually mean (Gurganus, 2017).

  To help struggling learners develop stronger number sense, experts recommend stressing the connections between form and meaning, process and concept. Practitioners suggest teaching students to locate and estimate numbers using a number line, to count up to and back from a target number, to state the cardinal number (the last counted word tells you how many objects there are in the entire set), and to recognize the names of numbers and how they relate to symbols (Payne & Huinker, 1993; Witzel & Little, 2016; Gurganus, 2017; Van de Walle et al., 2018a). Experts also suggest teaching students to recognize a small group of items without counting, understand five and 10 structures, and stress the importance of part-part-whole relationships (Payne & Huinker, 1993; Witzel & Little, 2016; Codding et al., 2017; Van De Walle, et al., 2018a). Researchers also consistently identify estimation and place value as two necessary elements of effective number sense instruction (Sowder, 1992; Payne & Huinkner, 1993; Sowder & Kelin, 1993; Groth, 2013; Sherman et al., 2013; Witzel & Little, 2016; Gurganus, 2017).

- **Whole number operations:** Fluency with whole number operations (addition, subtraction, multiplication, and division) is highly correlated with higher math performance in the first, third, and eleventh grades (Gersten, Jordan, Flojo, 2005; Jordan, Kaplan, Ramieni & Locuniak, 2009; Price, Mazzocco & Ansari, 2013). Yet as Codding et al. note (2017), studies indicate that more than a third of students in first and third grades do not display automaticity with whole number operations. All too often, addition, subtraction, multiplication, and division principles are introduced in isolation. Students are taught to memorize symbolic expressions (e.g., + , –, and =) and drill number combinations. Consequently, students fail to learn the underlying concepts behind whole number operations (Baroody & Standifer, 1993; Gurganus, 2017).

  Research and experts agree that word problems—not symbolic expressions—should be used to introduce or reintroduce whole number operations (Baroody & Standifer, 1993). Word problems, however, can be difficult for struggling learners to master because they have difficulty conceptualizing a problem. Intervention research shows that following a concrete-representational-abstract (CRA) sequence of instruction can help struggling students overcome these challenges (Baroody & Standifer, 1993; Kouba & Franklin, 1993; Bamberger & Oberdrof, 2010; Sherman et al., 2013; Witzel & Little, 2016; Gurganus, 2017; Saunders et al., 2017). When students are able to link concrete understanding of the math concept/skill, then represent it pictorially and connect it to a symbolic expression, they are better prepared to perform that math skill and truly understand math concepts at the abstract level (Baroody & Standifer, 1993; Witzel & Little, 2016; Gurganus, 2017).

- **Rational numbers:** Many researchers regard the rational number system as the bedrock of mathematical learning, due to its prominent role in numeration, measurement, geometry, algebra, and probability (Groth, 2013; Witzel & Little, 2016; Gurganus, 2017). Yet, as Lamon (2007, p. 629) points out, conceptual understanding for struggling students is "the most protracted in terms of development, the most difficult to teach, the most mathematically complex, the most cognitively challenging, but also the most essential to success in higher mathematics."

Fortunately, research has uncovered several instructional strategies that can improve struggling students' understanding of rational numbers. These include:

- Building conceptual understanding before formal vocabulary and procedures are introduced (Groth, 2013; Witzel & Little, 2016; Gurganus, 2017)
- Illustrating how fractions can be interpreted and represented in a variety of ways (Kieran, 1992; Lamon, 2007; Groth, 2013; Watson, Jones, & Pratt, 2013; Witzel & Little, 2016; Gurganus, 2017)
- Identifying situations where ratios and proportions are appropriate to solve problems (Langrall & Swafford, 2000; Witzel & Littel, 2016; Gurganus, 2017)
- Teaching students to "recognize the difference between absolute, or additive, and relative or multiplicative change" (Langrall & Swafford, 2000, p. 255)
- Focusing on the big idea that proportional reasoning involves multiplicative comparison (Carnine, Jones, & Dixon, 1994; Siegler et al., 2010; Watson et al., 2013; Gurganus, 2017; Van de Walle, et al., 2018b;)
- Distinguishing between proportional and nonproportional relationships (Watson et al., 2013; Witzel & Little, 2016; Gurganus, 2017)

- **Problem-solving:** Research confirms that providing word problems that stress students' understanding and real-world application of mathematics improves mathematical achievement (Ginsburg, Leinwand, Anstrom, & Pollock, 2005; Gersten et al., 2008). Data suggest that struggling students have difficulties solving word problems because they 1) don't understand the story structure or language; 2) are not able to identify the relevant and irrelevant information in the problem; 3) cannot select the appropriate strategy to solve the problem; 4) fail to execute the step-by-step plan required to solve the problem; 5) have difficulty creating a diagram or model; 6) can't self-monitor the problem-solving process; and/or 7) over-generalize the strategies they have learned to new word problems (Gersten et al., 2009; Bryant & Nunes, 2012; Shin & Bryant, 2015; Van Garderen & Scheuermann, 2015; Codding et al., 2017; Gurganus, 2017). Consequently, struggling learners need explicit instruction that teaches them how to identify the underlying problem structure before solving a problem (Jitendra & Hoff, 1996; Fuchs et al., 2008).

  One particularly effective practice for teaching problem-solving to struggling students is schema-based instruction (Jitendra & Hoff, 1996; Fuchs et al., 2008; Codding et al., 2017; Gurganus, 2017; Saunders et al., 2017). Research on schema-based instruction shows that when struggling students are explicitly taught to 1) identify common word problem types; 2) paraphrase word problems; 3) create visual representations to identify the underlying problem structure; 4) identify relevant information; 5) select an appropriate strategy to solve the problem; and 6) self-monitor their strategy, mathematical achievement improves (Witzell & Little, 2016; Codding et al., 2017; Gurganus, 2017).

- **Algebraic thinking:** There is a large body of literature that shows that algebra—the ability to use symbolic models to predict and explain mathematical and other situations—is highly correlated with high school success, college graduation, and career success (National Mathematics Advisory Panel, 2008). Yet data from the 2017 NAEP indicate that fourth and eighth grade students across the country did not reach proficiency on the algebra and functions scale of the NAEP mathematics assessments (National Center for Education Statistics, 2018b). Eighth grade students scored an average of 290 (below proficient) and fourth grade students scored an average of 243 (almost proficient).

  - Over the past few decades, researchers have documented several of the most common misconceptions related to algebraic thinking. Studies note that students struggle because they fail to:
  - Understand the meanings of symbols that represent unknowns, labels, placeholders, or constants (Kuchemann, 1981; Booth, 1984; Kieran, 1992; MacGregor & Stacey, 1997; Watson, 2007; Welder, 2012; Groth, 2013). To successfully develop algebraic reasoning skills, students must learn "that there are different uses for different letters in mathematical conventions" (Watson, 2007, p. 13), as well as practice translating between words and algebraic symbols (Groth, 2013).
  - Translate word problems into algebraic symbols (MacGregor & Stacey, 1997; Welder, 2012; Groth, 2013). Many students fail to see how a sentence can differ from the structure of an algebraic equation (Groth, 2013).

- Obtain a relational view of the equal sign (Gurganus, 2017). Students need to understand that = means “equal to” rather than “makes” or “to do.” Students who have a relational view of the equal sign tend to score higher on standardized mathematics test and are less likely to use ineffective guess-and-check strategies to solve problems (Knuth, Stephens, McNeil, & Alibali, 2006).
- Understand the order of operations and operational properties that undergird algebra problems (Driscoll, 1999; Watson, 2007; Gurganus, 2017). In reviewing decades of research on algebra learning and instruction, Watson (2007, p.23) found that students “tend to use procedural manipulations when solving equations and inequalities without a mental image or understanding to prevent errors.” Similarly, Groth (2013, p.218) points out that learners tend “to develop their own sets of beliefs about how operations should be carried out.” To build algebraic reasoning skills, Watson (2007) notes that students need to not only be taught inverse operations and “the nature of multiplication and division—both as the inverse of multiplication and as the structure of fractions,” but also that “subtraction and division are noncommutative, and that their inverses are not necessarily addition and multiplication” (p.18).

Researchers note that effective instruction should teach students to:

- Translate between words and algebraic symbols (Groth, 2013)
- Translate word problems into algebraic equations by translating the word problem into a diagram or table first (Groth, 2013)
- Compare representations of relationships in graphical, numerical, symbolic, and tabular forms, allowing for diverse thinking strategies (Watson, 2007; Gurganus, 2017)
- Obtain a relational view of the equal sign so that “arithmetic becomes the study of relations among numbers rather than purely about computation” (Watson et al., 2013, p. 23)
- Use procedural tasks such as the evaluation of arithmetic expressions to enhance awareness of structure (Banerjee & Subramaniam, 2012)
- Use real-life contexts to provide meaningful experiences with patterning (Gurganus, 2017)
- Use concrete objects, such as algebra tiles, to model equations, but explore their representations and limits before using them with students (Gurganus, 2017)

- **Measurement:** While measurement is a daily part of everyday life, a large majority of students in the United States, on the whole, lack even a basic understanding of measurement. According to the 2017 NAEP (National Center for Education Statistics, 2018b), fourth and eighth grade students scored below the proficient level on the domains relating to measurement. Experts agree that teaching measurement is important because “confusion about measurement concepts contributes to misunderstanding geometry, mathematical props in counting, geometry, mathematical properties, and fraction models.” (Wilson & Rowland, 1993, p. 172).

Research (Wilson & Rowland, 1993; Gurganus, 2017) shows that students who have difficulty measuring typically lack an understanding of:

- The unit and attributes of an object
- How to represent objects
- Reasoning with length
- The concept of conservation (the idea that an object maintains the same shape and size if it is moved or subdivided into its parts)
- The concept of transitivity (inferring an object is longer than another by referencing both to a third object)

Wilson & Rowland (1993) identify a research-based teaching sequence to support students’ measurement skills. They recommend teaching students to identify the property of the object to be measured, compare the attributes of an object, establish an appropriate unit for measuring an object, and create formulas to help count units (Wilson & Rowland, 1993; Watson et al., 2013; Gurganus, 2017).

Statistical reasoning: Statistical reasoning is “the way people reason with statistical ideas and make sense of information” (Garfield, 2002, p. 1). According to Garfield, this not only involves making “interpretations based on sets of data, graphical representations, and statistical summaries” but also includes “understanding distribution, center, spread, association, uncertainty, randomness, and sampling” (Garfield, 2002, p. 1). To improve students’ statistical reasoning skills, experts recommend helping students conduct statistical investigations, use technology, and run probability simulations, as well as exposing students to experimental probability, theoretical probability, and subjective probability (Shaughnessy, 1992; Groth, 2013).

- **Spatial reasoning:** Spatial reasoning is the ability to identify, represent, and move objects in two or three dimensions. According to Dobbins, Gagnon, & Ulrich (2014), a student's capacity to develop spatial reasoning skills is predicated on his or her ability to 1) recall information about a shape; 2) remember procedural information about formulas; 3) make connections between conceptual knowledge; and 4) draw upon metacognitive strategies to solve problems.

  To improve struggling learners' spatial reasoning skills, experts (Clements & Battista, 1992; Geddes & Fortunato,1993; Groth, 2013; Gurganus, 2017) suggest that instruction should 1) use clear language to describe spatial concepts; 2) carefully draw distinctions between common usage of definitions and mathematical usage; 3) provide opportunities to create spatial models; 4) teach students to interpret diagrams, graphs, and objects, drawing attention to critical attributes and relationships among them; 5) provide multiple exemplars; and 6) offer multiple opportunities for students to use technology to gain conceptual understanding.

- **Teaching the language of math:** Studies show vocabulary is critical to students' mathematical development (Miller, 1993; Monroe & Orme, 2002; Rubinstein, 2007; McRel, 2010; Smith & Angotti, 2012; Groth, 2013). As Miller (1993) points out, "[Without an understanding of the vocabulary that is used routinely in mathematics instruction, textbooks, and word problems, students are handicapped in their efforts to learn mathematics" (Monroe & Orme, 2002, citing Miller, 1993, p. 312). Educators and researchers agree that both broad vocabulary and specialized terms associated with mathematical topics (such as perfect numbers, quadratic equations, cosine, and mode) must be taught directly (McRel, 2010; Archer & Hughes, 2011).

Our solution: Foundational and content area math instruction

Edgenuity's MyPath and Pathblazer are designed to move struggling K–12 students to grade-level proficiency.

Pathblazer focuses on the graduated development of operations with whole numbers and rational numbers. In grades K–2, students create a firm foundation for success by developing their understanding of basic mathematical concepts such as counting and comparing numbers and shapes. With these skills in place, students can then move on to more advanced skills such as addition and subtraction, telling time, and understanding units of measurement. In grades 3–5, students build a solid understanding of operations with whole numbers. With this foundation, students in grades 6–8 can bridge to more complex work with rational numbers, including fractions, decimals, ratios, and percents.

MyPath's foundational learning paths address number sense, while basic and intermediate math paths are carefully sequenced to provide the concepts and skills required for success in algebra, including number properties and arithmetic with integers and rational numbers, proportional reasoning and relationships, and basic algebraic manipulations. Students also address measurement and spatial reasoning.

WHAT'S COVERED IN EDGENUITY'S MATH INTERVENTION SOLUTIONS?

Pathblazer K–2	Pathblazer 3–5	Foundational Learning Paths	Basic and Intermediate Learning Paths
Development of basic math concepts such as counting and comparing numbers	Operations with whole numbers	Number sense	Algebraic reasoning
Basic computation Addition and subtraction Fact fluency and operations	Rational numbers, including fractions, decimals, ratios, and percents	Whole numbers and operations	Rational numbers (percents, fractions, decimals, probability, ratios)
		Geometry	Geometry
Understanding units of measurement	Problem solving	Rational numbers (fractions and decimals)	Measurement

Pathblazer and MyPath address the areas that contribute to math competency.

- **Number sense:** Edgenuity's mathematics lessons are designed to help students think flexibly about numbers. To build conceptual understanding of numbers, online instruction models different methods to compute, count, measure objects, explain a number's relative position (e.g., first, second, third), and manipulate numbers in different ways. For example, in Pathblazer:
    - Students learn to assign one (and only one) count to each object of a set. They then practice number sequence by counting up to 20 objects arranged in a line, rectangle, array, circle, or a scattered configuration (Figure 44). They also count sounds and imaginary objects. Through a wide array of interactive activities, students gain a deeper understanding of counting by partitioning (touching and moving an object) and tagging (assigning a number to an object) items.
    - Online instruction focuses on stable order and cardinality. Students learn that the order in which one counts always remains the same. You start with 1 and count forward: 1, 2, 3, 4, 5. The counting never changes. Students also learn that the last number in a count sequence indicates the total number of items in the sequence.
    - Pathblazer teaches counting and skip-counting through songs, number lines, and hundreds charts, and presents problems that require counting. Students learn to count from a number, to count by 1s, 5s, and 10s, as well as to see groups of 2s and 3s. For example, students learn that a ten is a bundle of 10 ones (Figure 45), and that the decade numbers are 10s with zero 1s. To prevent students from memorizing the "counting by 1s, 2s, 5s, and 10s" sequence, students are asked to skip-count by 3s, 11s, and 12s.
    - Students learn expanded notation (writing a number to show the value of each digit, e.g., 452 = 400 + 50 + 2).

