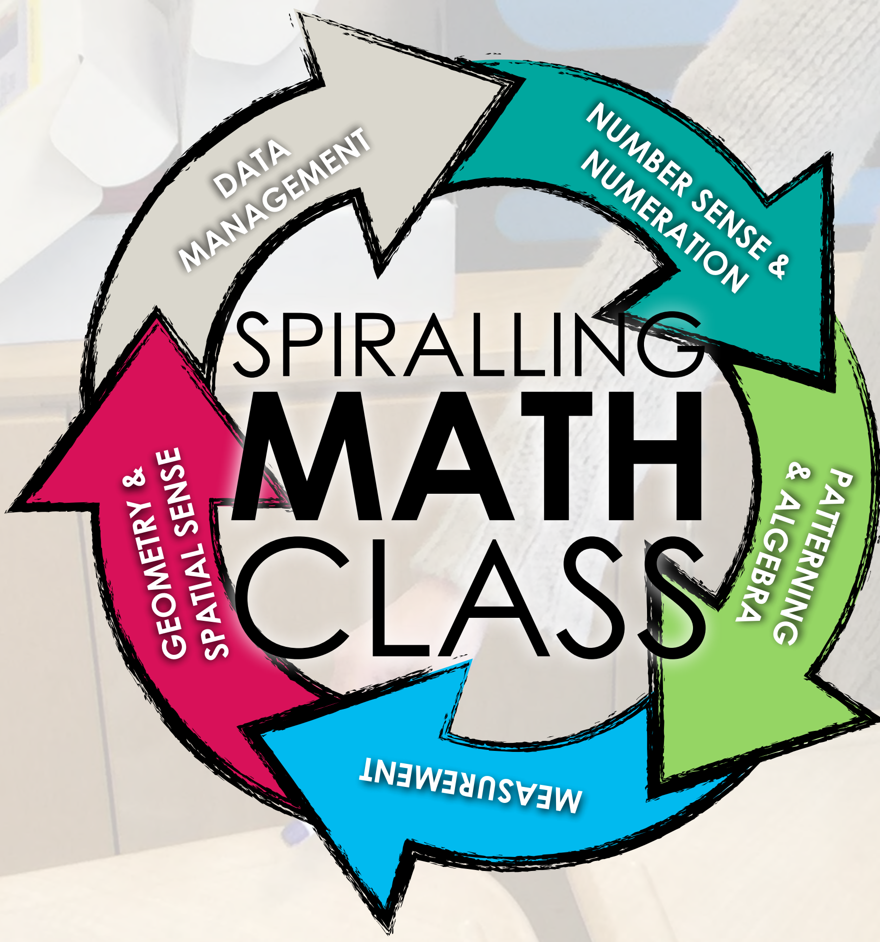
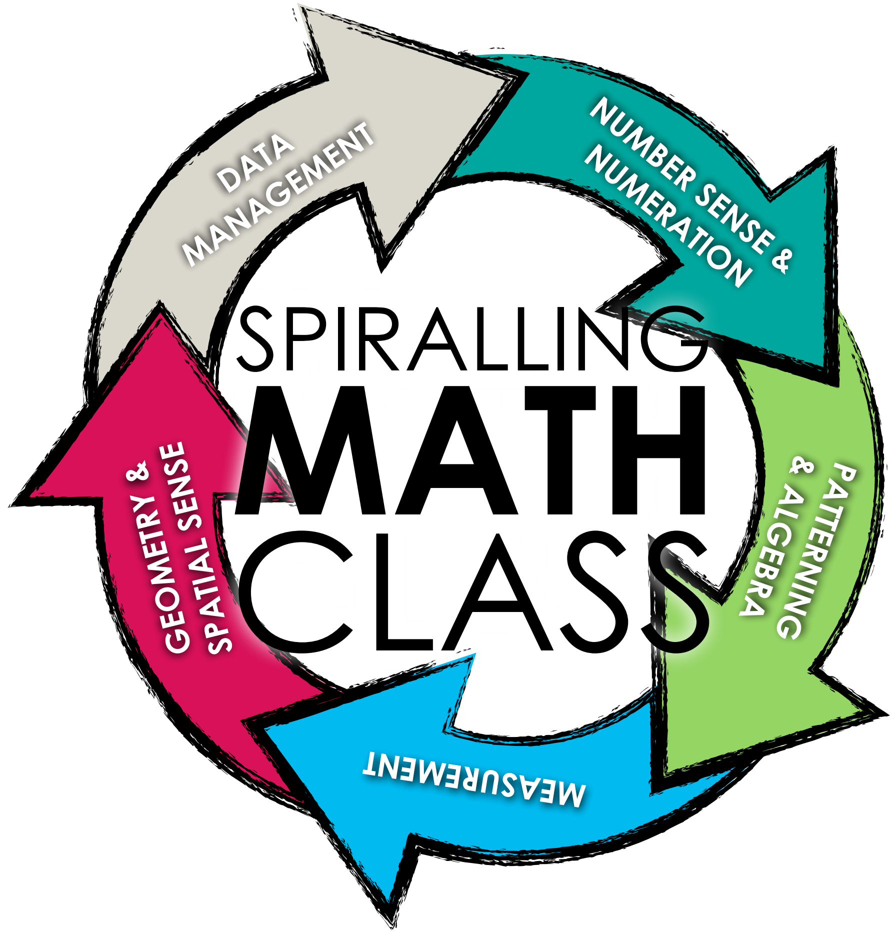


