Mathematical Foundations

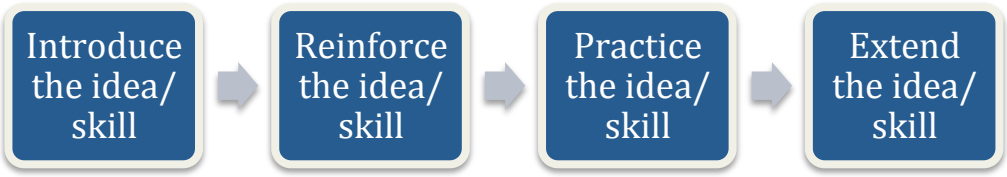
ORIGO Stepping Stones is an award-winning mathematics program written and developed by a team of experts who utilized all available educational research to provide educators with access to a world-class program. *Stepping Stones* version 1.0 was developed to honestly address both the content and the intent of the CCSSM. It is most important to note that *Stepping Stones 1.0* was developed shortly after the release of the CCSSM and well before the guidelines set forth by Achieve the Core.

Based on feedback from *Stepping Stones* users and now from organizations like Achieve the Core and EdReports, we are developing the next generation of *Stepping Stones* version 2.0. This new v2.0 program will provide even more support for educators to ensure successful implementation of the CCSSM.

Based on feedback, the authors of *ORIGO Stepping Stones* have carefully revised the scope and sequence of learning experiences that best promote deep understanding of mathematical concepts and fluency of skills. We know that mathematics requires teaching of concepts and skills that are closely interconnected. A good curriculum must carefully build a structure of understanding so that all prerequisite topics are in place before subsequent topics are connected. Without these careful connections, learning is largely superficial.

In *Stepping Stones,* key ideas and skills have been identified and placed in smaller blocks. These blocks, or "spaced-learning experiences," are spread out across the whole school year. In the lessons that follow, work is included to master what was taught alongside the other content development. So when students come to a new topic, it can be easily connected. Although practice is an essential component of any mathematic curriculum, *Stepping Stones* requires less practice time as key ideas are revisited during the course of everyday lessons throughout the year.

The teaching sequence for the work in *Stepping Stones* is summarized in the diagram below:



In the first stage students are **introduced** to the concept or skill using contextual situations, concrete materials, and pictorial representations to help students make sense of the mathematics.

In the second stage the concept or skill is **reinforced** through unique games or activities. This stage provides the opportunity to assimilate and internalize the concepts and skills as it serves to connect the concrete and pictorial models of the introductory stage to the symbolic of the practice stage.

Once students are confident with the concept or skill, they move to the third stage where visual models are no longer used. This stage aims to develop accuracy and speed of recall. During this stage a range of different types of written and oral activities are used to **practice** the skill to develop fluency.

As the name suggests, the final stage **extends** students' understanding of the concept or skill. For example, the "Make-Ten" thinking strategy for addition can be extended beyond the number fact range to include computation with greater whole numbers and decimal fractions.

Generally, there are two content strands represented in each *Stepping Stones* module. The work for the content within the module focuses on the key ideas or skills that are introduced, reinforced, and (to some extent) practiced. But there needs to be more work to "cement" these ideas. This occurs during the ongoing practice work until the ideas/skills are used to build the next part of the knowledge structure. The work cycles through again to extend the use of the idea/skill or to introduce another idea/skill.

Language Stages

To be most effective, young students need an understanding of mathematical concepts that involve more than just the symbolic notation used to record them. In fact, the authors believe instruction should provide stages of language development to ensure a deep understanding of mathematical concepts. Because language is the tool that learners use to connect new ideas to existing ideas, *Stepping Stones* embeds a developmental sequence for teaching it.

In the first stage, children are encouraged to use their own natural language to describe the mathematical concepts. For example, to describe situations involving subtraction students may use the words, "eat," "break," "jump away," "swim away," or "spend." Teachers should demonstrate this language and use real-world stories and illustrations to stimulate the use of this rich and meaningful language. This stage is aptly called the **Student Language** stage.