Figure 44

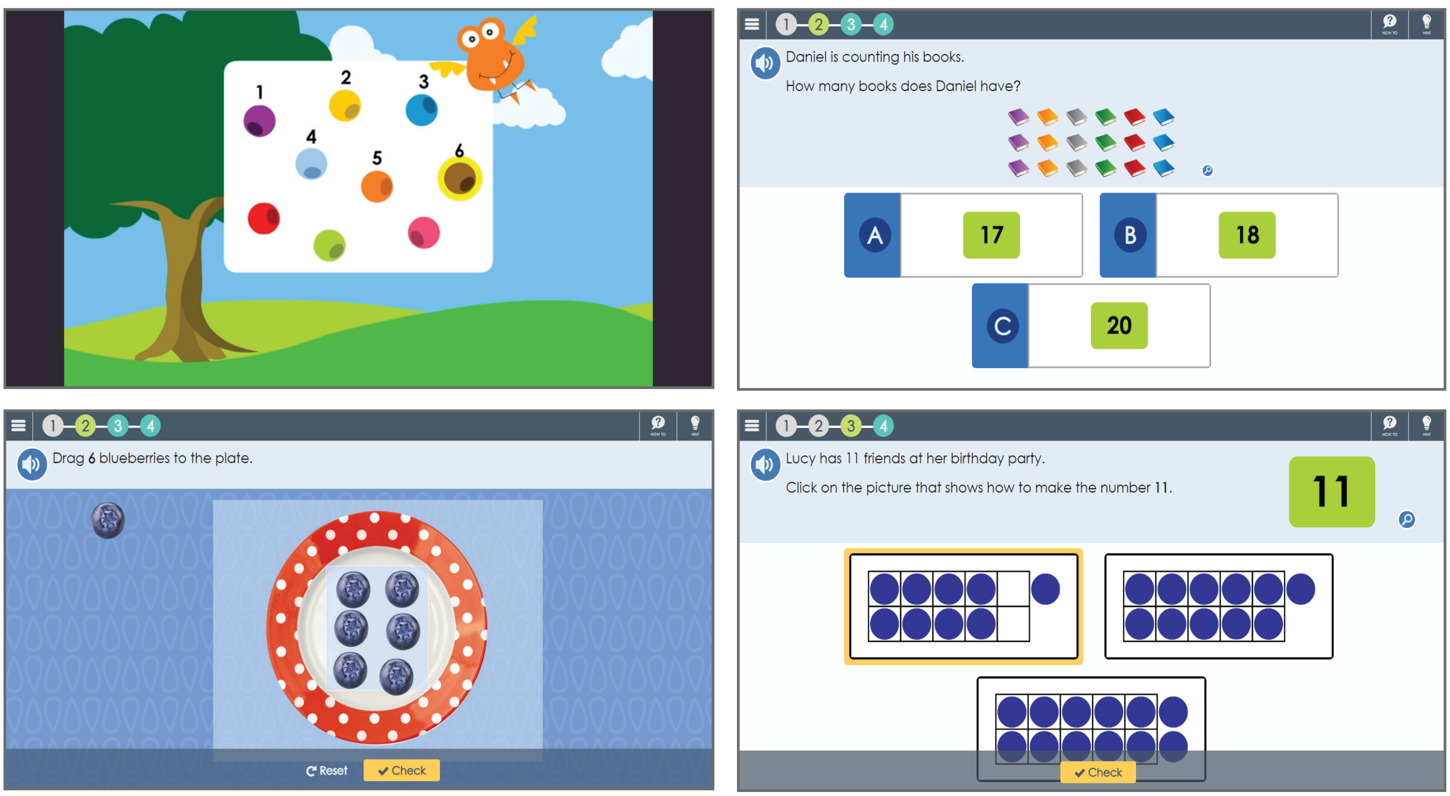
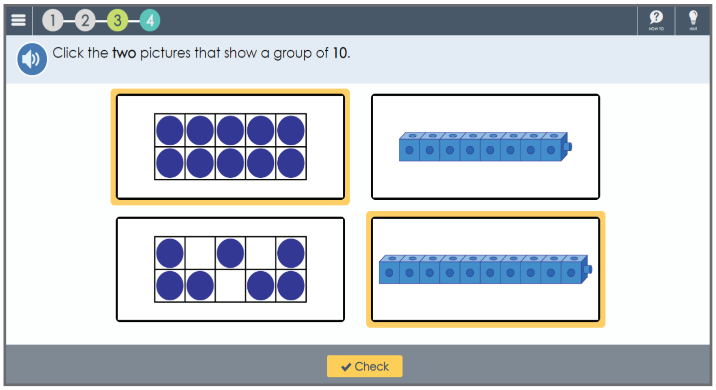


Figure 45

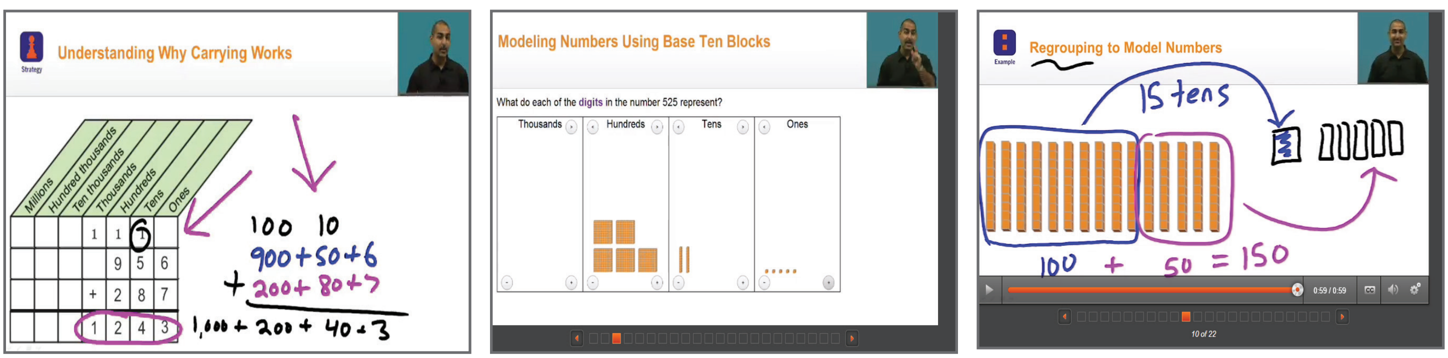


In MyPath, students develop conceptual understanding of the place value system by manipulating base ten blocks, reviewing equivalent numbers, and regrouping to model numbers (Figure 46). On-screen instruction directly addresses misconceptions reading the number zero. For example, students are reminded that 502 is not the same as 52. They also learn that in the number 782, the 8 represents 8 tens, not 8 ones.

Online lessons engage students in mental and computational estimation. For example, students learn how to:

- Estimate decimal products: Before the on-screen instructor shows how to calculate 37.8 × 11.2, he makes an estimate about the product. The instructor models his reasoning by saying he wants to find numbers that are easier to multiply in his head. He notes that 37.8 is close to 40 and that 11.12 is close to 10, so the product is close to 40 × 10 = 400. He then uses the distributive property to find the actual product, 423.36. When analyzing the number, the on-screen instructor describes how the exact product will be greater than or less than the estimate, depending on how the factors were rounded.
- Estimate square roots: An on-screen instructor shows how to estimate and compare roots by looking at the nearest whole number square, the nearest tenth place, and the nearest hundredth place

Figure 46

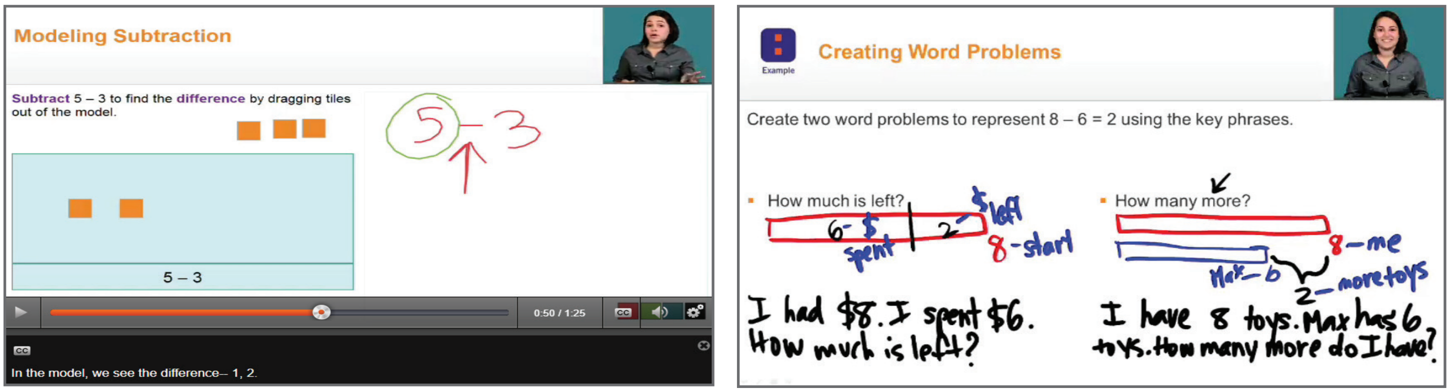


- **Whole number operations:** MyPath and Pathblazer use a CRA instructional approach to teach addition, subtraction, multiplication, and division. Instruction first illustrates how to use concrete manipulatives (base ten blocks, diagrams, pictures, and number lines) to solve a wide variety of word problems. It then shows students how to translate this concrete model into a pictorial one. Finally, students learn how to connect the pictorial representation with symbols and expressions.

  For example, in a Pathblazer lesson about addition, students use blocks to show that if you add seven blocks to three blocks, you will get ten blocks. Video instruction then shows how to add with dots and then models how this is translated into an equation (Figure 47). Similarly, a MyPath lesson uses tiles to show that if you take away three tiles from five tiles, you are left with two tiles. The on-screen instructor then illustrates how this can be represented by an expression (Figure 48).

Figure 47

Figure 48



In MyPath, students are explicitly taught whole number operations such as addition, subtraction, multiplication, and division (Figure 49). Video instruction spells out the critical attributes of and differences between operations. As students solve word problems, on-screen instructors model how to choose appropriate operations (Figure 50). Students learn a number of strategies to solve problems. For example, students practice decomposition strategies (e.g., 5 + 6 = 5 + 5 + 1) as well as visually representing whole number operations using number lines, ten frames, and arrays. Students learn how to compute accurately by watching expert teachers model how to use multiples of 100 as anchors when solving addition problems (Figure 51). Other strategies, such as skip-counting (counting by 2s, 3s, 5s, 10s, or 100s), help students carry out basic addition, subtraction, multiplication, and division operations (Figure 52).

Figure 49

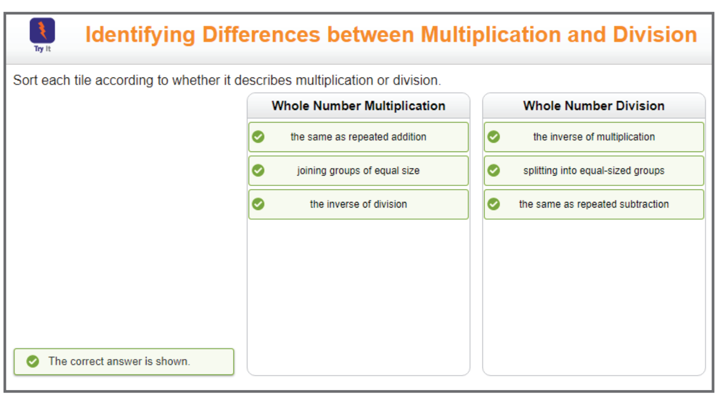


Figure 50

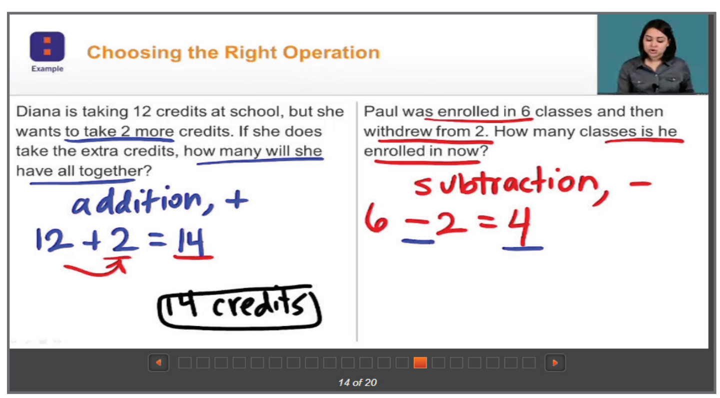


Figure 51

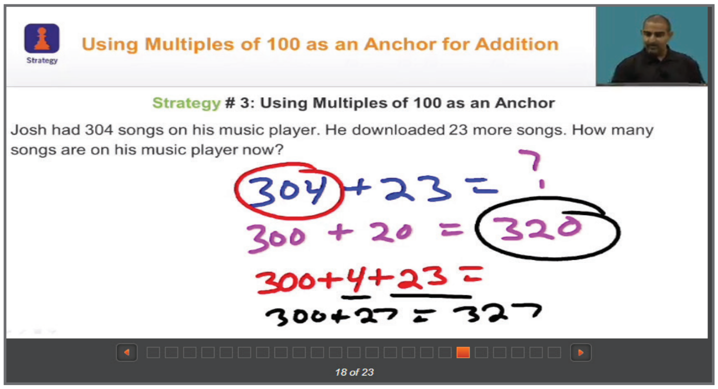
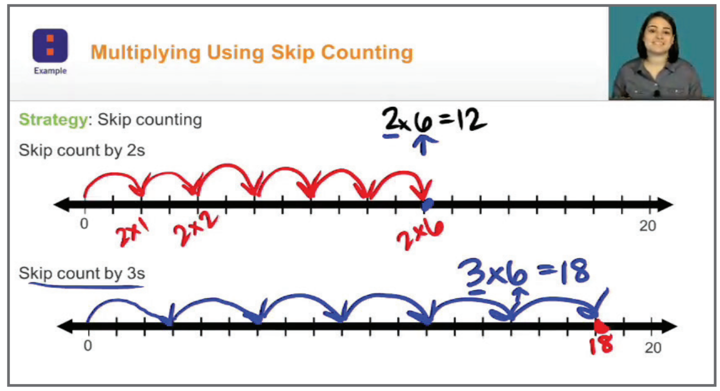


Figure 52



Pathblazer encourages students to use multiple representations to solve word problems. For example, Pathblazer teaches students to solve one-step addition word problems (with an initial amount unknown) using equations and number lines (Figure 53). Students build conceptual learning by diagraming equations (Figure 54) and manipulating base ten blocks (Figure 55) while adding numbers within 100. On-screen instructors teach students to solve multistep word problems with multiplication and division using a problem-solving chart. (Figure 56) They learn how to monitor what they know and what they need to know, and write down different strategies they could use to solve the problem. They then document a justification to their solution.

Figure 53

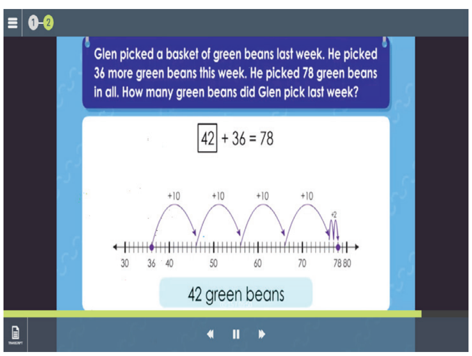


Figure 54

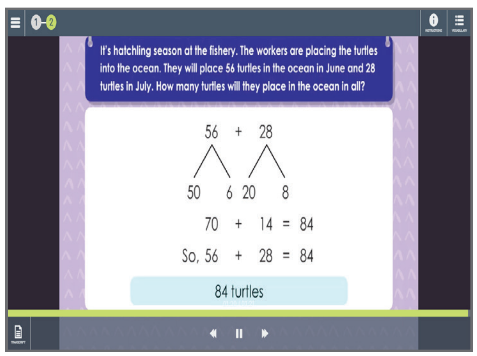


Figure 55

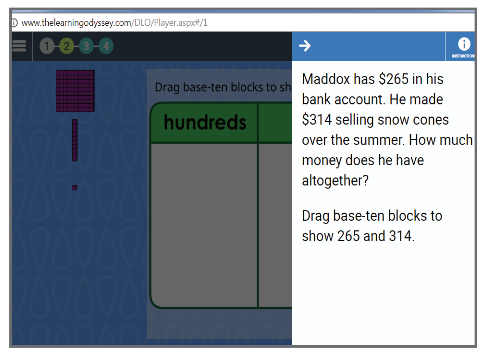
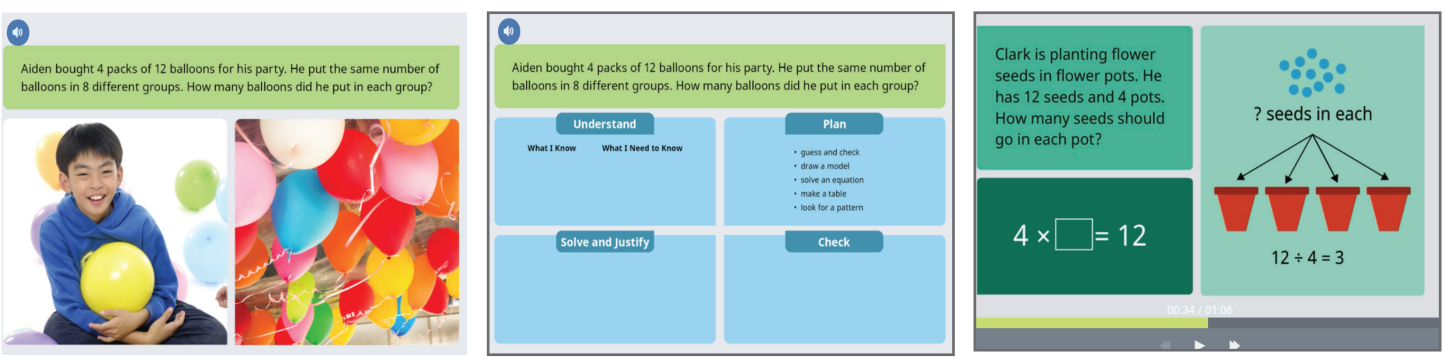
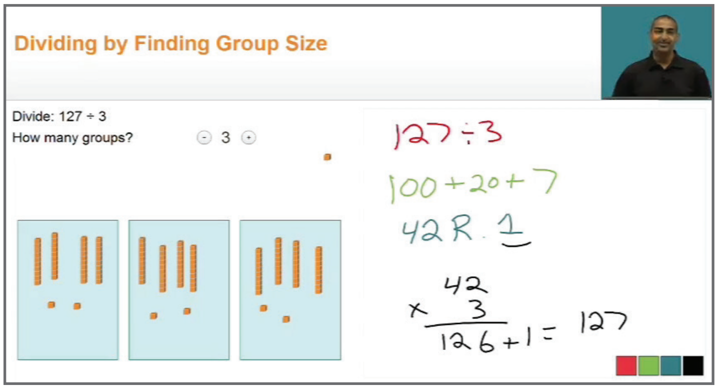


Figure 56



MyPath also teaches students to use virtual manipulatives when solving problems (Figure 57). For example, in a mathematics lesson students are told to place 10 and 1 blocks into three different groups when dividing 127 by 3. Student learn that the numbers inside the box represent the total amount placed in groups. This should be 127 if there is not a remainder. To divide, students see that tens will go in each group and that four tens will need to be placed in each group. They subtract 120 from the total because they have already placed those 120 in groups. The difference is what still needs to be divided. Students then model by placing an equal number of ones in each group. There are two ones added to each group. Students then subtract 6 from 7 and realize they have a remainder of 1.