WHAT IS SPIRALLING MATH CLASS

...AND WHY SHOULD I DO IT?

making MATH MOMENTS that MATTER



In This Guide, We'll Learn:

making MATH MOMENTS that MATTER

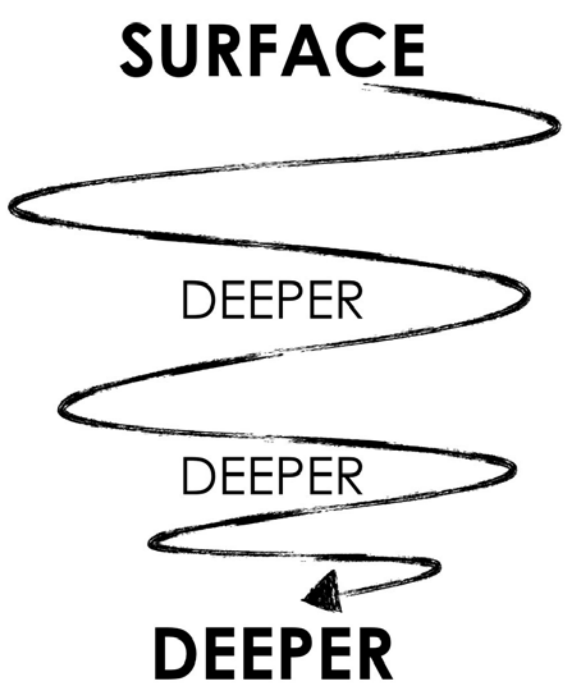
If you're like me, you've experienced the frustration of hearing a student say "I don't remember how to do that" when you ask them to solve a problem from earlier in the school year. This was one of my major challenges as a math teacher regardless of the grade level or mathematical proficiency of the student.

While there are many factors that impact whether your students will remember the content you teach them every day, spiralling the math curriculum was one of the easiest ways for me to give students the best chance of retaining the great learning we were doing each day. This guide will help you better understand what spiralling your math curriculum is and why it is worth doing.

Note: Most of the images and buttons below are clickable, so you can check out these resources in real time. (If the image is not clickable, it means the resource is no longer live.)

What Is Spiralling the Math Curriculum?

When we spiral curriculum in math class, we are organizing topics that might traditionally be taught in blocks, chapters, or units of study over a short period of time and we are introducing topics in smaller chunks and spreading them out over a longer period of time. While you can do this in many different ways, it is common to come back to the topic multiple times over the duration of the grade or course and going deeper each time. Spiralling is commonly referred to as "interleaving", "distributing", "spacing" or "mixing" the topics from the math curriculum, while teaching a concept in one unit or chapter like you see in many textbooks is commonly referred to as "blocked" or "massed" approaches.