The student language broadens as children begin to act out stories and problems using classroom resources. This **Material Language** stage includes language that is unique to the resources being used. For example, when acting out subtraction stories with concrete, hands-on resources new language such as "cover up" or "take away" may be introduced. Similarly, if pictures are being used, the students may say "cross out" or "erase" in the context of subtraction.

The third language stage refers to **Mathematical Language**. It is at this stage that students begin to exhibit mathematical precision in their language. For example, in the context of subtraction, students will use the term "subtract" and eventually "minus." Similarly, in reference to two-dimensional shapes, students will start to say "vertex" to describe what they may have once called a "pointy corner." The language at this stage is often considered to be unique to mathematics.

In the final **Symbolic Language** stage, students are introduced to the symbols or notation of that concept. Therefore, with subtraction, they learn that the "minus" sign is an abbreviation for all the language of the previous stages.

It is important to remember that students don't "move through" the stages as such. Rather, they begin by using their own natural language. Then, as we act out those stories in the classroom, we **add to** their language and mental picture of the concept. Then we **add more** mathematical and finally symbolic language to build a bigger and more comprehensive understanding of the concept.

Efficacy

A study conducted by Johns Hopkins University sought to evaluate the impact of *ORIGO Stepping Stones* on student achievement outcomes in the Worthington (OH) Public School District during the 2013-2014 school year. This study concluded as follows:

> *The mixed-methods evaluation design involved classroom observations, an online teacher survey, principal interviews, and student achievement scores on the Northwest Evaluation Association Measurement of Academic Progress and Measurement of Academic Progress for Primary Grades Assessments (NWEA MAP and MAP/MPG). The study measured the impact on student achievement of students using Stepping Stones compared to students who did not use the program, analyzing results of the NWEA Measure of Academic Progress exam.*

Key findings:

- The findings reveal demonstrated gains from students using *ORIGO Stepping Stones* on standardized tests.

- Of the nearly 3,000 students examined, over 50 percent improved more than their virtual comparison group.
- Worthington students produced growth that exceeded their control groups by 0.3 RIT points.
- Nearly 60 percent of students met or exceeded their Hybrid Growth Targets by 1.5 RIT points.
- The biggest gains were seen in first-grade students, with nearly 80 percent exceeding their Hybrid Growth Targets.
- Since this was only the first year that students and teachers were using the program, there is the potential for even greater gains as the students and staff continue with the program.

The final Johns Hopkins University report is available on the ORIGO Education website can be accessed by clicking on JHU Efficacy Study.

Supplemental Services

ORIGO Education provides supplemental services, including both embedded and on-site professional learning, to ensure successful implementation of *ORIGO Stepping Stones*.

Embedded within *ORIGO Stepping Stones* is a growing library of professional learning videos on contemporary elementary school mathematics. ORIGO MathEd is an invaluable resource that gives teachers ongoing access to a growing library of professional learning videos. These informative sessions provide teachers with the practical skills to help develop deeper understanding of the mathematical standards and practices in the classroom.

Online tutorials are available for teachers to review at the point of need. The topics include an introduction and overview of *ORIGO Stepping Stones* as well as suggestions for how to teach a lesson and plan for units. Using the tutorials, teachers can also learn about the assessment options and how to tailor lessons to meet the needs of all students.

As part of an *ORIGO Stepping Stones* adoption, teachers also receive professional learning to ensure successful implementation. Participants learn the basics of how to navigate the components of *Stepping Stones*, plan for instruction, use assessments, and access embedded professional learning content.

In summary, *ORIGO Stepping Stones* is a world-class mathematics program, built from a solid foundation of research, which embeds strategic approaches toward

language and concept development. Formal and informal studies continue to indicate that students of teachers who effectively implement *Stepping Stones* achieve greater results than their peers. Through careful sequencing of content, proven instructional design, and engaging professional learning, ORIGO Education is committed to making mathematics meaningful, enjoyable, and achievable for all elementary students.