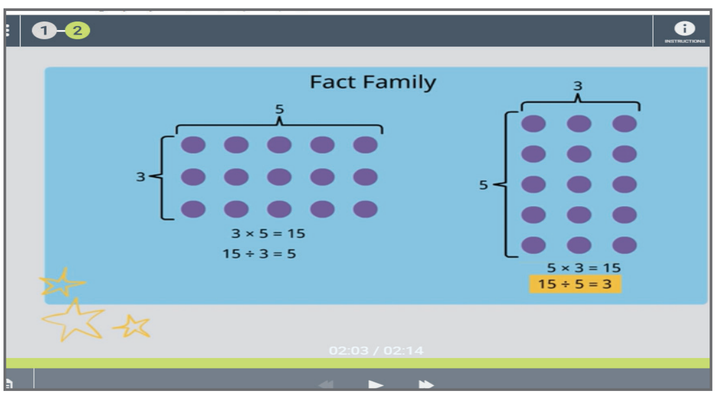
Figure 57



Edgenuity never teaches whole numbers in isolation. For example, MyPath and Pathblazer capitalize on fact families—a group of three numbers that are related—to illuminate the close relationship between addition and subtraction as well as the relationship between multiplication and division. Fact families also teach students the inverse (2 * 6 = 12 and 12 ÷ 6 = 2), commutative (6 * 2 = 12 and 2 * 6 = 12), associative (2 + (3 + 4) = (2 + 3) + 4), and distributive (2(3 + 4) = 2 * 3 + 2 * 4) properties of whole number operations. Edgenuity teaches students that in general, there are four math facts to be made with each family.

For example, in a Pathblazer lesson, students consider the fact family 3, 5, and 15. In the family, 3, 5, and 15 are related because one can multiply two of the numbers to get the last number (3 * 5 = 15). One can also switch the first two numbers, using the commutative property of multiplication, and still get the same answer (5 * 3 = 15). If multiplication is the direct relationship among these family members, then division is the family cousin through the inverse property (Figure 58). Division is the opposite of multiplication, but it is still related.

Figure 58

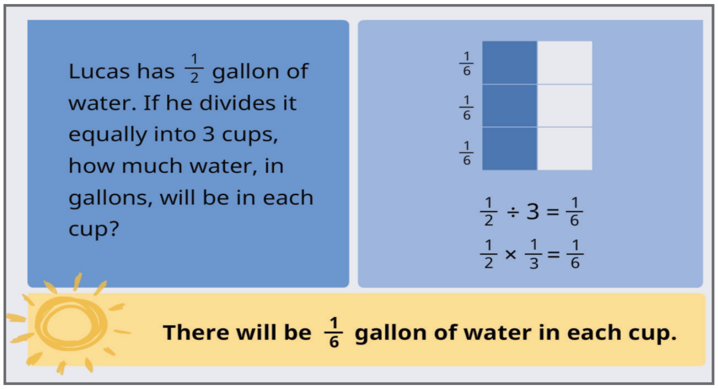


- Rational numbers: Rational numbers and proportional reasoning are strongly emphasized in both MyPath and Pathblazer. Throughout mathematics lessons, students are reminded that ratios compare two or more quantities and that fractions compare parts to a whole. Lessons illustrate how fractions can be used to show:

  - Part-to-whole interpretations, where ¾ can represent 3 pieces out of 4 equal lasagna slices.
  - Quotient interpretations, where ¾ of a cup of dog food can represent 3 cups divided equally among 4 puppies.
  - Measurement interpretations, where ¾ can represent 3 lengths of size that are ¼ units each.
  - Ratio interpretations, where ¾ can be described as a ratio (there are 3 parts lemonade for every 4 parts strawberries).
  - Operator interpretations, where ¾ can represent 75 percent of an image.

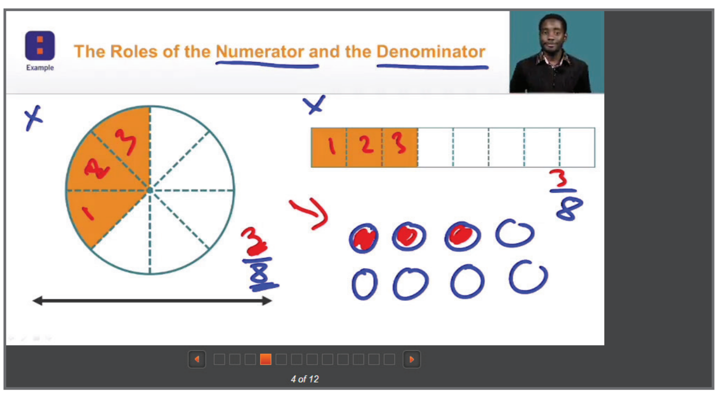
MyPath and Pathblazer deliberately build conceptual understanding before teaching vocabulary and procedures. For example, a Pathblazer lesson on rational numbers uses a CRA instructional approach to teach students how to divide a fraction by a whole number. Students are asked to solve a word problem where they need to divide ½ gallon into 3 cups. Students are taught to first make an area model that represents the first number in the expression (½). Then students learn to divide the pictorial representation into pieces, as determined by the whole number (3). The video then explains that the size of each smaller part ($^1/_6$) determines what ½ divided by 3 is. Students then learn how the concrete model they have created is connected to a written expression with symbols (Figure 59).

Figure 59



Similarly, in a MyPath lesson, an on-screen instructor uses students' informal knowledge to build conceptual understanding of the term "common denominator." First, the instructor reviews the roles of the numerator and the denominator using tiles, a pie model, a number line, and an area model (Figure 60). Later in the lesson, the on-screen instructor asks students how much greater $^7/_8$ is than ¾, thereby laying the groundwork for common denominators and adding and subtracting fractions. Students gain experience with this concept before the term "common denominator" is formally defined and explained.

Figure 60



Both MyPath and Pathblazer stress solving ratio problems using a multiplicative, not additive approach. They clarify when multiplication can be used to solve problems. Video instruction explains that multiplication can be used to convert larger units to smaller units of measurement, because it takes more of the smaller unit to make up the size of the larger unit. Conversely, the on-screen teacher shows how division can be used to convert smaller units to larger units of measurement.

Students are encouraged to use tables, tape diagrams, graphs, area graphs, and equations to help solve word problems involving decimals and fractions. For instance, in a MyPath mathematics lesson an on-screen instructor models how to draw pictures and write out steps to multiply and subtract decimals (Figure 61). But more importantly, students are coached when to use each model. In a MyPath mathematics lesson, students learn to divide fractions by whole numbers using circles, rectangular charts, line graphs, and equivalent fractions (Figure 62). The on-screen instructor notes that circle models are beneficial when you have a small divisor and horizontal models are good to use when you have a larger divisor. Number line fractions are particularly good for representing improper fractions, for comparing fractions to whole numbers, and for thinking of fractions as a kind of number rather than a kind of shape. Equivalent fractions are useful if you don't need a visual model.

Figure 61

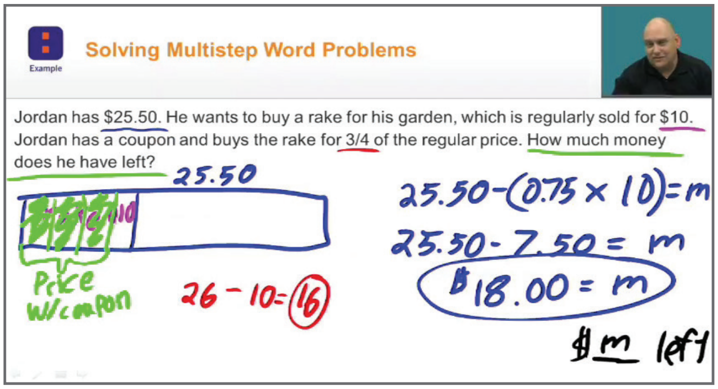
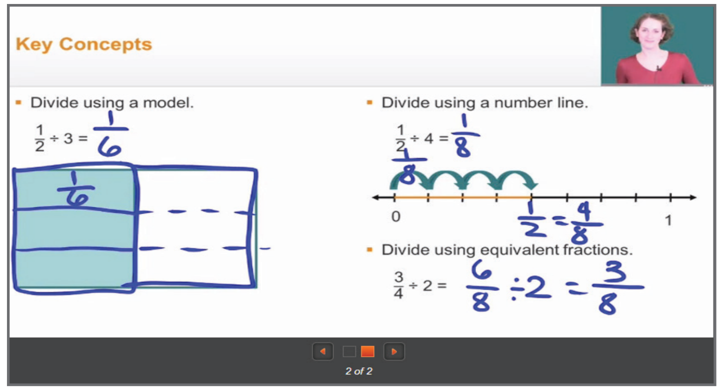


Figure 62



MyPath and Pathblazer's video instruction models how ratios can be used to solve constant-rate word problems. Both programs provide examples of how to use proportions to calculate unit rates, make conversions, identify percentages and percentage of increase or decrease, determine changing units of measurement, pinpoint scale and size, identify a part of the ratio when one knows another part, and make comparisons.

In a MyPath lesson, students learn to compare fractions to decimals (Figure 63), as well as to compare fractions to one another using area graphs (Figure 64) and number lines (Figure 65). In both Pathblazer and MyPath, area models, fraction bars, graphs, and grids help students apply ratios to real-world problems involving recipes, conversions, speed, scaling, mixture, music rates, density, percent, rates of change, geometry, and probability.

Figure 63

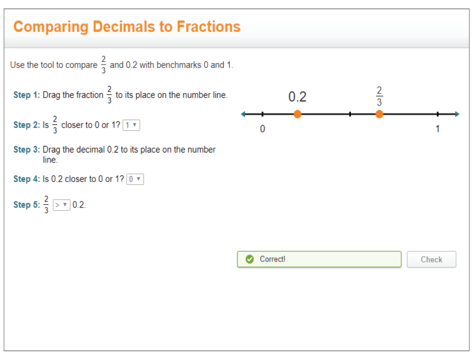


Figure 64

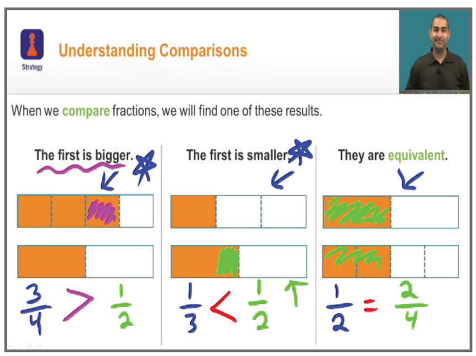
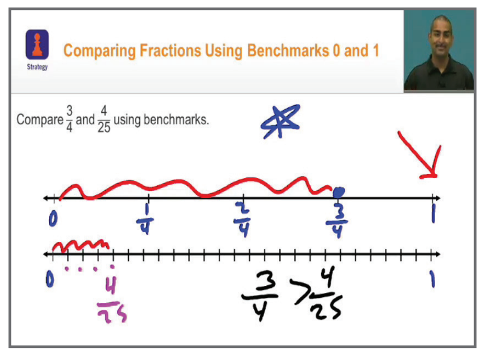


Figure 65



- **Problem-solving:** Pathblazer (Figure 66) and MyPath (Figure 67) mathematics lessons explicitly teach students to follow a four-step process to solve word problems. Activities focus on understanding the language of word problems, breaking them down into steps, and checking work, so students develop a plan of attack and build procedural fluency.

Figure 66

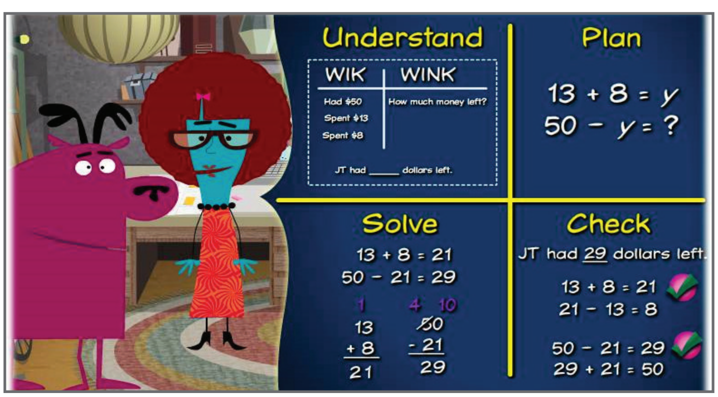
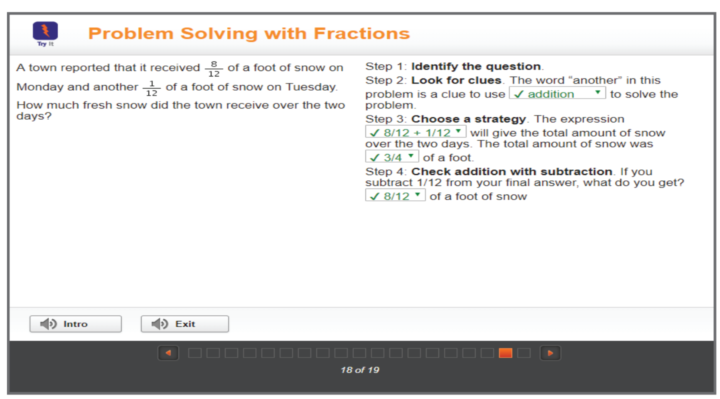


Figure 67



For example:

- **Understand the problem:** Students are taught to paraphrase the information required to solve the problem, and identify irrelevant information and the question at hand. To further facilitate understanding, students are taught to recognize different word problem types (Figure 68).
  - **Combine part-part-whole problems:** These problems involve combining two or more quantities to make a total. The unknown is either the total or the amount in one of the subsets. If the total is the unknown, we add. If one of the parts is unknown, we subtract the other parts from the total.
  - **Change problems:** These problems involve some quantity being increased or decreased. The unknown may be the starting amount, the change amount, or the ending amount.
  - **Additive comparison problems:** These problems involve a comparison between two quantities using the relations more than or less/fewer than. The unknown may be the initial quantity, the compared quantity, or the difference between the two quantities.
  - **Equal group problems:** These problems have three parts: the number of groups, the number of items in each group, and the total number in all the groups. The task is to find the missing part of the problem.
  - **Multiplicative comparison problems:** These problems involve comparing a set of two distinct but similar items. Each item has a common property that is counted but described in a different way (e.g., Emily has four times as many quarters as her brother. If her brother has five quarters, how many does Emily have?)
  - **Ordered pair problems:** These problems involve asking questions where two factors are matched in pairs.
  - **Multiplicative problems:** These problems involve ratio, proportion, and percent.

- **Devise a plan:** Students identify key information and then develop a model to check answers. For example, a Pathblazer lesson asks students which strategy you would choose if you have find the number of ½ gallons in 6 gallons (Figure 69). They are taught when and why to use each strategy. In a MyPath lesson, students are asked what information you would need to figure out how much money Josh has left if you knew he earned $80 and spent $24 on a backpack and $32 on new shoes (Figure 70).

Figure 68

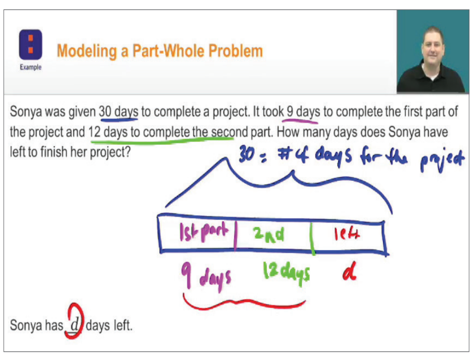


Figure 69

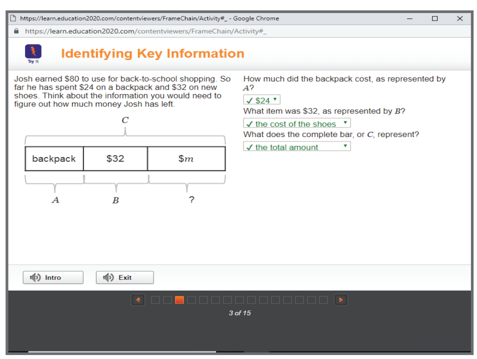
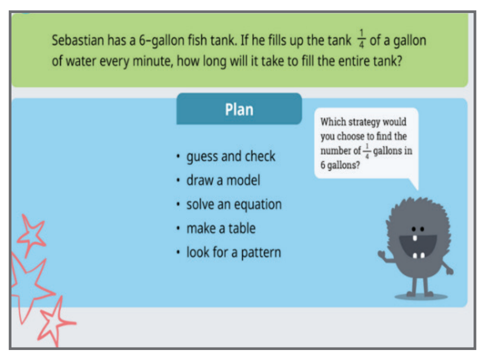
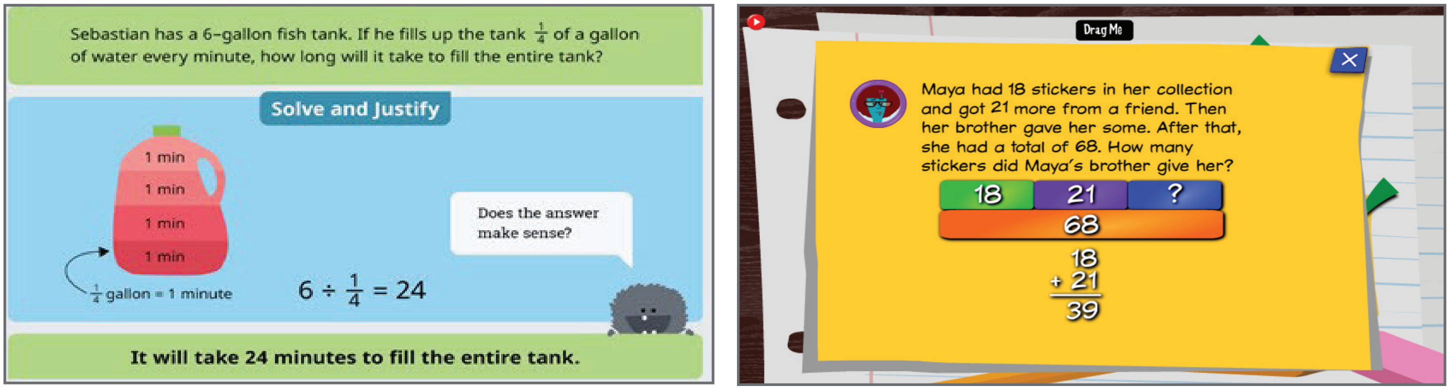


Figure 70



- **Carry out the plan:** Students learn how to monitor their thinking as they complete problems. By viewing worked examples and listening to think-alouds, students learn to ask questions such as:
  - Are there words I don't know that I must understand to solve the problem?
  - Will the strategy I'm using to solve this problem be helpful?
  - Am I learning anything important as I solve the problem?
  - Am I making mistakes?
  - Do I need to revise my strategy?
- **Check the answer:** Once students determine a solution (or solutions), they are coached to justify their answer and to compare it with expectations (Figure 71). On-screen instructors remind students to consider whether the answer choice makes sense in the context of the problem.