Generally when I think of spiralling math curriculum, I picture spiralling through all of the big ideas through tasks early on in the course at a surface level. At the end of this first spiral, we go back through these same ideas to build on our surface knowledge and dig deeper. We continue to spiral through these concepts introducing more complex and rigorous tasks as we help students build their conceptual understanding and develop procedural fluency. I like to see this thinking as very similar to that of John Hattie when he speaks about **surface learning and deep learning**. By spiralling the curriculum and using well planned, thoughtful guided inquiries and investigations, you can help students develop much needed surface learning and deep learning.

When you read about this spiralling, the big question many may have is "why can't I do this by organizing my curriculum in units like I always have?" Well, the research suggests that loading up all of the learning for a concept over a continuous block of time just doesn't have the same effect as mixing it up and spreading it out.

Why Interleaving Is Better Than Blocking

When we interleave math concepts throughout the duration of a course rather than approaching that concept in a continuous block over a shorter period of time, research from over the past 100 years suggests that students learn concepts more deeply and they retain that information for a longer period of time versus blocking.

Hermann Ebbinghaus

Experiments by **Herman Ebbinghaus** which were conducted on himself were the first to investigate properties of human memory. In his experiments, Ebbinghaus would create a lists of about 20 three letter words. These nonsensical words were created starting with a constant, followed by a vowel, and ending with a constant.

constant

vowel

constant

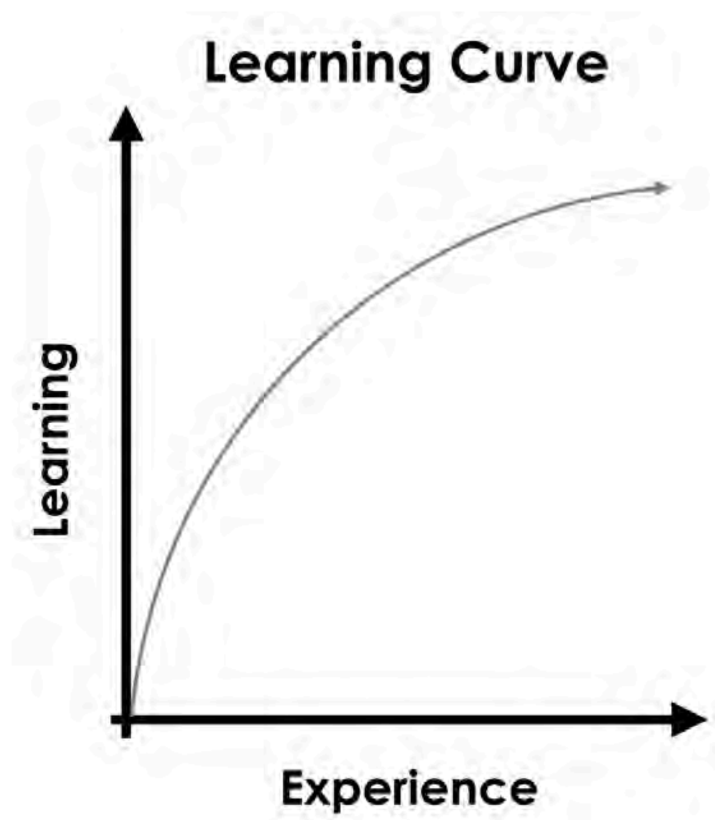
"baf"

