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The Spiral:
Why *Everyday Mathematics* Distributes Learning

What is a spiral curriculum?
In a spiral curriculum, learning is spread out over time rather than being concentrated in shorter periods. In a spiral curriculum, material is revisited repeatedly over lessons and units across the grade. Different terms are used to describe such an approach, including "distributed" and "spaced." A spiral approach is often contrasted with "blocked" or "massed" approaches. In a massed approach, learning is concentrated in continuous blocks. In the design of instructional materials, massing is more common than spacing.

Why does Everyday Mathematics spiral?
Everyday Mathematics (EM) spirals because spiraling works. When implemented as intended, EM's spiral is effective: EM students outscore comparable non-EM students on assessments of long-term learning, such as end-of-year standardized tests. Spiraling leads to better long-term mastery of facts, skills, and concepts.

Spiraling is effective with all learners, including struggling learners. Learning difficulties can be identified when skills and concepts are encountered in the early phases of the spiral and interventions can be implemented when those skills and concepts are encountered again later in the spiral.

What is the research basis for spiraling?
The "spacing effect" – the learning boost from distributing rather than massing learning and practice – has been repeatedly found by researchers for more than 100 years. Findings about distributed learning are among the most robust in the learning sciences, applying across a wide range of content and for all ages from infants to adults. "Space learning over time" is the first research-based recommendation in a recent practice guide from the U. S. Department of Education's Institute of Educational Sciences (Pashler et al., 2007). In a recent review of the literature, Lisa Son and Dominic Simon write, "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" (2012).

Why does spacing work better than massing?
The reasons for the "spacing effect" are not fully understood. One possibility is that massing reduces attention so that learning is weaker. Another possibility is that effortful processing of the sort involved in spaced learning enhances long-term retention. Easy learning often doesn't lead to the best retention; more difficult learning can lead to more robust encoding of information and better long-term learning (Schmidt & Bjork, 1992). This explanation identifies the spacing effect as an example of a "desirable difficulty" that enhances learning. A third possibility is that spiraling helps learners make connections over time, which creates more robust pathways for recalling information. Multiple, strategically spaced and strategically progressing learning experiences may produce deeper, more conceptual learning.

Why aren't more curricula built with a spiral structure?
Most curricula are not designed to take advantage of the spacing effect, much to the frustration of the psychologists who have documented its power (Dempster, 1988; Rohrer, 2009). One reason is that the

spacing effect is counterintuitive: People feel that massing leads to higher performance, which is true in the short term – cramming does work for the short term – but is not true if the goal is long-term learning. People confuse short-term performance with long-term learning and inaccurately predict that massed practice will lead to better long-term learning than spaced practice. UCLA psychologist Robert Bjork uses the term "illusion of competence" to describe this feeling (1999). Another reason spiraling is not common in curriculum design is that many teachers are unaware of the benefits of spacing learning over time. Teachers may also be discouraged to realize how much their students forget, something that is more apparent with spacing (in which topics are revisited after students have had time to forget) than with massing (in which topics are not revisited so that forgetting is not as obvious). A third reason is that students find spaced learning harder than massed learning, so they tend to prefer a massed approach even though it's less efficient. A final reason that spiral curricula are not common is that building such curricula is complicated. *Everyday Mathematics*, for example, weaves instruction, practice, and assessment in intricate patterns extending over months and even years. Designing and building a spiral curriculum is more difficult than designing and building a conventional, massed curriculum, but, as the research shows, it's worth the effort.

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