Figure 71



- **Algebraic thinking:** Edgenuity mathematics instruction explicitly teaches students that the role of literal symbols—from labels, givens, unknowns, parameters, and constants—changes depending on context. Mathematics lessons begin by examining specific unknowns when exploring numerical expressions to express quantities. First, students see how a literal symbol can be evaluated and mentally replaced with a number ($a + 5 = 8$). They also explore how computation can be performed around a literal symbol. For example, in a MyPath lesson, to solve $44 = 7x + 2$, an on-screen instructor coaches students to ignore the literal symbol, subtract 2, and divide by 7. On-screen instructors show how this method works to solve equations such as $ax + b = c$, but cannot be used to solve equations such as $ax + b = cx + d$, because the literal symbols are on both sides.

  Lessons also teach students to think about the operations needed to translate between words and algebraic symbols. Students are taught to look for key clues (e.g., quotient indicates the result of a division problem), identify which variables are known and unknown, and then determine which operation models the relationship described.

  MyPath and Pathblazer teach students a relational view of the equal sign. On-screen instructors discuss the meaning of the equal sign frequently throughout lessons and explicitly model correct use of the equal sign. Students are reminded that the equal sign means that two quantities have the same quantitative value. In a Pathblazer lesson, video instruction models the concept of equivalence with pan-balance scales, showing that when the two sides have the same weight, the equation is equivalent (Figure 72). In a MyPath lesson, an on-screen instructor uses an area model to demonstrate equivalence (Figure 73).

Figure 72

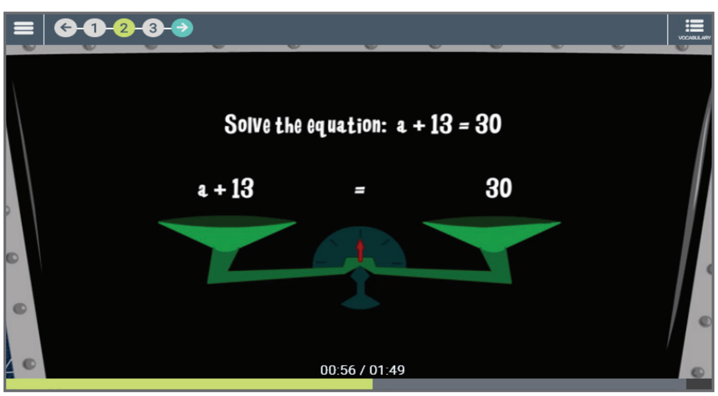
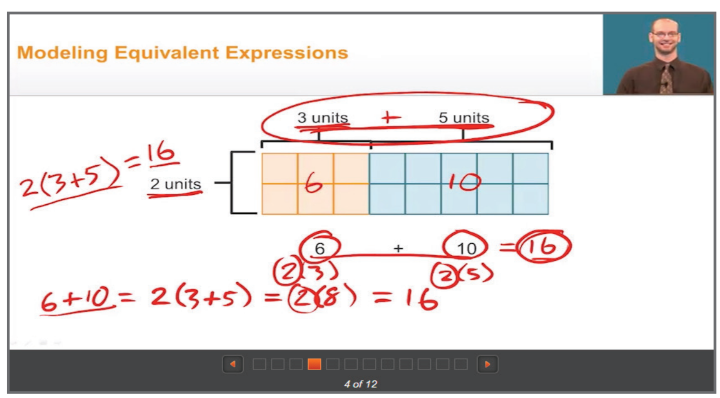


Figure 73



Video instruction guides students to be flexible with numbers to ease mental calculations. Both MyPath and Pathblazer stress the underlying additive and multiplicative relations behind operations. For example, on-screen teachers remind students that:

- Equations such as $a + b = c$ (e.g., $2 + 3 = 5$) are additive. Because addition and subtraction have an inverse relationship, one undoes the other. This means one can find x if $2 + x = 5$.
- Equations such as $c = ba$ are multiplicative. Because multiplication and division have an inverse relationship, this means $a = c/b$ and $c/a = b$.

- Equations such as (a + b) + c = a + (b + c) and (ab) c = a (bc) are associative, meaning it doesn't matter how you group the numbers or which numbers you calculate first. In a Pathblazer lesson, students learn that 5 * 36 × 2 = (5 * 2) × 36. This does not work for subtraction (Figure 74).
- Expressions such as a(b + c) can be distributed, so that the equation equals ab + ac. For example in a Pathblazer lesson, students are reminded that 9 * 2 1/3 = 9 × 2 + 9 × 1/3 (Figure 75).
- Addition and multiplication are both commutative. Subtraction and division are not.

Figure 74

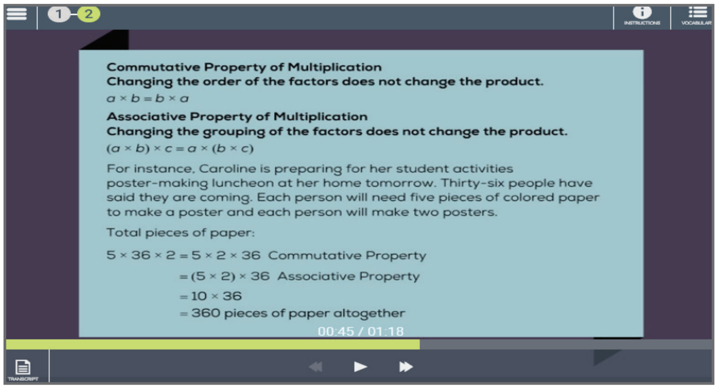
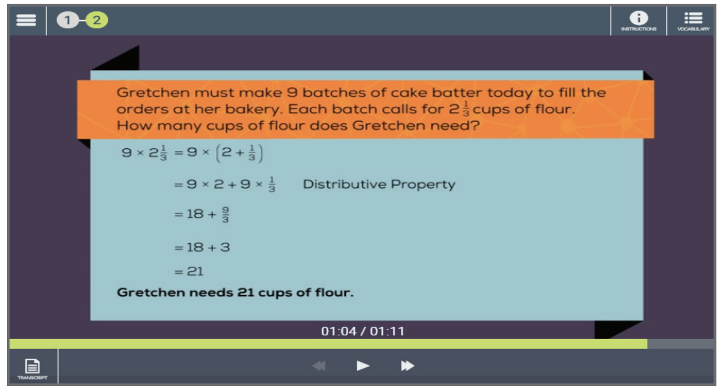


Figure 75



In a MyPath lesson, an on-screen teacher models how a student can use number relationships to find the quotient of 5 divided by ¼. Using an area model, the instructor points out that she could count each fourth to find the quotient, but the faster way to solve the problem would be to count groups of 4 by multiplying by 5.

Students are given multiple opportunities to apply different operations to a wide array of formulas, equations, identities, properties, and functions. Tasks and assignments involving words, tables, graphs, and symbols allow students to see how different operations can affect expressions, inequalities, equalities, and functions. For example, a Pathblazer lesson compares the relationship between the time Tanesha saved and the amount of money she saved. Students are asked to predict whether Tanesha will have enough savings for a video game system (Figure 76). Similarly, a MyPath lesson shows the proportional relationship of a factory's production data. Students plot each point on a graph and then create an equation that fits the line (Figure 77).

Figure 76

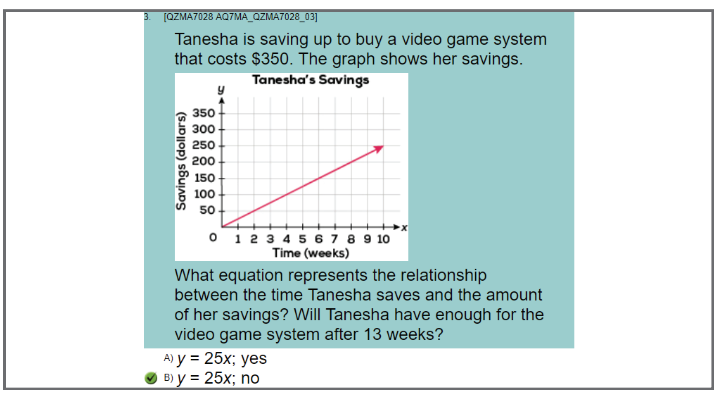
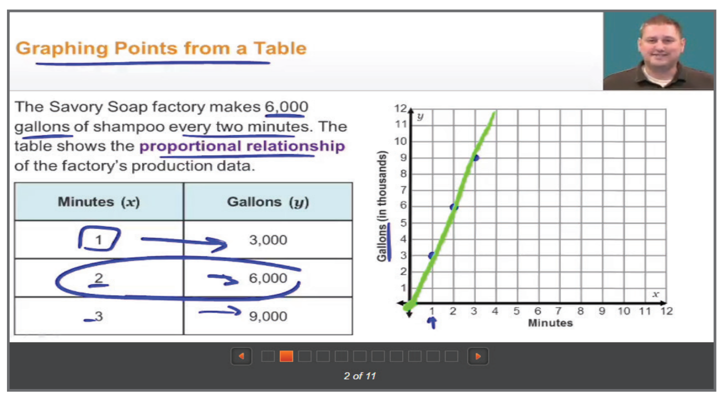
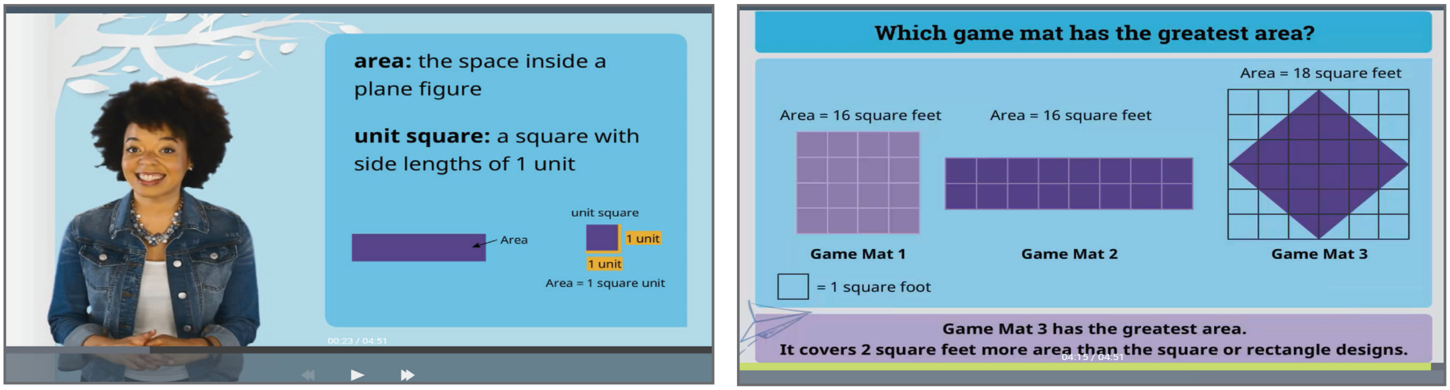


Figure 77



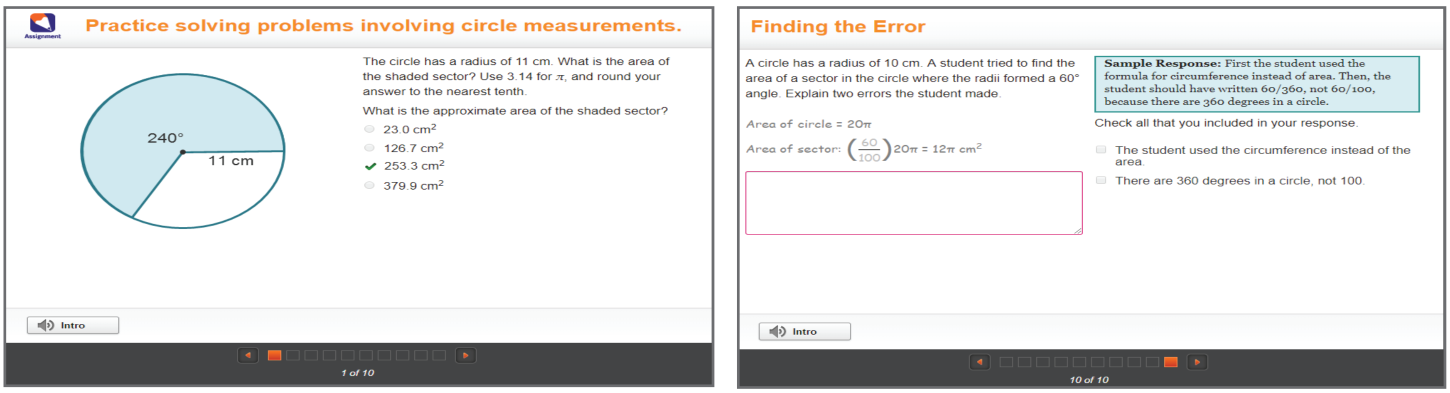
- **Measurement:** Edgenuity's lessons are designed to teach students to understand the attributes of what is being measured, to choose appropriate units, to estimate, to develop useful processes, and to use instruments and student-created formulas to facilitate their work. For example, in a Pathblazer lesson, an on-screen instructor defines area as the space inside a plane figure and a unit square, with one side's length the property to be measured. Students are then asked to measure the area of three game mats. Video instruction asks students to compare the area of the three game mats to determine which has the biggest area (Figure 78). Students decide on a formula to measure area. They first count and then come to realize that the base times the height is the area of a square or diamond.

Figure 78



Instruction is designed to address common misconceptions and student errors with measurement. For example, a MyPath lesson asks students to identify an error in sample student work about the area of a sector of a circle (Figure 79). Students discover that the sample student used the formula for circumference instead of area.

Figure 79



- **Statistical reasoning:** Throughout Edgenuity lessons, students investigate concepts of probability. On-screen teachers provide conceptual definitions and directly address misconceptions. Edgenuity teaches students to identify and graph factors that are relevant, constructing multiple statistical representations of a system and communicating to others what the statistical system suggests. By avoiding tasks that require students to produce graphs as ends in themselves and encouraging more meaningful activities, on-screen educators help build students' graph comprehension.

  For example in Pathblazer, students use a virtual spinner to find the experimental probability of obtaining a blue outcome (Figure 80). Because students can perform experiments multiple times, they are able to explore the law of large numbers—which states that the larger the sample, the more likely the result is a good prediction for the whole population. In addition, students create their own sample spaces and make predictions about theoretical probabilities of certain outcomes. In a MyPath lesson, students predict how many students will have plans to go to college (Figure 81).

Figure 80

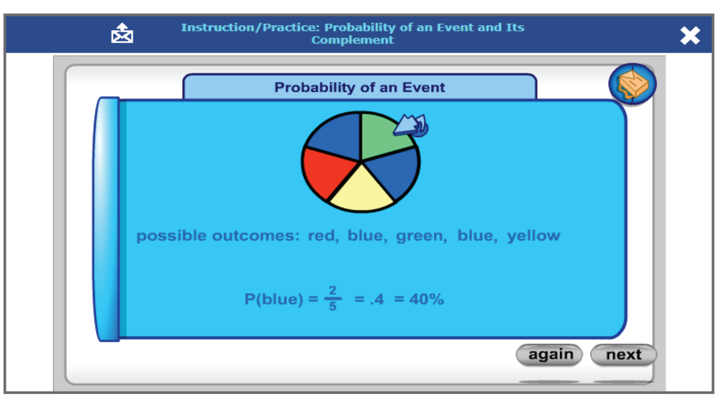
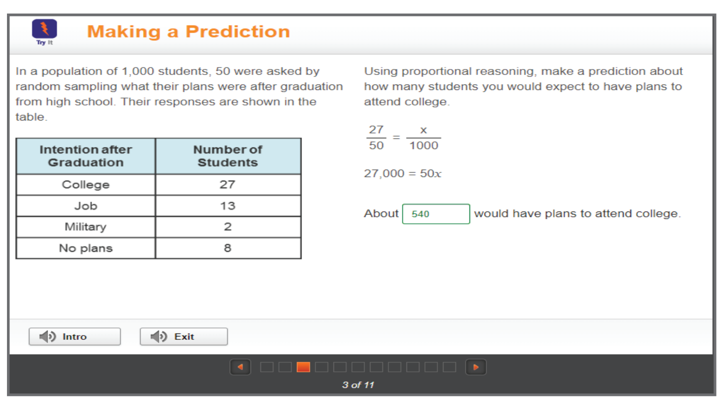


Figure 81



- **Spatial reasoning:** Edgenuity's lessons use precise language to describe spatial concepts. Diagrams are clearly labeled and specifically call out key visual elements to build spatial reasoning. For example, in a Pathblazer lesson, video instruction defines triangles, quadrilaterals, pentagons, and hexagons. Students are then asked to find common objects that have the same shapes. They then drag each shape's name to the correct group of shapes (Figure 82).