Sample List

baf	ged
cef	hoh
dof	cik
fah	lox
tod	mib
med	paq
zat	riw
hej	bos
kuz	tor
jas	gah

The Learning Curve

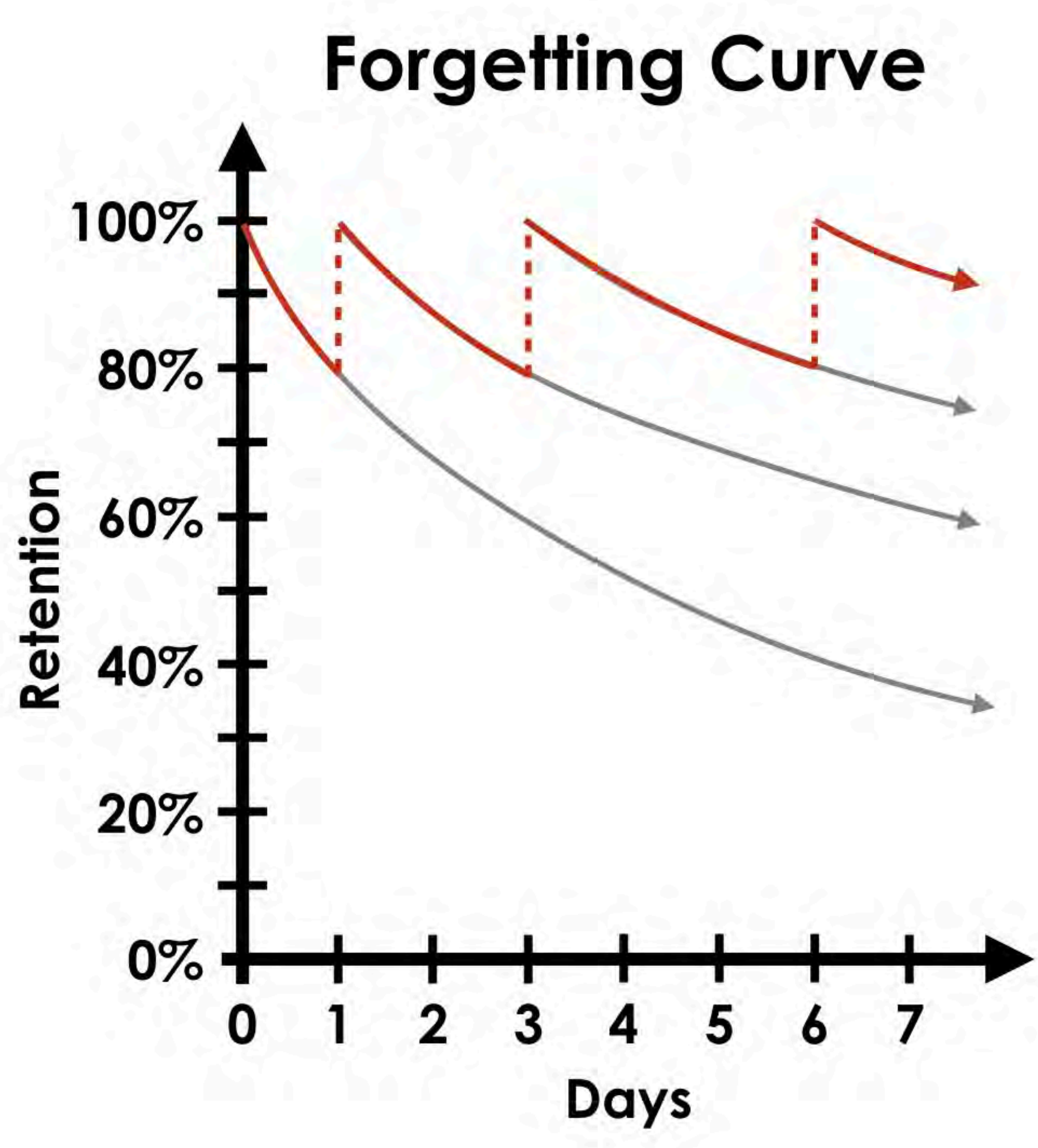
To test the process of committing new learning to memory, he would read and say each item on the list, before moving onto the next. When he was finished the entire list, he would return to the beginning of the list and repeat the process. As you would expect, as the repetitions increased, so did his ability to recall the items in the list. This work by Ebbinghaus was responsible for the creation of the world's first **learning curve**.



