

## A Story of Units: Overview

Mathematics is a logical, sequential story and is most effectively taught as such.

The story’s main character at the elementary level is the unit, the basic building block of arithmetic. Themes such as measurement, place value, and fractions run throughout—each given the amount of time proportionate to its significance in the story. The story climaxes when a student learns to add, manipulate fractions, or find the area of a circle.

New York’s Common Core Learning Standards support the story-driven teaching of math.

The content and pacing of New York’s Common Core Learning Standards lend themselves to an interpretation that prioritizes thoughtful sequencing, emphasizes key topics, and makes fluency a chief goal. Crafted artfully, a curriculum with these characteristics can be extremely effective when put in the hands of teachers who have been trained to deliver it.

Most US textbooks do not tell a story, but rather prioritize the teaching of procedures and employ a spiraling approach where portions of topics are taught in part and then returned to, sometimes years later, with the expectation that students will “connect the dots.” But teaching procedures as skills, outside of a broader and deeper context, is risky. Students can easily forget a procedure and will fail if they do not have more knowledge upon which to draw. Spiraling—even when done at its best—can be undermined by a wide array of factors including varying teacher quality, student mobility, and poor attendance.

A Story of Units was created to teach the logical, sequential story of elementary level mathematics using the best in instructional design.

The lesson plans and the corresponding materials reflect the six instructional shifts<sup>1</sup> required to teach the Common Core Learning Standards.

Shift 1: Focus—“...focus deeply on only the concepts that are prioritized in the standards so that students reach strong foundational knowledge and deep conceptual understanding and are able to transfer mathematical skills and understanding across concepts and grades.”

A Story of Units fosters a deep understanding of mathematics procedures within the context of key foundational concepts. Overarching themes, such as “place value,” “multiplication,” and “fractions” form the backbone of the curriculum and all skills and concepts students learn are related back to these core ideas. Thus, students are able to comprehend the interconnectedness of math concepts and transfer their mathematical skills and understanding across grades.

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<sup>1</sup> Instructional Shifts in Mathematics, EngageNY Website

**Shift 2: Coherence**—“Principals and teachers carefully connect the learning within and across grades... Each standard is not a new event, but an extension of previous learning.”

A Story of Units carefully prioritizes and sequences the Common Core Learning Standards with a deliberate emphasis on mastery of priority cluster standards. The meticulous sequencing enables students, upon completion of each module, to transfer their mathematical knowledge and understanding to new, more challenging concepts.

**Shift 3: Fluency**—“Students are expected to have speed and accuracy with simple calculations; teachers structure class time and/or homework time for students to memorize, through repetition, [and] core functions...”

A Story of Units emphasizes fluency as a daily, substantial, and sustained activity. Fluency tasks are strategically designed for the teacher to easily administer and grade. Modules offer a variety of fluency activities that teachers may select to differentiate for their students, including mental math activities; interactive drills; quick, efficient games with dice, spinners, cards; concept worksheets, etc. Such activities can be used throughout the school year with new material to strengthen skills, and enable students to see their accuracy and speed measurably increase each day.

**Shift 4: Deep Understanding**—“Teachers teach more than “how to get the answer” and instead support students’ ability to access concepts from a number of perspectives so that students are able to see math as more than a set of mnemonics or discrete procedures.”

In A Story of Units students use writing and speaking to solve mathematical problems, reflect on their learning, and analyze their thinking. The lessons and homework require students to write their solutions to word problems several times a week. Thus, students learn to express their understanding of concepts and articulate their thought process through writing. Similarly, students participate in daily lesson debriefs and learn to verbalize the patterns and connections between the lesson and their prior learning, in addition to hearing their peers’ perspectives. The goal is to incorporate reflection time into students’ every day math experience.

**Shift 5: Applications**—“Teachers provide opportunities at all grade levels for students to apply math concepts in “real-world” situations.

A Story of Units is designed to help students understand how to choose and apply the correct mathematics concept to solve real-world problems. To achieve this, the modules use tools and models, interesting problems that cause students to think quantitatively and creatively, and patterns that repeat so frequently that students come to see them as connected to their

environment and other disciplines. The modules ensure that students have abundant opportunity to determine methods for solving problems with no teacher input. Following is a sample word problem from grade 4, which students must determine how to solve independently.

*328 grams of flour is mixed with 256 grams of sugar for a cake. What will be the total weight of flour and sugar for 5 such cakes? Express your answer in kilograms and grams.*

Shift 6: Dual Intensity—“Students are practicing and understanding. There is more than a balance between these two things in the classroom—both are occurring with intensity.”

A Story of Units implements a balanced approach to lesson design. Each lesson is structured to incorporate at least 10-20 minutes of fluency activities, while the remaining time is devoted to developing conceptual understanding and procedural skills, taught during the “I do,” “we do,” “you do” teacher-student interaction structure.

Overarching themes are presented in a logical and compelling sequence to convey the story of forming, relating, and manipulating units.