Figure 82

In MyPath, an on-screen instructor explains the similarities and differences between two-dimensional and three-dimensional figures. The on-screen instructor asks students to think about the relationship between length, width, and height (Figure 83). Similarly, in another MyPath lesson students sort properties related to rays and segments (Figure 84).

Figure 83

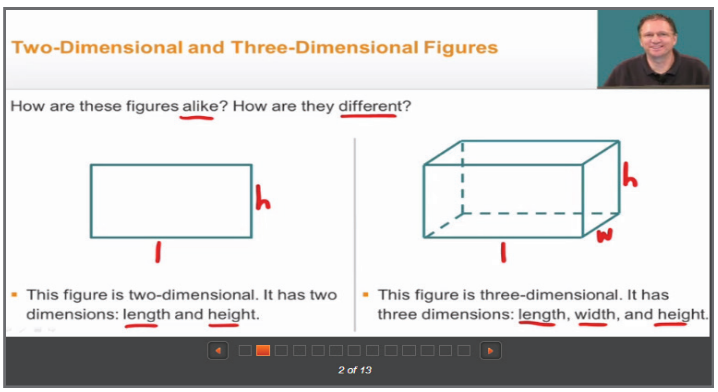
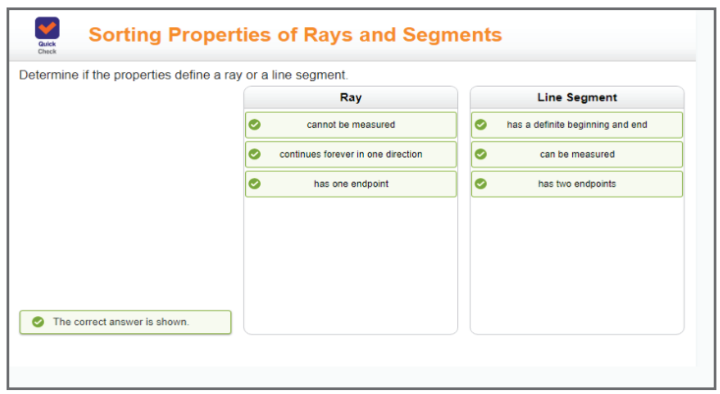


Figure 84



Assignments and tasks ask students to describe the properties of geometric figures in detailed diagrams and require students to note relationships between objects. For example, in a MyPath lesson on surface area, the on-screen instructor demonstrates how to draw a net to calculate the surface area of a prism. The on-screen instructor points out which square and triangle faces should be used to calculate the surface area (Figure 85). Similarly, in a Pathblazer lesson, students determine the number of cubes it would take to fill the volume of a box, represented by two-dimensional drawings (Figure 86).

Figure 85

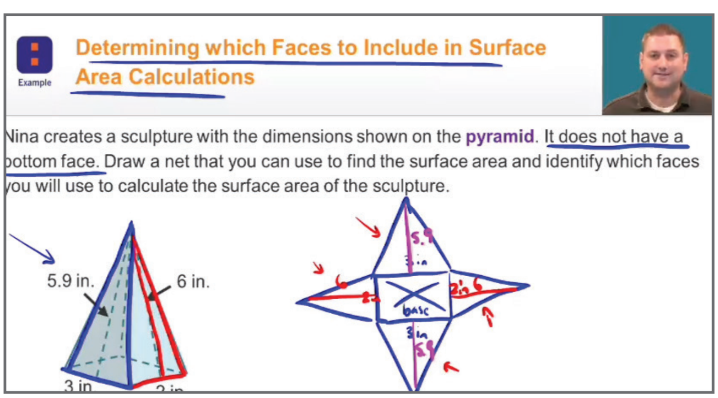
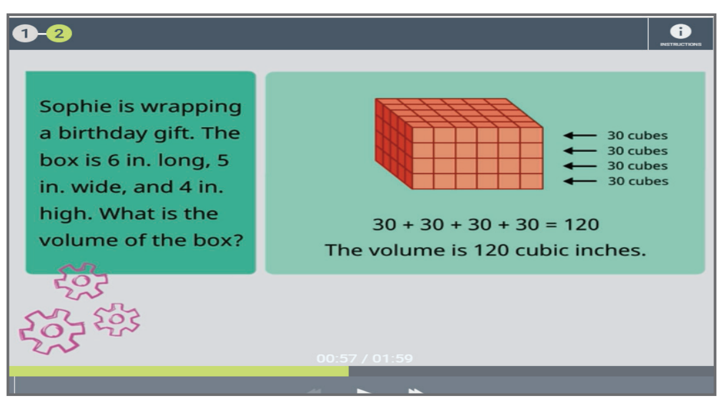


Figure 86



Using interactive tools and simulations, students gain a deeper understanding of the material. For example, in MyPath lessons, students explore the properties of rotations (Figure 87). An interactive tool in Pathblazer enables students to decompose composite figures to find their area (Figure 88).

Figure 87

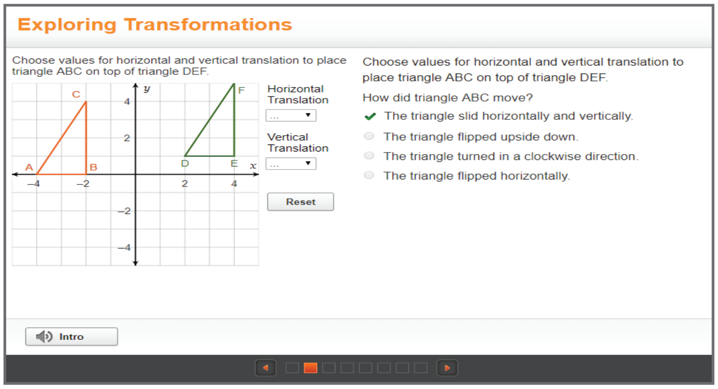
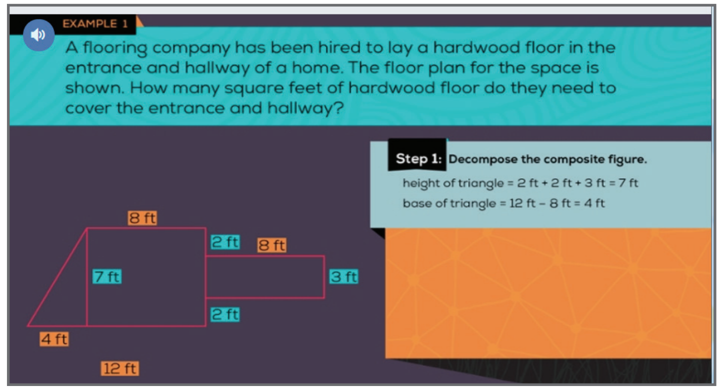


Figure 88

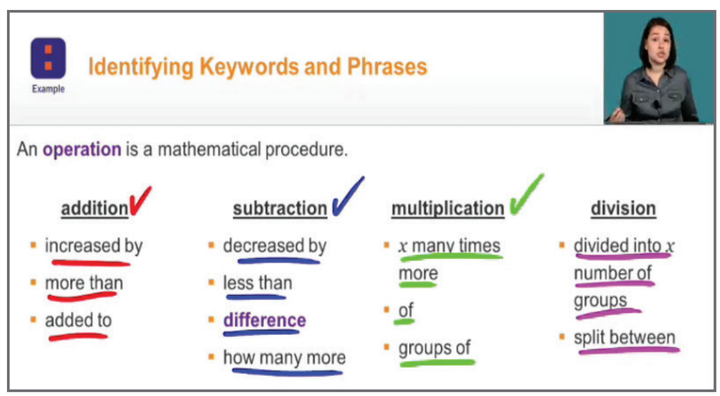


- **Teaching the language of math:** Pathblazer offers mathematical vocabulary features that help students focus on the meaning of mathematical terms in everyday language. In-context vocabulary support helps demystify unknown terms and build an understanding of how to talk about math. By asking for explanations of how problems were solved, the program builds students' abilities to talk about their developing mathematical thinking. Math glossaries provide additional in-context vocabulary support (Figure 89).

  MyPath explicitly teaches and spirals academic and domain-specific vocabulary. In Edgenuity lesson warmups, students preview four to six academic (e.g., number, angle, equation) and domain-specific (e.g., perfect square, quadratic equations, cosine, mode) vocabulary words in the Words to Know section. During instruction, on-screen teachers define and teach critical words. On-screen instructors describe words' meanings and key attributes of words, as well as providing contextual and definitional information (Figure 90). After instruction, students engage in activities that require them to identify nonexamples and examples, explain phenomena using descriptive patterns, complete concept maps, and submit word squares. Students continue to build their academic vocabulary as they are asked to justify and explain their mathematical reasoning while answering questions. Throughout instruction, students review the lesson's vocabulary words and can look up any word whose meaning they do not know.

Figure 89

Figure 90



BUILD CONFIDENCE THROUGH ERROR CORRECTION PROCEDURES, REGULAR FEEDBACK, AND POSITIVE ATTITUDES

Experts agree that students' understanding of content material is largely shaped by their previous experiences and everyday knowledge (National Research Council, 2012). As Robert Marzano (2004, p. 1) points out, "What students already know about the content is one of the strongest indicators of how well they will learn new information relative to the content." The problem, however, is that struggling students' prior knowledge can be incomplete and may lead to errors (Swan, 2005; National Research Council, 2012). Experts agree that effective instruction should review prerequisite learning (Rosenshine, 1995), expose misconceptions (Swan, 2005), and guide students toward effective strategies and more advanced understanding (Swan, 2001; Fuson, Kalchman, & Bransford, 2005; Stein et al., 2006; Ashlock, 2010; Archer & Hughes, 2011).

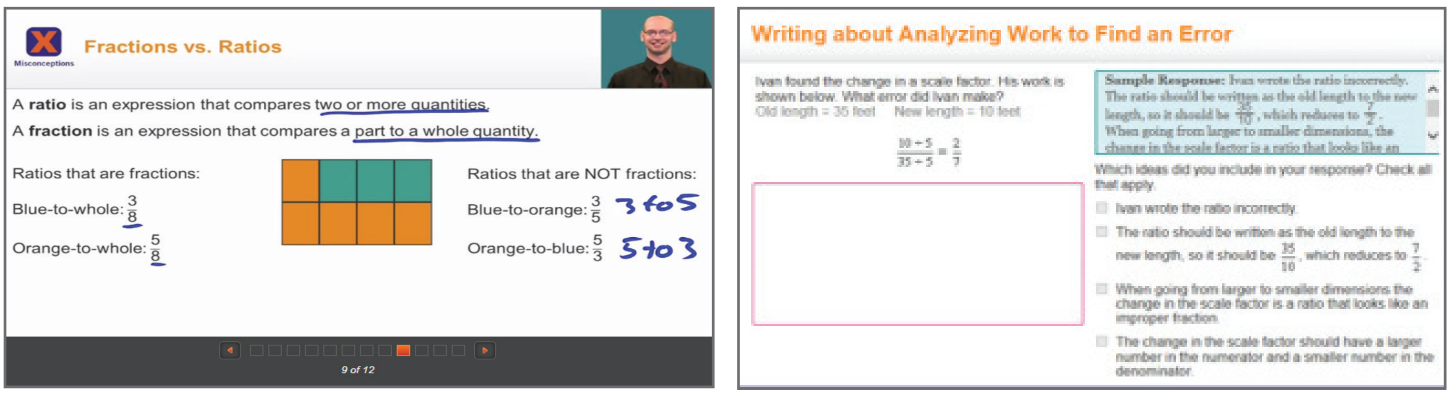
To help students address faulty assumptions, students must receive “explanatory feedback that helps learners correct errors and practice correct procedures” (National Research Council, 2012, p. 4-12). Such feedback can accelerate the rate of learning by eliminating the gap between students’ conception of knowledge and the desired response (Archer & Hughes, 2011; National Research Council, 2012). Research indicates that online courses with multimedia are uniquely positioned to not only provide students with immediate feedback on whether their answer is correct or incorrect, but also what can be done to improve future performance (M.B. Swan, 2003; National Research Council, 2012).

Our solution: Build confidence through error correction procedures, regular feedback, and positive attitudes

MyPath and Pathblazer’s video instruction provides clear, detailed explanations about common misconceptions (with examples and nonexamples) and explains how to avoid errors and interpret concepts correctly—thereby strengthening students’ conceptual understanding.

In MyPath, visual cues focus students’ attention on common errors. The misconception icon reminds students to check their own interpretation of a difficult topic. For example, students often wrongly conflate ratios with fractions because they use the same notation. In a MyPath lesson on ratio notation, students learn that while a ratio compares two or more quantities, a fraction compares a part to a whole. The on-screen teacher uses verbal explanations and visual representations to further clarify this concept (Figure 91). Students then are asked to analyze and write about this misconception in activities that ask them to identify a similar error.

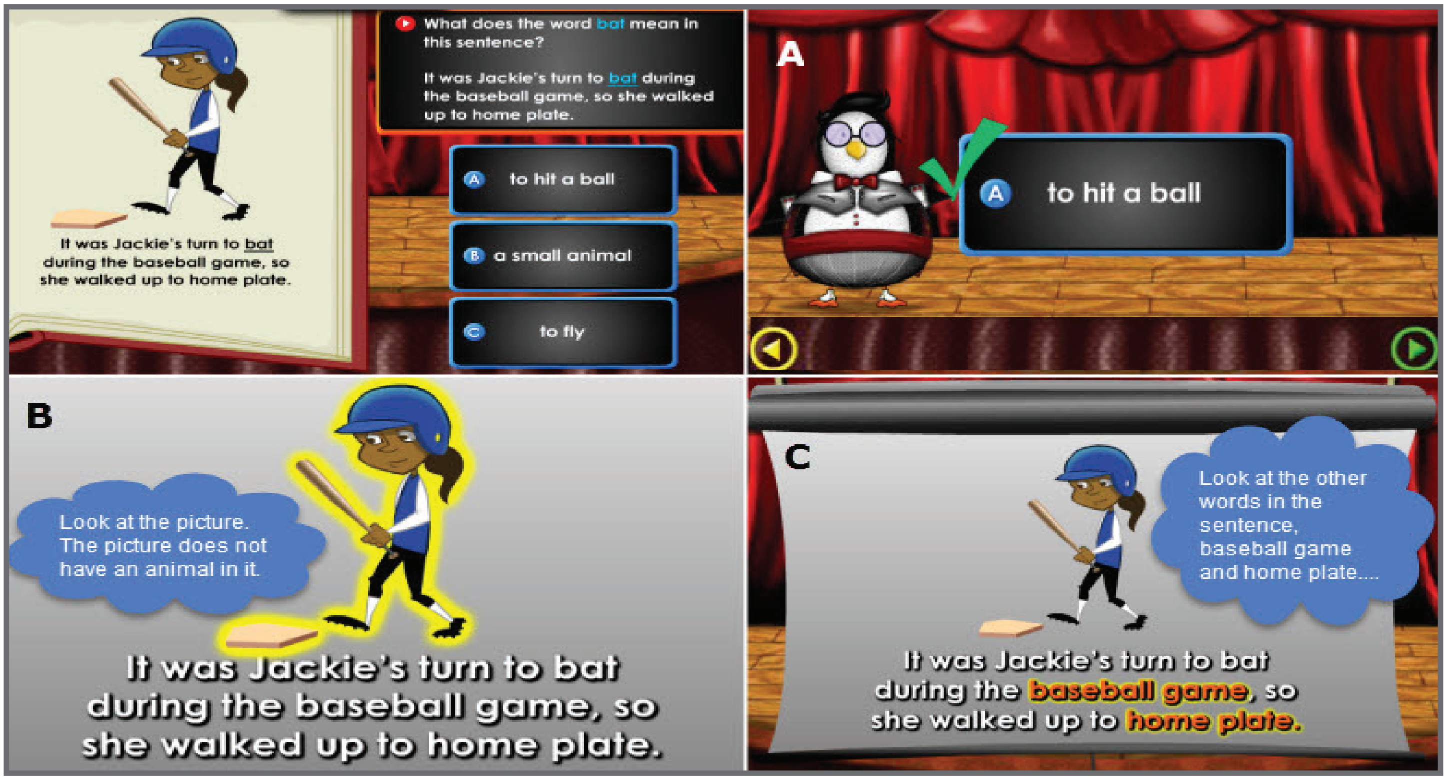
Figure 91



Pathblazer capitalizes on a critical mistakes analysis framework to provide students with correction and guidance when they answer incorrectly and instructional reinforcement when they answer correctly. When developing instructional content, Edgenuity analyzed the most common critical mistakes students made when learning particular concepts. The curriculum designers structured lessons and activities to recognize student mistakes and provide personalized feedback to the student based on the errors he or she makes. As a result, when a student answers a question incorrectly in a Pathblazer activity, the activity identifies the type of mistake and branches the student to the feedback specific to that mistake.

For example, in a Pathblazer reading activity, students are asked to use context clues to determine a word’s meaning (Figure 92). Video instruction asks students to define the word bat in the sentence, “It was Jackie’s turn to bat during the baseball game, so she walked up to home plate.” The answer is “to hit a ball.” If the student selects the answer “a small animal,” they receive feedback that their answer selection is incorrect in the context of the sentence. The student is provided not only with another opportunity to answer the question, but also with guidance about why the incorrect answer was incorrect. If the student then selects the answer “to fly,” they are directed to look at the other words in the sentence, to find a word that might relate to a baseball game and home plate. The critical mistakes framework turns an error in logic or understanding into an additional opportunity to teach the concept.

Figure 92



PRIME STUDENTS FOR LEARNING AND MAKE INSTRUCTION ACCESSIBLE

Struggling students often come to school believing they will not be able to succeed academically. Many feel they are not capable of learning and avoid participation in classroom activities (Margolis & McCabe, 2003). Students such as these often disengage from school because the instruction they have received in school has not yet been understandable or meaningful to them. Many struggle to take control of their own learning because they have never been taught strategies for how to learn.