The Forgetting Curve

While these experiments were exciting, what Ebbinghaus is most well known for is the **forgetting curve**. Using the same types of 3 letter, nonsensical lists of syllables, he then began focusing his experiments on how long he could retain these items in his memory over time. His research showed that once he had "learned" a list, his retention would decrease with each passing day that he did not attempt retrieving the items from his memory. However, when he retrieved a list from his memory after short intervals of time that gradually increased, the forgetting curve would become less steep.

In the graph below, we can see an example retrieving information from memory after 1, 3 and 6 days after initial learning:



Ebbinghaus believed that the speed of forgetting depends on a number of factors such as the difficulty of the learned material (in other words, how meaningful it is to the individual), its representation (such as what connections to prior learning is made with the new learning) and and physiological factors such as stress, sleep or even how open to learning the individual is.

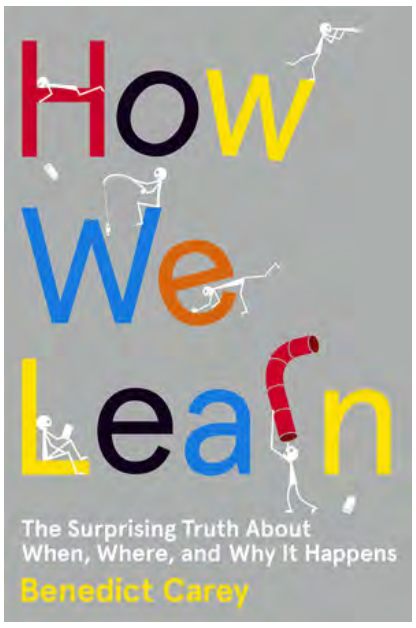
Other Research Supporting Spacing Over Massing

In **The Educational Psychology Review**, Son and Simon state:

> *"On the whole, both in the laboratory and the classroom, both in adults and in children, and in the cognitive and motor learning domains, spacing leads to better performance than massing."*
>
> Son, L. K., & Simon, D. A. Distributed learning: Data, metacognition, and educational implications. Educational Psychology Review (2012): 1-21.

CLICK TO TWEET

Surprisingly, much of what we believe to be true about learning is actually false as explained in Benedict Carey's book How We Learn: The Surprising Truth About When, Where, and Why it Happens:



READ THE BOOK

> *"Let go of what you feel you should be doing, all that repetitive, over-scheduled, driven, focused ritual. Let go, and watch how the presumed enemies of learning – ignorance, distraction, interruption, restlessness, even quitting – can work in your favor."*
>
> Carey, Benedict. 2014. How we learn: the surprising truth about when, where, and why it happens (222)

CLICK TO TWEET

Wonder and Curiosity Drives Learning

While I won't be suggesting that we promote distractions, interruptions, restlessness and quitting in our math classes, some of the key ideas from the book have interesting implications for math class and school in general. First and foremost, Carey concludes that learning happens best when it is driven by wonder and curiosity rather than by fear or envy. When you consider the traditional approach to teaching math class is usually blocking or massing concepts in a short period of time followed by a one shot test, it would seem that the learning is more likely to be driven by fear (i.e.: failing) or envy (i.e.: wanting the highest grade) rather than by **wonder and curiosity** as Carey suggests.

READ THE ARTICLE

In order to promote learning driven by wonder and curiosity, Carey argues that we should help students become curious thinkers – not as a means to do individual tasks like completing a section in a textbook, but for cultivating a love of learning in general. As a teacher who used to teach in units or blocks, I find it much easier to spark curiosity in my students when I spiral math curriculum using **3 act math tasks to teach concepts** because solution strategies are much less predictable, students are not expected to use a specific formula or algorithm explicitly taught moments before during a teacher directed lesson and each of these contextual tasks creates an intellectual need for the learning.

I know that if I can get students curious about a problem and get them to put some skin in the game by sharing what they notice and wonder as well as making predictions before all of the required information is shared, students are much more likely to learn and retain this new knowledge.