In order to get a sense for how A Story of Units unfolds, following are brief descriptions of some of the story’s overarching themes.

*Numbers to 10.* In Pre-kindergarten and kindergarten, initially one object is one unit. “Let’s count the frogs! (the unit) 1 frog, 2 frogs, 3 frogs.” Students then relate numbers to each other and to 5 and 10. For example, in building a growth pattern of unit cubes to 10 with a color change at 5, students see that 7 is one unit more than 6, 1 less than 8, 2 more than 5 and 3 less than 10. It can be broken into 1 and 6, 2 and 5, 3 and 4. 7 can be a unit to manipulate (broken apart), to be formed (by adding one more to 6) and related (“It needs 3 more to be ten”). Later, this same growth pattern can be used to teach the distributive property though one unit might have a value of four. 5 fours + 2 fours = 7 fours.  $4 \times 5 + 4 \times 2 = 4 \times 7$ .

*Addition and Subtraction.* For example, in order to add 8 and 6, students form a unit of ten and add the remainder.  $8 + 6 = 8 + (2 + 4) = (8 + 2) + 4 = 10 + 4 = 14$ . They extend that skill to add 18 + 6, 80 and 60, 800 kg + 600 kg, 8 inches + 6 inches (making a unit of 12 inches rather than 10) and 8 ninths + 6 ninths. Adding compound units 2 dogs 4 puppies + 3 dogs 5 puppies means adding like units just as 2 tens 4 ones + 3 tens 5 ones, 2 feet 4 inches + 3 feet 5 inches, 2 hours 4 minutes + 3 hours 50 minutes, etc.

*Place Value and the Standard Algorithms.* With regards to this overarching theme, the place value system is simply an organized and compact way to write numbers using *place value units* that are multiples of 10: ones, tens, hundreds, etc. Explanations of all standard algorithms hinge upon the manipulation of these place value units (ex: 10 tens = 1 hundred).

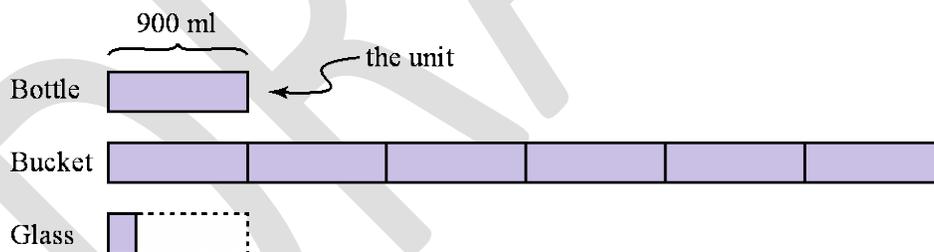
**Multiplication.** The easiest (and one of the earliest) ways to form a new unit is to create groups of another unit. Kindergarten students take a stick of 10 linker cubes and break it into twos. “How many cubes are in your stick?” “10” “Break it and make twos.” “Count your twos with me, “1 two, 2 twos, 3 twos... We made 5 twos!” Groups of 4 apples (or just four) can be counted: 1 four, 2 fours, 3 fours, etc. Relating the new unit to the one used to create it develops the idea of multiplication: 3 groups of 4 apples equal 12 apples (or 3 fours is 12). Manipulating the new unit brings out other relationships: 3 fours + 7 fours = 10 fours.

**Fractions.** Forming fractional units is exactly the same as what was done for multiplication above, but the “group” is now allowed to be the amount when a whole unit is subdivided equally: 1 fourth is the length of a segment on the number line such that the length of 4 concatenated fourth segments on the line equals 1. The new unit can then be counted and manipulated just like whole numbers: 3 fourths + 7 fourths = 10 fourths. Relating addition, subtraction, multiplication, division of quantities in this and other fractional units back to the whole unit develops fraction arithmetic.

**Word Problems.** Forming units to solve word problems is one of the most powerful examples of this overarching theme. In the situation,

“Each bottle holds 900 ml of water.  
A bucket holds 6 times as much water as a bottle.  
A glass holds  $\frac{1}{5}$  as much water as a bottle.”

we can use the bottle capacity to form a unit pictorially and illustrate the other quantities in relationship to that unit:



The unit can then be used to answer word problems about this situation, like: “How much more does the Bucket hold than 4 bottles?” (2 units or 1800 ml).

The goal of A Story of Units is to build students’ understanding of units from the concrete to the pictorial to the abstract as they move, seamlessly, from grade to grade.

Attached to this document is a chart that provides a fly-over view of the Story of Units modules. Each module appears in sequence and is sized to reflect the portion of the school year it would consume. Also attached are a series of grade-based documents that illustrate the pacing, standards coverage, and fluency goals for each grade. As these documents, along with the thematic descriptions above, strive to make clear, the goal of the curriculum materials is to build students’ understanding of units from the concrete to the pictorial to the abstract as they move, seamlessly, from grade to grade.