Studies show that teaching students metacognitive strategies such as planning ahead, self-monitoring, self-explanation, self-evaluation, and self-regulation activities have “a particularly large impact on students who are lower-achieving” (National Research Council, 2005, p. 577). As Wilson & Conyers (2016, p. 10) note, “Teaching struggling learners how, when, and why to use these strategies may help them catch up in academic performance and recognize that they can succeed in achieving learning goals with hard work and persistent effort.”

Experts agree that curriculum can be made more accessible by providing students with multiple means of representation, expression, and engagement (CAST, 2011). Visual aids such as graphic organizers can enable struggling students who have difficulty with audio, written, or verbal instruction to organize key concepts (Nesbit & Adesope, 2006, citing Larkin & Simon, 1987; Sweller, 2008; Mayer, 2011). In addition, presenting problems in a variety of real-world contexts can make academic subject matter more understandable and clear to struggling students by helping these students see the importance of what they are learning (Bransford, Brown, & Cocking, 2000; Ginsburg et al., 2005; Gersten et al., 2008; McRel, 2010).

Our solution: Prime students for learning and make instruction accessible

MyPath and Pathblazer are designed to help students get past aversions to subject matter that they have found frustrating and a source of failure in the past.

- **Prime students for learning:** Pathblazer and MyPath explicitly teach students generalizable strategies such as planning ahead, determining importance, self-monitoring, self-evaluation, and self-regulation, to teach students how to think about their learning. Students learn to draw on already known concepts and apply that understanding in new, unfamiliar contexts that enable them to persevere in the face of difficulty and rebuilt shattered confidence. They are also taught how to identify appropriate learning strategies and to monitor their own understanding. For example:

- **Planning ahead:** Students in MyPath and Pathblazer are taught to come up with a strategy before attempting to read a text or solve problems. Video instruction coaches students to ask themselves:

  - ❑ What is the question at hand?
  - ❑ What words or ideas cue information that is needed to solve the problem?
  - ❑ What strategies and data are needed to solve the problem?
  - ❑ How do my prior experiences relate to the problem?
  - ❑ What can I draw or write down to solve the problem? Table? Chart? List? Diagram?
  - ❑ What do I think the outcome will be?

Before instruction begins, on-screen instructors remind students to use strategies they have already learned. For example:

  - ❑ When solving a real-world problem, check that your answer makes sense.
  - ❑ When you need to find the structure of a passage, figure out how the key ideas connect.
  - ❑ When a problem has a lot of information, plan to make a list, chart, or diagram to organize what you know.
  - ❑ When reading an informational text, determine what the headings tell you about each section.
  - ❑ When you have to determine a dimension needed to solve a problem, look for relationships between geometric figures.

- **Determining importance:** Video instruction in Pathblazer and MyPath prompts students to highlight, underline, and take notes to help them determine importance. The instructors use think-aloud demonstrations to model their thinking and provide guidance on the critical elements to pay attention to as they solve problems.

- **Self-monitoring:** Students in MyPath and Pathblazer are taught to monitor their thought processes to make sure they understand what they are reading or how they are solving mathematical problems. For example, videos remind students:

  - ❑ Are there words I don't know that I must understand to solve the problem?
  - ❑ Am I using an appropriate strategy to solve the problem?
  - ❑ Am I learning anything important as I solve the problem?
  - ❑ Am I making mistakes?
  - ❑ Do I need to revise my strategy?

- **Self-evaluation:** Students are taught to evaluate their performance by asking themselves questions such as:

  - ❑ How do I know the answer to the question is correct?
  - ❑ If my answer isn't correct, what could I do differently?

In MyPath, at critical points in instruction, students are asked to respond to open-ended prompts. Once students have constructed their responses, they are given a model answer and asked to compare their own writing to the model, using a checklist to evaluate the elements of the model that they included in their own answer. By comparing their response to a model and completing the checklist, they critically assess their own work and identify strengths and weaknesses in their thinking and communication.

- **Self-regulation:** Pathblazer and MyPath incorporate multiple tools to assist students in establishing a learning routine and teach the self-regulation skills they need to persist through tasks.

In MyPath, students stay on track with the help of a progress tracking display—a color-coded progress bar that shows whether students are on target, behind schedule, or ahead of schedule for lesson completion. In addition, an interactive Course Map and printable progress report helps students view and track the assignments they should be completing each day (Figure 93). In Pathblazer, the Student Completion Report and Student Portfolio help students monitor their content mastery and progress (Figure 94). These tools aid students in goal setting and encourage students to take ownership of their learning.

Figure 93

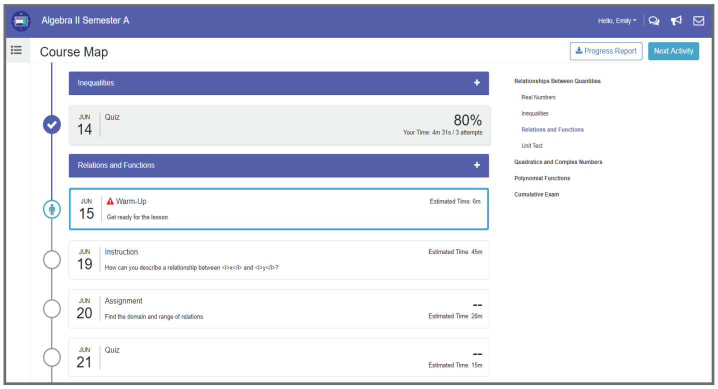
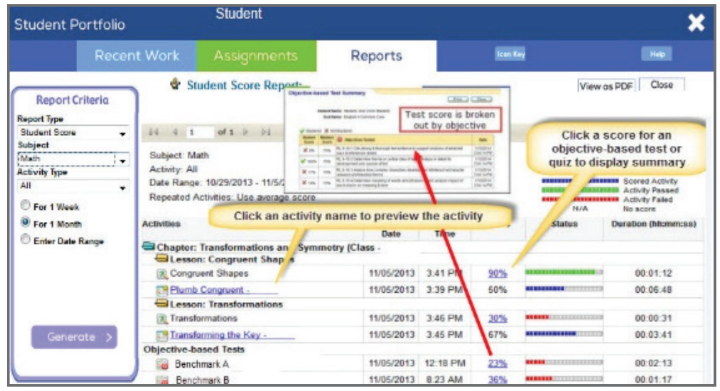


Figure 94



- **Multiple means of representation:** Pathblazer and MyPath present critical concepts and skills through a variety of modalities (e.g., verbal, audio, visual) and representations (e.g., concrete, manipulative, graphical, numerical, symbolic). For example:
  - In a Pathblazer mathematics lesson, students learn to interpret products by drawing pictures, using educational manipulatives, and multiplying on number lines.
  - In a MyPath reading lesson, students explore how an author's word choices can influence the mood and central ideas of text. During the lesson, students analyze protest signs from 1957, a presidential speech about the Little Rock Nine, and excerpts from Melba Patillo Beal's memoir *Warriors Don't Cry*.

Pathblazer and MyPath use a wide range of graphic organizers to give learners an organizing framework for new information. Before instruction, advance organizers preview content that students will learn later in the lesson and relate information to prior knowledge. During instruction, web structures, tree diagrams, matrixes, think-around structures, and concept maps (fishbone and spider maps) present conceptual information. T-charts, Venn diagrams, and concept tables compare and contrast concepts, events, and ideas by exploring similarities and differences. Timelines, flow charts, and sequence graphics illustrate procedures, demonstrate cause and effect, and explore how events developed over time. After instruction, graphic organizers summarize important ideas and make connections and patterns in concepts presented. For example:

- A MyPath reading lesson uses a concept map to identify the essential steps to making an inference: identifying text details and background (Figure 95).
- In Pathblazer, a reading activity uses a Venn diagram to showcase the similarities and differences between the stories in "The Tortoise and the Hare" and "The Lion and the Mouse" (Figure 96).

Figure 95

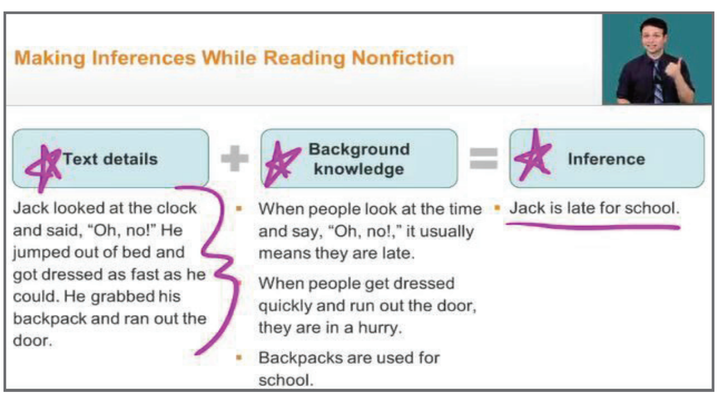
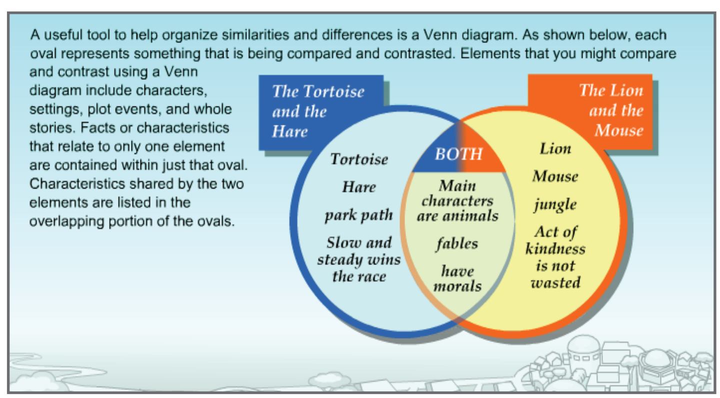


Figure 96



In Pathblazer and MyPath, teachers can personalize instruction based on an individual student's needs. Prior to instruction, teachers can create individualized tutoring modules by customizing targeted supplemental learning blocks. Teachers can also enable various accommodations and modifications, such as allowing more time on assessments, changing passing thresholds and grade weights, or allowing additional attempts on assessments.

- **Multiple means of expression:** Pathblazer and MyPath feature multiple options for expression, action, and communication. Students can express knowledge using a variety of technologies, including interactive discussion forums, graphic organizers, surveys, virtual manipulatives, and graphing calculators. These multiple means of expression appeal to a variety of learning styles and allow students to demonstrate their knowledge in a variety of ways. Toolbars allow students to mark up text (highlighting, word lookup, and annotation) and provide a number of specialized tools for math (a variety of calculators and other learning supports). MyPath also allows students to take notes in an online digital notebook and to receive language support via the translation feature, which can be enabled for specific students as desired.

  Pathblazer and MyPath's academic tasks ask students to show what they know in a variety of ways. Question formats include multiple choice, short responses, annotation, charts, concept maps, and virtual manipulatives. Learning activities use graphic organizers as a vehicle for students to show what they have learned. For example, in a Pathblazer reading activity, students are asked to manipulate a sequential diagram to organize the major plot points in "The Little Red Hen" (Figure 97). In a MyPath mathematics lesson on input and output relations, students are asked to interpret and complete a table in an open response question (Figure 98). As the lesson progresses, students are asked to drag and drop a list of ordered pairs that satisfy one of two equations.

Figure 97

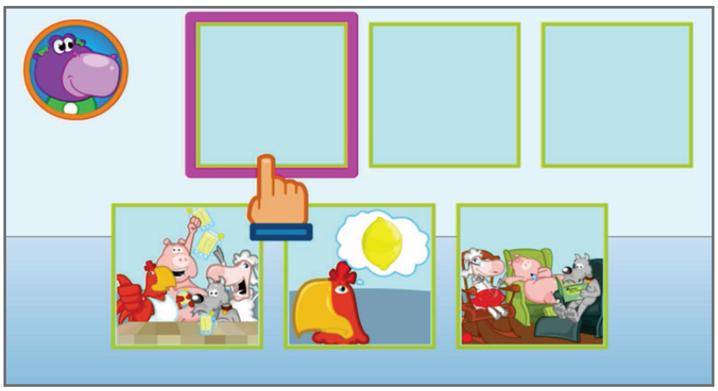
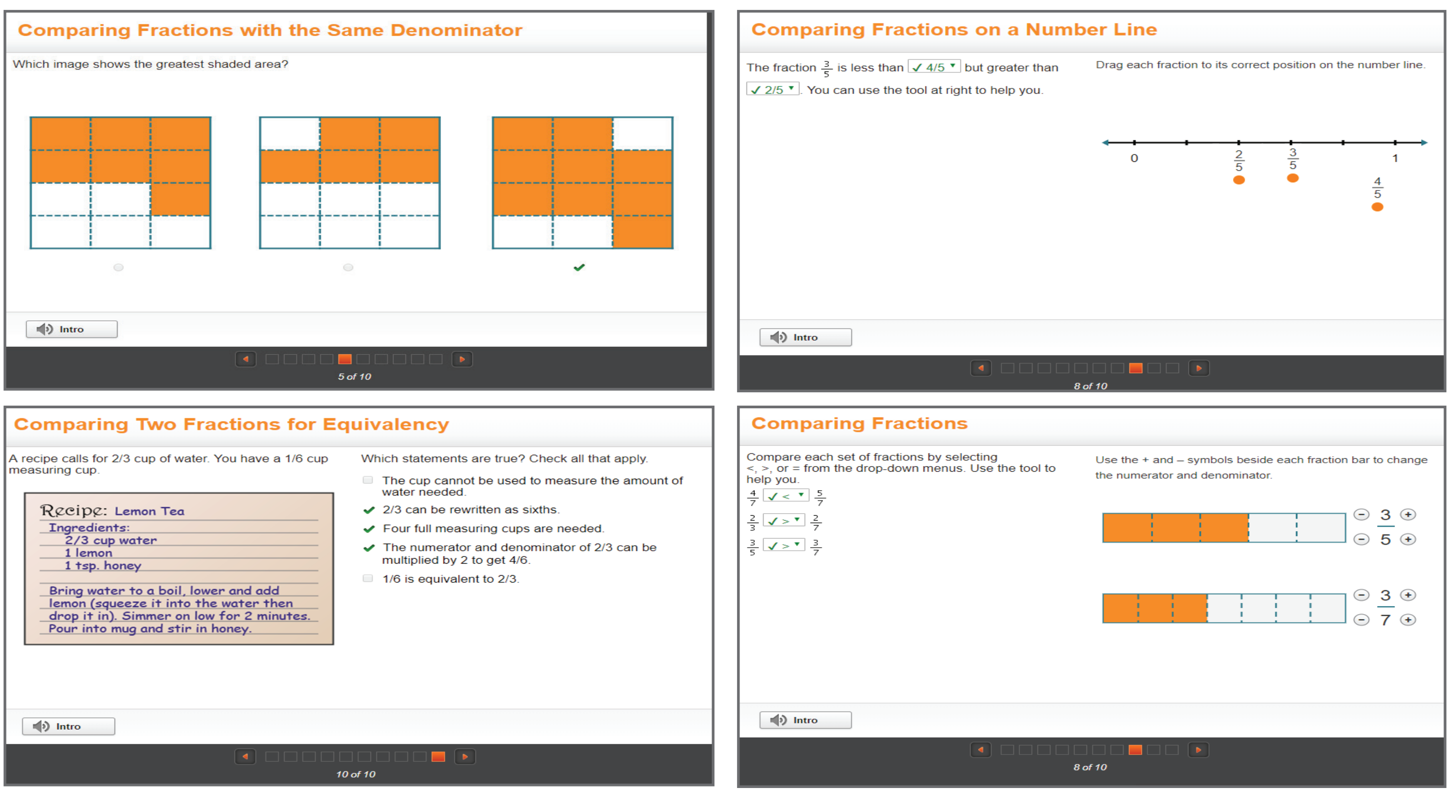


Figure 98



- **Multiple means of engagement:** Instruction in MyPath and Pathblazer is designed to develop the motivation students need to catch up, keep up, and get ahead.

MyPath and Pathblazer optimize relevance through contemporary topics, thematic units, and applications to real-world problems. In the MyPath math lesson "Save the Aliens," students determine the equation of a line of travel that takes their spaceship to the correct location (Figure 99). They apply what they know about linear equations as they examine the relationship between test scores and other variables. Through these applications, students create and analyze models representing the relationship between two quantities. In a MyPath reading lesson, students read and evaluate different media sources and public service announcements (Figure 100). They analyze World War II advertisements and examine career information from the Bureau of Labor Statistics.

Figure 99

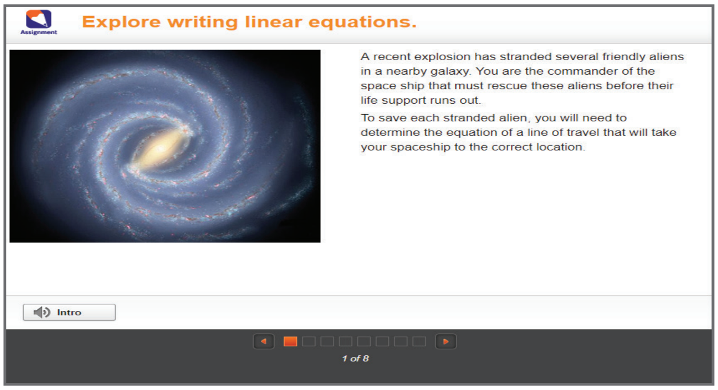
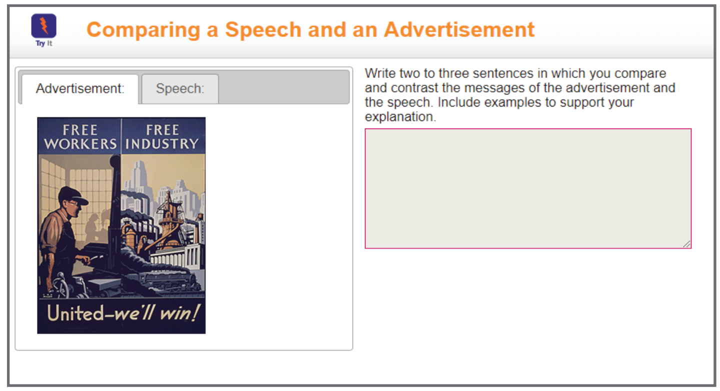


Figure 100



When explicit connections are made between what students are learning and their experiences, the information is more relevant and the practical value of the lesson is more obvious. For example students deepen their understanding of whole number operations when they relate subtraction and addition to music (Figure 101). An engaging video on disease management extends students' understanding of an informational text (Figure 102).