Effect of Spiralling on Retention

Although the decades of research has clearly indicated that interleaving math concepts and spacing practice is much more effective than teaching in blocks and massing practice, we are still seeing the majority of textbooks and math classes organized in units or blocks.

Why?

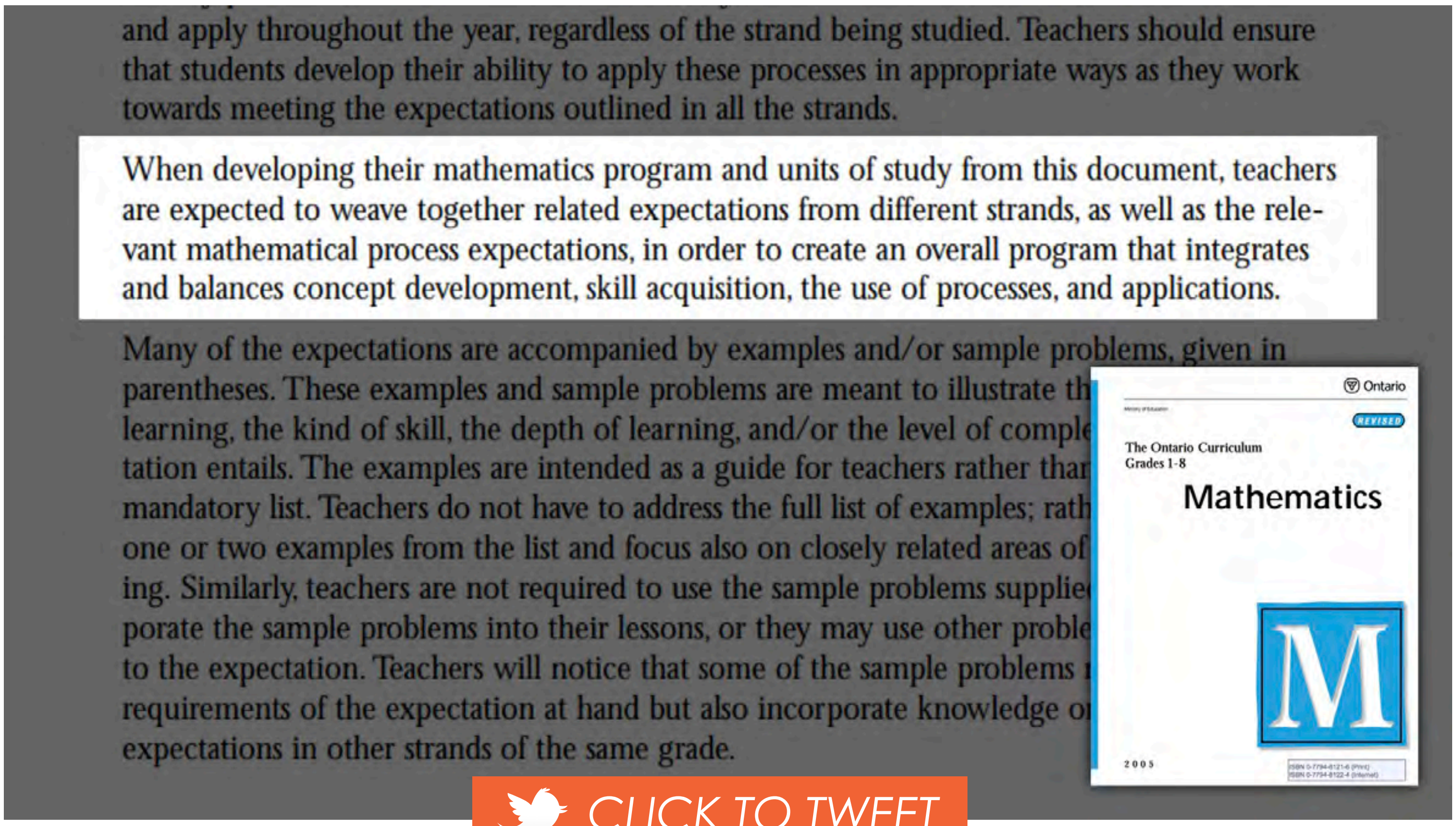
One possible reason is because of the **illusion of understanding** often experienced when we teach or learn using blocked instruction and massed practice. Because students are focusing their attention on few concepts and practicing them repeatedly over a short period of time, the facts, steps and procedures are fresh in their minds and they appear to "know it". Unfortunately, this perceived fluency is short lived and often results in a lack of retention over time. Many of us and our students have experienced this sort of memory loss when we "draw a blank" on a written assessment and I'm sure every teacher has had their students claim they don't remember how to solve a problem related to a concept they learned the previous year.