Figure 101

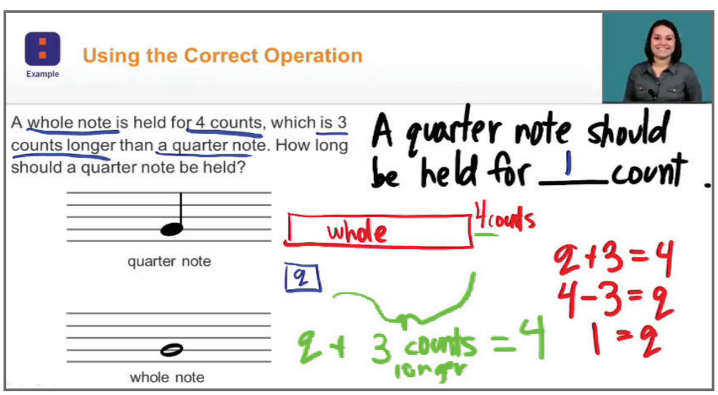
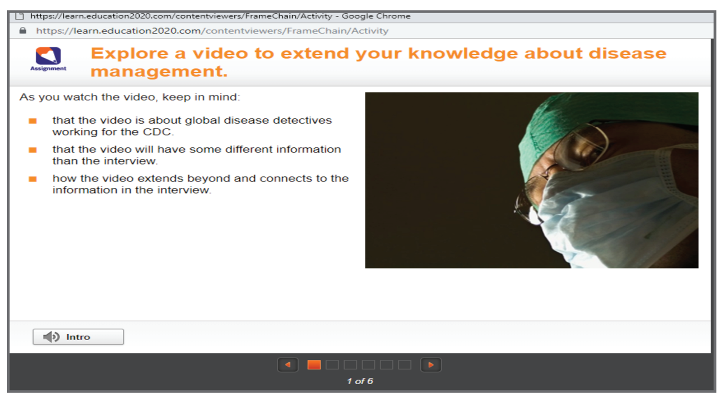


Figure 102



In Pathblazer, activities immerse students in conversations with a rotating cast of characters throughout each lesson. Based on cognitive research, this interactive method of delivering instruction makes concept development multisensory for the student by using a conversational and personalized style.

Communication tools in Pathblazer and MyPath foster collaboration and community, creating additional ways to engage students in content. In MyPath, teachers can pose discussion board questions that prompt students to share thoughts on what they are learning. In-system messaging provides students with additional opportunities to collaborate with teachers and sustain engagement. In Pathblazer, the online forum Community facilitates focused discussion between teachers and students. Discussions are embedded in the program's scope and sequence, and school staff can create their own topics and threads. Community topics and discussions can be assigned to selected students, tracked, and reported. Teachers can also use Community for professional learning community support or other teacher-teacher discussion.

CONCLUSION

Edgenuity's intervention solutions incorporate research-based best practices for struggling students. Both MyPath and Pathblazer allow teachers to continuously screen students' skills and monitor students' skill development. In reading, students receive focused instruction in print awareness/alphabet knowledge, phonological/phonemic awareness, phonics, sight words, fluency, vocabulary, comprehension, and writing. In math, they obtain critical content instruction in number sense, whole numbers, rational numbers, problem solving, algebra, measurement, geometry, and spatial reasoning. In both areas, instruction is designed to help students develop metacognitive skills for monitoring and regulating their thinking processes while learning.

Edgenuity interventions directly address misconceptions, and ILPs capitalize on multimedia instruction and graphic organizers to present information and engage students in developing their own knowledge. The programs also implement principles of Universal Design for Learning to make learning more accessible to students. With well over 1 million enrollments each year, Edgenuity provides the tools and resources to help struggling students achieve their potential.

For case studies and success stories describing how Edgenuity has met the diverse needs of students across a range of circumstances, please visit www.edgenuity.com/efficacy.

REFERENCES

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, Massachusetts: MIT Press.

Adelman, C. (2006). *The Toolbox Revisited: Paths to degree completion from high school through college*. Washington, D.C.: U.S. Department of Education, 2006.

Archer, A., & Hughes, C. (2011). *Explicit instruction: Effective and efficient teaching*. New York: Guilford Publications.

Ashlock, R. (2010). *Error Patterns in Computation: Using error patterns to improve instruction*. Upper Saddle River, New Jersey: Pearson Prentice Hall.

Baker, S., Gersten, R., & Lee, D. (2002). A synthesis of empirical research on teaching mathematics to low-achieving students. *The Elementary School Journal*, 103(1), 51–73.

Bamberger, H., & Oberdorf, C. (2010). *Activities to undo math misconceptions, grades 3–5*. Portsmouth, New Hampshire: Heinemann.

Banerjee, R., & Subramaniam, K. (2012). Evolution of a Teaching Approach for Beginning Algebra. *Educational Studies in Mathematics*, 80, 351-367.

Baroody, A., & Standifer, D. (1993). "Addition and subtraction in the primary grades." In R. Jensen (Ed.), *Research ideas for the classroom. Early childhood mathematics* (pp. 72-102). New York: Macmillan.

Baumann, J. F., Edwards, E. C., Boland, E., Olejnik, S., & Kame'enui, E. J. (2003). Vocabulary tricks: Effects of instruction in morphology and context on fifth grade students' ability to derive and infer word meaning. *American Educational Research Journal*, 40, 447–494.

Beck, I. L., McKeown, M. G., & Kucan, L. (2002). *Bringing words to life: Robust vocabulary instruction*. New York: Guilford Press.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education: Principles, Policy & Practice, 5*(1), 7–74.

Booth, L. (1984). *Algebra: Children's strategies and errors: A report of the strategies and errors in the secondary school project*. London: NFER Nelson.

Bowers, P. N., Kirby, J. R., & Deacon, S. H. (2010). Effects of morphological instruction on literacy skills: A systematic review of the literature. *Review of Educational Research, 80*(2), 144-179

Bradley, L., & Bryant, P. (1983). Categorizing sounds and learning to read: A causal connection. *Nature*, 301, 419-421.

Bransford, J. D., A. L. Brown, & Cocking, R. R., Eds. (2000). *How People Learn*. Washington, D.C., National Academy Press.

Bryant, P., & Nunes, T. (2012). *Childrens' understanding of probability: A literature review*. London: Nuffield Foundation. Retrieved from http://www.nuffieldfoundation.org/sites/default/files/files/Nuffield_CuP_FULL_REPORTv_FINAL.pdf

Buehl, D. (2011). *Developing Readers in the Academic Disciplines*. Newark, Deleware: International Reading Association.

Carnine, D., Jones, E., & Dixon, R. (1994). Mathematics: Educational tools for diverse learners. *School Psychology Review, 23*(3), 406–427.

Cavanaugh, C. (2013). "Student achievement in elementary and high school." In M. G. Moore (Ed.), *Handbook of distance education*, 3rd. ed. (pp. 170–184). New York: Routledge.

Center for Applied Special Technology (CAST) (2011). *Universal Design for Learning Guidelines*, version 2.0. Wakefield, Massachusettes: Author.

Chard, D. J., Vaughn, S., & Tyler, B. J. (2002). A synthesis of research on effective interventions for building reading fluency with elementary students with learning disabilities. *Journal of Learning Disabilities*, 35, 386–406.

Clark, R. C. (2005). "Multimedia learning in e-courses." In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learnin*g (pp. 589–616). New York: Cambridge University Press.

Clay, M. (1985). Engaging with the school system: A study of interaction in new entrant classrooms. *New Zealand Journal of Educational Studies, 221*(1), 20-38. Retrieved from http://www.nzare.org.nz/nzjes.aspx

Clay, M. (2005). *An observation survey of early literacy achievemen*t, 2nd ed. Portsmouth, New Hampshire: Heinemann.

Clements, D., & Battista, M. (1992). "Geometry and Spatial Reasoning." In D. Grous (Ed). *Handbook of Research on Mathematics Teaching and Learning* (pp. 420–464). Reston, Virginia: National Council of Teachers of Mathematics.

Codding, R. S., Volpe, R. J., & Poncy, B. C. (2017). *Effective math interventions: A guide to improving whole-number knowledge*. New York: Guilford Press.

Combs, B. (2012). *Assessing and addressing literacy needs: Cases and instructional strategies*. Los Angeles: Sage Publications, Inc. Retrieved from https://us.sagepub.com/sites/default/files/upm-binaries/40373_3.pdf

Copeland, S. R., & Keefe, E. B. (2017). "Teaching Reading and Literacy Skills to Students with Intellectual Disability." In M. L. Wehmeyer & K. A. Shogren (Eds.), *Handbook of Research-Based Practices for Educating Students with Intellectual Disability* (pp. 636-687). New York: Routledge.

Coxhead, A. (2000) A new academic word list. *TESOL Quarterly, 34*(2), 213-238.

Cunningham, A. E. (1990). Explicit versus implicit instruction in phonemic awareness. *Journal of Experimental Child Psychology, 50*(3), 429-444.

Cunningham, A. E. & Stanovich, K. E. (1998). What reading does for the mind. *American Educator, 22*(1&2), 8-15. Retrieved from http://www.keithstanovich.com/Site/Research_on_Reading_files/Cunningham_Stano_Amer_Educator_1998.pdf

Doabler, C. T. & Fien, H. (2013). Explicit Mathematics Instruction: What Teachers Can Do for Teaching Students With Mathematics Difficulties. *Intervention in School and Clinic*, 48, 276–285.

Dobbins, A., Gagnon, J. C., & Ulrich, T. (2014). Teaching geometry to students with math difficulties using graduated and peer-mediated instruction in a response-to-intervention model. *Preventing School Failure*, 58(1), 17-25.

Donlan, C. (2007). "Mathematical development in children with specific language impairments." In D. B. Berch & M. M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning difficulties and disabilities* (pp. 151–172). Baltimore, Maryland: Brookes.

Dougherty, B., Bryant, D. P., Bryant, B. R., & Shin, M. (2017). Helping students with mathematics difficulties understand ratios and proportions. *TEACHING Exceptional Children, 49*(2), 96–105.

Driscoll, M. (1999). *Fostering algebraic thinking: A guide for teachers grades 6-10*. Portsmouth, New Hampshire: Heinemann

Duke, N. K., Pearson, D., Strachan, S. L., & Billman, A.K. (2011). "Essential Elements of Fostering and Teaching Reading Comprehension." In Alan E. Farstrup & S. Jay Samuels (Eds.), *What Research Has to Say About Reading Instruction*, 4th ed. (pp. 51-93). Newark, Delaware: International Reading Association, Inc.

Duncan, G. J., & Magnuson, K. (2011). "The nature and impact of early achievement skills, attention skills, and behavior problems." In G. J. Duncan & R. J. Murnane (Eds.), *Whither opportunity: Rising inequality, schools, and children's life chances* (pp. 47-70). New York: Russell Sage Foundation.

Ehri, L. C. (1992). “Reconceptualizing the development of sight word reading and its relationship to recoding.” In P. Gough, L. Ehri & R. Treiman (Eds.), *Reading acquisition* (pp. 107–143). Hillsdale, New Jersey: Lawrence Erlbaum.

Ehri, L. C. (2002). “Phases of acquisition in learning to read words and implications for teaching.” In R. Stainthorp & P. Tomlinson (Eds.), *Learning and teaching reading* (pp. 7–28). London: British Journal of Educational Psychology Monograph Series II.

Ehri, L. C. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of Reading*, 9, 167-188.

Fisher, D. & Frey, N (2013). *Rigorous Reading: 5 Access Points for Comprehending Complex Texts*. Thousand Oaks, California: Corwin.

Fisher, D. & Frey, N. (2014). *Close Reading and Writing From Sources*. Newark, Delaware: International Reading Association.

Fisher, D., Frey, N., & Lapp, D. (2011). “What the research says about intentional instruction.” In S. J. Samuels & A. E. Farstrup (Eds.), *What research has to say about reading instruction*, 4th ed. (pp. 359–378). Newark, Delaware: International Reading Association.

Foorman, B., Beyler, N., Borradaile, K., Coyne, M., Denton, C. A., Dimino, J., Furgeson, J., Hayes, L., Henke, J., Justice, L., Keating, B., Lewis, W., Sattar, S., Streke, A., Wagner, R., & Wissel, S. (2017). *Foundational skills to support reading for understanding in kindergarten through 3rd grade* (NCEE 2016-4008). Washington, DC: National Center for Education Evaluation and Regional Assistance (NCEE), Institute of Education Sciences, U.S. Department of Education. Retrieved from http://whatworks.ed.gov

Frayer, D., Frederick, W. C., & Klausmeier, H. J. (1969). *A Schema for Testing the Level of Cognitive Mastery*. Madison, Wisconsin: Wisconsin Center for Education Research.

Fuchs, L. S., Fuchs, D., Compton, D. L., Bryant, J. D., Hamlett, C. L., & Seethaler, P. M. (2007). Mathematics screening and progress monitoring at first grade: Implications for responsiveness to intervention. *Exceptional Children, 73,* 311–330.

Fuchs, L. S., Seethaler, P. M, Powell, S.R., Fuchs, D., Hamlett, C., & Fletcher, J.M. (2008). Effects of preventative tutoring on the mathematical problem solving of third-grade students with math and reading difficulties. *Exceptional Children, 74,* 155–173.

Fuson, K. C., Kalchman, M., & Bransford, J. D. (2005). “Mathematical understanding: An introduction.” In M.S. Donovan and J.D. Bransford (Eds.), *How students learn: Mathematics in the classroom* (pp. 215–256). Washington, D.C.: National Academies Press.

Garfield, J. (2002). The challenge of developing statistical reasoning. *Journal of Statistics Education, 10*(3), 323-341. Retrieved from www.amstat.org/publications/jse/v10n3/garfield.html

Geddes, I., & Fortunato, D. (1993). Geometry: Research and classroom activities. In D.T. Owens (Ed.), *Research Ideas for the Classroom: Middle Grade Mathematics* (199-222). New York: Macmillan Publishing Company.

Gersten, R., Beckmann, S., Clarke, B., Foegen, A., Marsh, L., Star, J. R., & Witzel, B. (2009). *Assisting students struggling with mathematics: Response to Intervention (RtI) for elementary and middle schools* (NCEE 2009-4060). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies. ed.gov/ncee/wwc/publications/practiceguides/

Gersten, R., Compton, D., Connor, C.M., Dimino, J., Santoro, L., Linan-Thompson, S., & Tilly, W.D. (2008). *Assisting students struggling with reading: Response to Intervention and multi-tier intervention for reading in the primary grades. A practice guide*. (NCEE 2009-4045). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc/ publications/practiceguides/

Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. *Journal of Learning Disabilities*, 38, 293-304.

Gillon, G. T. (2018). *Phonological awareness: from research to practice*. New York: The Guilford Press.

Ginsburg, A, Leinwand, S., Anstrom, T., & Pollock, E. (2005). *What the United States Can Learn From Singapore's World-Class Mathematics System*. Washington, D.C.: American Institutes for Research.

Graham, S., & Perin, D. (2007). *Writing next: Effective strategies to improve writing of adolescents in middle and high schools—A report to the Carnegie Corporation of New York*. Washington, D.C.: Alliance for Excellence in Education.

Graves, M.F. (2016). *The vocabulary book: Learning and instruction*, 2nd ed. New York: Teachers College Press.

Graves, M., Schneider, S., & Rinstaff, C. (2018). Empowering students with word-learning strategies: Teach a child to fish. *The Reading Teacher*, 71(5), 533-543.

Groth, R. E. (2013). *Teaching mathematics in grades 6-12: Developing research-based instructional practices*. Thousand Oaks, California: Sage.

Gurganus, S. P. (2017). *Math instruction for students with learning problems*, 2nd ed. New York: Routledge.

Hernandez, Donald J. (2011). *Double Jeopardy: How Third-Grade Reading Skills and Poverty Influence High School Graduation*. New York: The Annie E. Casey Foundation.

Hudson, R.F., Lane, H.B., & Pullen, P.C. (2005). Reading fluency assessment and instruction: What, why, and how? *The Reading Teacher,* 58(8), 702-714.

Jenkins, J. R., Hudson, R. F., & Johnson, E. S. (2007). Screening for at-risk readers in a response to intervention framework. *School Psychology Review, 36,* 582–600.

Jitendra A. K. & Hoff, K. (1996). The effects of schema-based instruction on the word-problem-solving performance of students with learning disabilities. *Journal of Learning Disabilities*, 29, 421–431.

Johnson-Glenberg, M. C. (2000). Training reading comprehension in adequate decoders/poor comprehenders: Verbal versus visual strategies. *Journal of Educational Psychology, 92*(4), 772-782.

Jordan, N. C., Kaplan, D., Ramineni, C., & Locuniak, M. N. (2009). Early math matters: Kindergarten number competence and later mathematics outcomes. *Developmental Psychology*, 45(3), 850-867.