When we distribute or interleave concepts and space practice over time, this forces our brains to work harder to retrieve the information and ultimately builds our retrieval strength. By waiting to come back to a concept just before it feels like it is fully forgotten, we are giving our brains exercise to retrieve those memories and build a stronger neural pathway to that information. Thus, Carey not only recommends interleaving and spacing practice, but also using tests as an effective studying technique to promote retention rather than just as a measurement tool. The logic here is that each test where a student works on problems independently and without the aide of peers or resources is an opportunity for them to practice retrieving that information that is stored deep in their brain.

Imagine that: using a test to study rather than studying for the test.

Some Jurisdictions Explicitly Promote a Spiralled Curriculum

Interestingly enough, my colleague **Jana LePage-Kljajic** brought to my attention the fact that the Ontario Mathematics Curriculum explicitly states that teachers should be teaching in some sort of spiralled format:

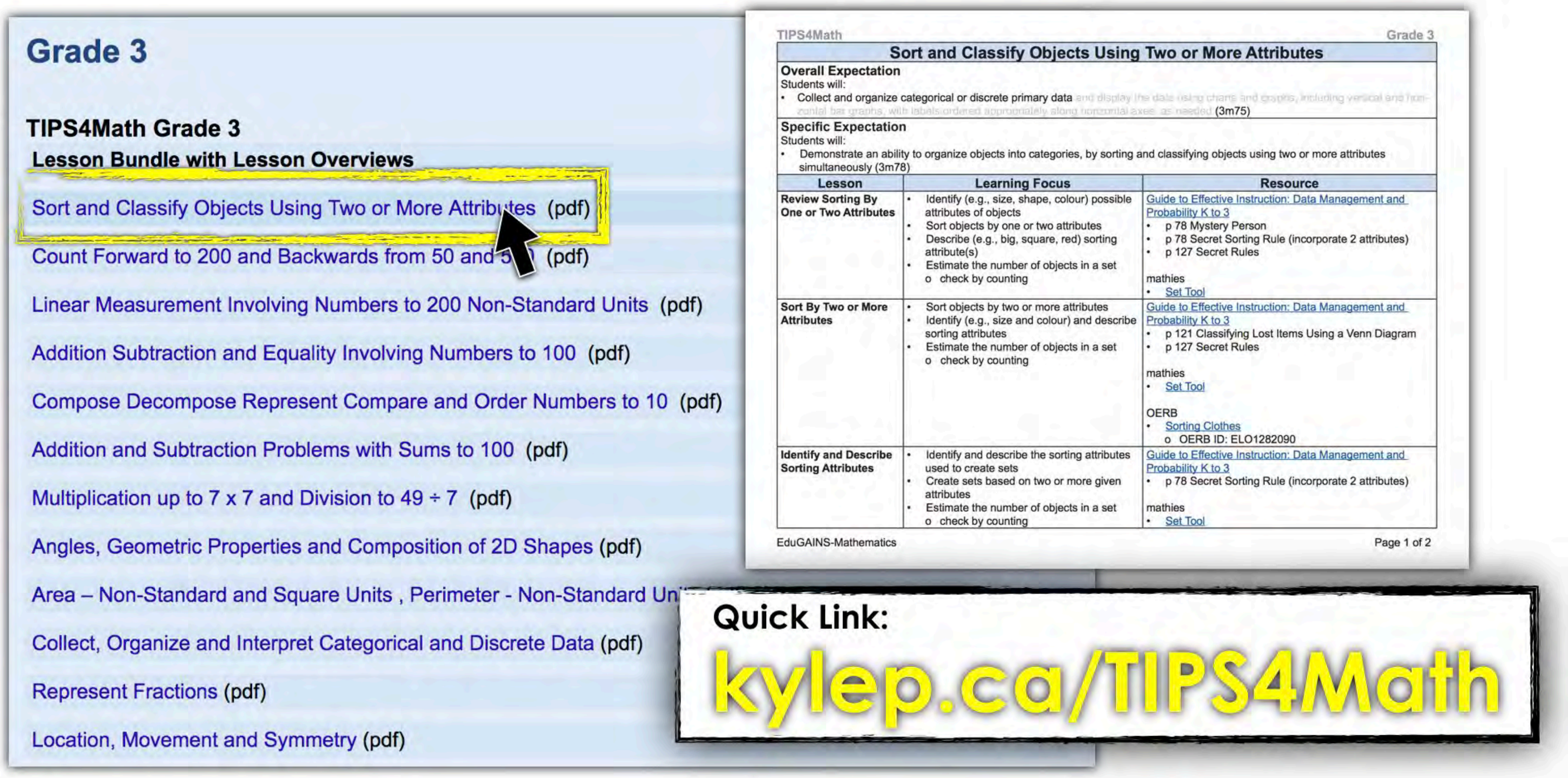

and apply throughout the year, regardless of the strand being studied. Teachers should ensure that students develop their ability to apply these processes in appropriate ways as they work towards meeting the expectations outlined in all the strands.

When developing their mathematics program and units of study from this document, teachers are expected to weave together related expectations from different strands, as well as the relevant mathematical process expectations, in order to create an overall program that integrates and balances concept development, skill acquisition, the use of processes, and applications.