Kastberg, D., Chan, J.Y., & Murray, G. (2016). *Performance of U.S. 15-Year-Old Students in Science, Reading, and Mathematics Literacy in an International Context: First Look at PISA 2015* (NCES 2017-048). U.S. Department of Education. Washington, D.C.: National Center for Education Statistics. Retrieved from http://nces.ed.gov/ pubsearch

Keene, E. O., & Zimmermann, S. (2007). *Mosaic of thought: Teaching comprehension in a reader's workshop*, 2nd ed. Portsmouth, New Hampshire: Heinemann.

Kieran, C. (1992). "The Learning and Teaching of School Algebra." In D. Grous (Ed.), *Handbook of Research on Mathematics Teaching and Learning* (pp.390–419). Reston, Virginia: National Council of Teachers of Mathematics.

Kingston, N. & Nash, B. (2011). Formative assessment: A meta-analysis and a call for research. *Educational Measurement: Issues and Practice*, 30, 28–37.

Knuth, E. J., Stephens, A. C., McNeil, N. M., & Alibali, M. W. (2006). Does understanding the equal sign matter? Evidence from solving equations. *Journal for Research in Mathematics Education*, 37(4), 297-312.

Kouba, V. L., & Franklin, K. (1993). "Multiplication and division: Sense making and meaning." In R. Jansen (Ed.), *Research ideas for the classroom. Early childhood mathematics* (pp. 103-126). New York: Macmillan.

Kozioff, M. A., LaNunziata, L., Cowardin, J., & Bessellieu, F. B. (2000). Direct instruction: Its contributions to high school achievement. *The High School Journal*, 84(2), 54–71.

Kuchemann, D. (1981) “Algebra.” In K. Hart (Ed.) *Children’s Understanding of Mathematics* (pp.102-119). London: Murray.

Kuhn, M.R., & Stahl, S. A. (2000). *Fluency: A review of developmental and remedial practices* (CIERA Rep. No. 2-008). Ann Arbor, Michigan: Center for the Improvement of Early Reading Achievement.

Lai, M. K., & Schildkamp, K. (2012). “Data-based decision-making: An overview.” In K. Schildkamp, M. K. Lai, & L. Earl (Eds.), *Data-Driven Decision-Making Around the World: Challenges and Opportunities* (pp. 9–21). Dordecht: Springer.

Lamon, S. J. (2007). “Rational numbers and proportional reasoning: Toward a theoretical framework for research.” In. F. K. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp.629–667). Charlotte, North Carolina: Information Age Publishing

Langrall, C.W., & Swafford, J. (2000). Three balloons for two dollars: Developing proportional reasoning. *Mathematics Teaching in the Middle School*, 6, 254–261.

Larkin, J. H., & Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science*, 11, 65–99.

Lesnick, J., Goerge, R., Smithgall, C., & Gwynne J. (2010). *Reading on third grade level in third grade: How is it related to high school performance and college enrollment?* Chicago: Chapin Hall at the University of Chicago Press.

Maccini, P., & Gagnon, J. C. (2006). Mathematics instructional practices and assessment accommodations by secondary special and general educators. *Exceptional Children*, 72, 217-234.

MacGregor, M. & Stacey, K. (1997). Students’ understanding of algebraic notation 11-15. *Educational Studies in Mathemaics, 33*(1), 1–19.

Marchand-Martella, N.E., Martella, R.C., Modderman, S.L., Petersen, H.M., & Pan, S. (2013). Key areas of effective adolescent literacy programs. *Education & Treatment of Children, 36*(1), 161-184.

Margolis, H., & McCabe, P. (2003). Self efficacy a key to improving the motivation of struggling learners. Preventing school failure. *Alternative Education for Children and Youth,* 47(4), 162–169.

Marzano, R.J. (2004). *Building background knowledge for academic achievement: Research on what works in schools.* Alexandria, Virginia: ASCD.

Marzano, R.J. (2007). *The art and science of teaching*. Alexandria, Virginia: ASCD.

Mayer, R. E. (2011). *Applying the science of learning*. Upper Saddle River, New Jersey: Pearson.

McNamara, D. S. (Ed.) (2007). *Reading comprehension strategies: Theories, interventions, and technologies*. New York: Erlbaum.

McRel. (2010). *What we know about mathematics teaching and learning*, 3rd ed. Bloomington, Indiana: Solution Tree Press.

Means, B., Toyama, Y., Murphy, R., & Bakia, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. *Teachers College Record*, 115(3). Special Section, pp. 1–47.

Miller, D. L. (1993). Making the connection with language. *Arithmetic Teachers, 40*(6), 311—316

Moats, L. C., & Tolman, C. (2009). *Language essentials for teachers of reading and spelling (LETRS)*, Module 1: The challenge of learning to read, 2nd ed. Longmont, Colorado: Sopris West.

Monroe, E. E., and Orme, M. P. (2002). Developing mathematical vocabulary. *Preventing School Failure, 46*(3), 139–142

Murnane, R.J., Willett, J.B., & Levy, R. (1995). The growing importance of cognitive skills in wage determination. *Review of Economics and Statistics, 77*(2), 251-266.

Nash, H., & Snowling, M. (2006). Teaching new words to children with poor existing vocabulary knowledge: a controlled evaluation of the definition and context methods. *International Journal of Language and Communication Disorders*, 41, 335-354.

National Center for Education Statistics (2018a). The Nation's Report Card: 2017 NAEP mathematics & reading assessments highlighted results at grade 4 and 8 for the nation, states, and districts. Retrieved from https://www.nationsreportcard.gov/reading_math_2017_highlights/

National Center for Education Statistics (2018b). The Nation's Report Card: 2017 NAEP Data Explorer. Retrieved from https://www.nationsreportcard.gov/ndecore/xplore/NDE

National Center for Response to Intervention (2010). *Essential components of RTI—A closer look at response to intervention*. Washington, D.C.: U.S. Department of Education, Office of Special Education Programs, National Center on Response to Intervention. Retrieved from http://www.rti4success.org/resource/essential-components-rti-closer-look-response-intervention

National Early Literacy Panel (2008). *Developing early literacy: Report of the National Early Literacy Panel*. Washington, D.C.: National Institute for Literacy. Retrieved from http://www.nifl.gov/earlychildhood/NELP/ NELPreport.html

National Institute of Child Health and Human Development (NICHD) (2000). *Report of the National Reading Panel*. Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups (NIH Publication No. 00-4754). Washington, D.C.: U.S. Government Printing Office.

National Mathematics Advisory Panel (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, D.C.: U.S. Department of Education.

National Research Council (NRC). (2005). *How students learn: Science in the classroom*. Committee on How people learn, A Targeted Report for Teachers, M. S. Donovan & J. D. Bransford (Eds.). Division of Behavioral and Social Science and Education. Washington, D.C.: The National Academies Press.

National Research Council (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. Committee on Defining Deeper Learning and 21st Century Skills, James W. Pellegrino & Margaret L. Hilton, Eds. Board on Testing and Assessment and Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, D.C.: The National Academies Press.

Nesbit, J. C., & Adesope, O. O. (2006). Learning with concept and knowledge maps: A meta-analysis. *Review of Educational Research, 76*(3), 413–448.

Paquot, M. (2010). *Academic Vocabulary in Learner Writing: From Extraction to Analysis*. New-York: Continuum, 261.

Pane, J. F., Steiner, E.D., Baird, M.D., & Hamilton, L.S. (2015). *Continued progress: Promising evidence on personalized learning*. Santa Monica, California: RAND Corporation.

Payne, J.N., & Huinker, D.M. (1993). "Early Number and Numeration." In R.J. Jensen (Ed.) *Research Ideas for the Classroom: Early Childhood Mathematics* (pp. 43–70). New York: Macmillan..

Piasta, S.B. & Wagner, R.K. (2010). Developing Early Literacy Skills: A Meta-Analysis of Alphabet Learning and Instruction. *Reading Research Quarterly*, 45, 8-38.

Price, G. R., Mazzocco, M. M., & Ansari, D. (2013). Why mental arithmetic counts: Brain activation during single digit arithmetic predicts high school math scores. *Journal of Neuroscience*, 33, 156–163. Retrieved from: http://www.jneurosci.org/content/33/1/156

RAND Reading Study Group (RRSG) (2002). *Toward an R&D program in reading comprehension*. Santa Monica, California: RAND. Retrieved from http://www. rand.org/pubs/monograph_reports/2005/MR1465.pdf

Raphael, T. E., George, M., Weber, C. M., & Nies, A. (2009). "Approaches to teaching reading comprehension." In S. E. Israel & G. G. Duffy (Eds.), *Handbook of research on reading comprehension* (pp. 449-469). New York: Routledge.

Rasinski, T.V. (2003). *The fluent reader: Oral reading strategies for building word recognition, fluency, and comprehension*. New York: Scholastic.

Rasinski, T. V., & Hoffman, J. V. (2003). Theory and research into practice: Oral reading in the school literacy curriculum. *Reading Research Quarterly*, 38, 510-522.

Rose, D. H., & Meyer, A. (2000). The future is in the margins: The role of technology and disability in educational reform. A report prepared for the U.S. Department of Education Office of Special Education Technology. Washington, D.C.: USDOE. Retrieved from http://www.udlcenter.org/sites/udlcenter.org/files/Meyer-Rose_FutureisintheMargins.pdf

Rose, H., & Betts, J. R. (2004). Do gains in test scores explain labor marketing outcomes? *Economics of Education Review*, 25, 430-446.

Rosenshine, B. (1995). Advances in research on instruction. *Journal of Educational Research, 88*(5), 262–268.

Rosenshine, B., & Stevens, R. (1986). "Teaching functions." In M.C. Wittrock (Ed.), *Handbook of research on teaching*, 3rd ed. (pp.376–391). New York: Macmillan.

Rubinstein, R. (2007). Focused Strategies for Middle-Grades Mathematics Vocabulary Development. *Mathematics Teaching in Middle School, 13*(4), 200–207.

Sarama, J., & Clements, D. H. (2009). *Early childhood mathematics education research: Learning trajectories for young children*. New York: Routledge.

Saunders, F.A., Browder, M.D., & Root, R. J. (2017). "Teaching Reading and Literacy Skills to Students with Intellectual Disability." In M. L. Wehmeyer & K. A. Shogren (Eds.), *Handbook of Research-Based Practices for Educating Students with Intellectual Disability* (pp. 688-735). New York: Routledge.

Scarborough, H. (1998). "Early identification of children at risk for reading disabilities: phonological awareness and some other promising predictors." In B. K. Shapiro, P. Accardo, & A. J. Capute (Eds.), *Specific Reading Disability: A view of the spectrum* (pp. 75-119). Timonium, Maryland: York Press.

Scarborough, H. S. (2001). "Connecting early language and literacy to later reading (dis)abilities: Evidence, theory, and practice." In S. Neuman & D. Dickinson (Eds.), *Handbook for research in early literacy (*pp. 97–110). New York: Guilford Press.

Shanahan, T. (2005). *The National Reading Panel Report: Practical advice for teachers*. Naperville, Illinois: Learning Point Associates.

Shaughnessy, J. M. (1992). "Research in Probability and Statistics." In D. Grous (Ed). *Handbook of Research on Mathematics Teaching and Learning* (pp.465–494). Reston, Virginia: National Council of Teachers of Mathematics.

Sherman, H., Richardson,L., & Yard,G. (2013).*Teaching learners who struggle with mathematics*: *Systematic Intervention and Remediation*, 3rd ed.. Longrove, Illinois: Waveland Press, Inc.

Shin, M., & Bryant, D. P. (2015). A synthesis of mathematical and cognitive performances of students with mathematics learning disabilities. *Journal of Learning Disabilities, 48*(1) 96–112.

Siegler, R., Carpenter, T., Fennell, F., Geary, D., Lewis, J., Okamoto, Y., Thompson, L., & Wray, J. (2010). *Developing effective fractions instruction for kindergarten through 8th grade: A practice guide* (NCEE#2010-4039). Washington, D.C.: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from whatworks.ed.gove/publications/practiceguides

Smith, A. T. and Angotti, R .L (2012). Why are There So Many Words in Math? *Voices From the Middle*, 20(1), 43–51.

Sowder, J. (1992). “Estimation and Number Sense.” In D. Grous (Ed). *Handbook of Research on Mathematics Teaching and Learning* (pp.371–390). Reston, Virginia: National Council of Teachers of Mathematics.

Sowder, J. T., & Kelin, J. (1993). “Number sense and related topics.” In Owens, D. T. (Ed.), *Research Ideas for the Classroom: Middle Grades Mathematics* (pp.41–57). National Council of Teachers of Mathematics Research Interpretation Project. New York: Simon & Schuster Macmillan.

Stahl, S.A., & Fairbanks, M.M. (1986). The effects of vocabulary instruction: A model-based meta-analysis. *Review of Educational Research*, 56, 72-110.

Stanford, P., Crowe, M.W., & Flice, H. (2010). Differentiating with Technology. *Teaching exceptional children plus, 6*(4) Article 2. Retrieved from http://escholarship.bc.edu/education/tecplus/vol6/iss4/art2

Stanovich K.E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly 1986*, 21(4):360–406.

Stanovich, K. E. (2000). *Progress in Understanding Reading: Scientific Foundations and New Frontiers*. New York: Guilford Press.

Stein, M., Kindler, D., Silbert, J., & Carnine, D. W. (2006). *Designing effective mathematics instruction: A direct instruction approach*, 4th ed. Columbus, Ohio: Merrill Prentice Hall.

Subban, P. (2006). Differentiated Instruction: A research basis. *International Education Journal,* 7(7), 935–947.

Swan, K. (2003). “Learning effectiveness online: What the research tells us.” In J. Bourne & J. C. Moore (Eds.), *Elements of quality online education: Practice and direction* (Sloan-C series, vol. 4). Needham, Massachusetts: Sloan Center for Online Education.

Swan, M. (2001). “Dealing with misconceptions in mathematics.” In P. Gates (Ed.), *Issues in mathematics teaching* (pp. 147-165). London: Routledge.

Swan, M. (2005). *Improving Learning in Mathematics: Challenges and Strategies (Standards Unit)*. Nottingham, United Kingdom: Department for Education and Skills Standards Unit, University of Nottingham.

Swan, M. B. (2003). “Making Sense of Mathematics.” In Thompson (Ed.), *Enhancing Primary Mathematics Teaching* (pp.112–124). Maidenhead, United Kingdom: Open University Press.

Sweller, J. (2008). “Human cognitive architecture.” In J. M. Spector, M. D. Merrill, J. van Merriënboer, & M. P. Driscoll (Eds.), *Handbook of research on educational communications and technology*, 3rd ed. (pp.369–381). New York: Lawrence Erlbaum Associates.

Tankersley, K. (2003). *Threads of reading: Strategies for literacy development*. Alexandria, Virginia: Association for Supervision and Curriculum Development.

Teale, W. H., & Sulzby, E. (1986). *Emergent literacy: Writing and reading*. Norwood, New Jersey: Ablex.

Tomlinson, C. A., & Moon, T. R. (2013). *Assessment and student success in a differentiated classroom*. Alexandria, Virginia: ASCD.

Torgesen, J. K. (2002). The prevention of reading difficulties. *Journal of School Psychology, 40*(1), 7–26

Torgesen, J. K. (2006) *Intensive reading interventions for struggling readers in early elementary school: A principal's guide*. Portsmouth, New Hampshire: RMC Research Corporation, Center on Instruction.

Van de Walle, J., Bay-Williams, J. M., Lovin, L. A., & Karp, K .S. (2018a). *Teaching Student Centered Mathematics: Grades 3-5*, 3rd ed. New York: Pearson Education, Inc.

Van de Walle, J., Bay-Williams, J. M., Lovin, L. A., & Karp, K. S. (2018b). *Teaching Student Centered Mathematics: Grades 6-8*, 3rd ed. New York: Pearson Education, Inc.

Van Garderen, D. & Scheuermann, A. M. (2015). Diagramming word problems: A strategic approach for instruction. *Intervention in School and Clinic, 50*(5) 282-290.

Vaughn, S., Wanzek, J., Murray, C. S., & Roberts, G. (2012). *Intensive interventions for students struggling in reading and mathematics: A practice guide*. Portsmouth, New Hampshire: RMC Research Corporation, Center on Instruction.

Wagner, R. K., Torgesen, J. K., Rashotte, C. A., Hecht, S. A., Barker, T. A., Burgess, S. R., Donahue, J., & Garon, T. (1997). Changing relations between phonological 46 processing abilities and word-level reading as children develop from beginning to skilled readers: A 5-year longitudinal study. *Developmental Psychology*, 33, 468-479.

Watson, A. (2007). Algebraic reasoning. Paper 6. London: Nuffield Foundation.

Watson, A., Jones, K., & Pratt, D. (2013). *Key ideas in teaching mathematics*. Oxford, United Kingdom: Oxford University Press.

Welder, R. (2012). Improving Algebra Preparation: Implications from Research on Student Misconceptions and Difficulties. *School Science and Mathematics*, 112(4), 255–264.

Wilson, D., & Conyers, M. (2016) *Teaching Students to Drive Their Brains: Metacognitive Strategies, Activities, and Lesson Ideas*. Alexandria, Virginia: ASCD.

Wilson, P. S., & Rowland, R. E. (1993). "Teaching measurement." In R. J. Jensen (Ed.), *Research ideas for the classroom: Early childhood mathematics* (pp. 171-194). New York: Macmillan.

Witzel, B.S., & Little, M.E. (2016). *Teaching elementary mathematics to struggling learners*. New York: Guilford.

Yopp, H. K. (1992). Developing Phonemic Awareness in Young Children. *Reading Teacher, 45*(9) 696-703.

Edgenuity
where learning clicks