Many of the expectations are accompanied by examples and/or sample problems, given in parentheses. These examples and sample problems are meant to illustrate th learning, the kind of skill, the depth of learning, and/or the level of comple tation entails. The examples are intended as a guide for teachers rather thar mandatory list. Teachers do not have to address the full list of examples; rath one or two examples from the list and focus also on closely related areas of ing. Similarly, teachers are not required to use the sample problems supplie porate the sample problems into their lessons, or they may use other proble to the expectation. Teachers will notice that some of the sample problems r requirements of the expectation at hand but also incorporate knowledge o expectations in other strands of the same grade.

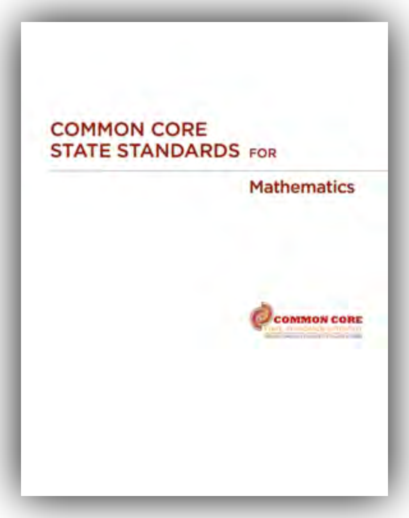
CLICK TO TWEET

Recently, the Ontario Ministry of Education released a completely spiralled Grade 1 to Grade 8 Math Resource on the EduGains website called **TIPS4Math**. Definitely a great place to start if you are teaching elementary mathematics in Ontario.



ACCESS RESOURCE

Although I couldn't find it stated as explicitly, the Common Core State Standards (CCSS) for Mathematics does mention a spiral-like approach:



ACCESS COMMON CORE

> *"... not only stressing conceptual understanding of key ideas, but also by continually returning to organizing principles such as place value and the laws of arithmetic to structure those ideas."*
>
> Common Core State Standards (CCSS) for Mathematics

CLICK TO TWEET

Although I'm less familiar with the University of Chicago's Everyday Math program, it is also a spiralled curriculum and they share their logic behind the organization **here**.