Curriculum Associates: Putting Scientific Evidence to Work in Reading Instruction
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Oh no, not again! Yes, the reading wars have returned! The reading wars between proponents of phonics-based and other approaches designed to teach children to read have been around for many years (Smith, 2002; Shanahan, 2020). It seems that every few decades this iterative battle erupts anew between proponents of intensive phonics instruction and other approaches designed to teach children to read. The first modern iteration of the reading wars was touched off by Rudolph Flesch's (1955) book, *Why Johnny Can't Read and What You Can Do About It.* This book asserted U.S. students couldn't read well at the time due to a lack of intensive phonics instruction following decades of whole-word instruction as was exemplified in the popular *Dick and Jane* readers published by Scott Foresman & Company (Gray, Monroe, Artley, & Arbuthnot ,1956). Since then, several iterations of the reading wars have ensued with the last one as recent as the *Scientifically Based Reading Research* (SBRR) debates that occurred in the early 2000s.

Barely a day goes by without a national headline, somewhere online or in print, proclaiming the failure of elementary teachers and teacher educators to teach reading by applying the findings of the *Science of Reading* (SOR) in schools and classrooms (Rotherham, 2020; Shanahan, 2020; Wexler, 2019; Willingham, 2017). It is true that many children today are not learning to read proficiently. Currently in the U. S., only about one-third of fourth-grade students are reading proficiently (NCES, 2019). Tragically, this <u>can</u> be a real-life disaster for young students who fail to learn to read and write early and well.

For classroom teachers, headlines such as these are a source of frustration and confusion leading to a condition some teachers call, curricular whiplash. For teacher educators, headlines such as these are an invitation to heated debates about the nature of science itself and the epistemology of what counts as knowledge. All combined, the topics of "science," "reading," "reading instruction," and "science of reading" have recently come to a head as students' reading proficiency scores on state, national, and international assessments have remained stubbornly flat for decades leaving all too many students struggling to read and write proficiently enough to animate lives of opportunity in today's complex, information age society.

There are several purposes this Curriculum Associates' white paper on the *Science of Reading (SOR)* is intended to serve. First, we, like many others, aim to clarify what is meant by the term - *Science of Reading (SOR)*. Second, we describe what the *Science of Reading* has revealed about how people learn to read. Third, we describe how models and theories have informed the research that forms the *Science of Reading* (SOR) research base. Fourth, we draw a clear distinction between the terms – *Science of Reading (SOR)* and *Science of Reading Instruction (SORI)* - owing to the difficulty of translating basic research findings directly into effective instructional recommendations for teaching reading. Fifth, we describe the evidentiary standards of "scientific" research that have established a reliable evidence-base about how people learn to read and how reading should be taught. Sixth, we outline what is known about what the *Science of Reading Instruction* supports as general and specific instructional practices, approaches and products as well as those practices, approaches and products that are not supported by the current corpus of scientific instructional research studies. Finally, we end with a statement of Curriculum Associates' commitment to the *Science of Reading Instruction* as this pertains to its product development and research.

What is meant by the term - *Science of Reading* (SOR)?

To be sure, we recognize that to even attempt a definition of the term - *Science of Reading* (SOR) - is to enter where few dare to tread. There are many definitions one might select, but we have selected a definition provided by the world's largest organization devoted to advancement of reading and literacy – *The International Literacy Association* (ILA) as shown below.

> The *Science of Reading* (SOR) is "a corpus of objective investigation and accumulation of reliable evidence about how humans learn to read and how reading should be taught."
>
> *International Literacy Association, 2020*

So then, what has the *Science of Reading* or the corpus of objective investigation and accumulation of reliable evidence revealed about how people learn to read?

The Science of Reading and How People learn to Read

In her best-selling book, *My Stroke of Insight: A Brain Scientist's Personal Journey*, Harvard trained neuroanatomist, Jill Bolte Taylor, recounts in detail her loss of physical and intellectual abilities after suffering a massive stroke. Taylor (2006) tells her readers that learning to read was the <u>most</u> difficult thing she had to relearn as she recovered.

Reading, she noted in her book, is an enormously abstract and complex cognitive skill. And, we routinely expect that kindergarten students will learn this enormously complex skill at age five. What do we know about how reading works in the human mind? Willingham (2017) in his book, *The Reading Mind: A Cognitive Approach to Understanding How the Mind Reads*, offers an accessible *tour de force* in answer to this question.

To begin, writers use the alphabet to code spoken language into written language. In simplest terms, readers begin the road to reading by decoding writing in order to recover their spoken language. Decoding allows learners to access the spoken word and its meanings stored in long term memory by converting symbols into sounds…a process known commonly as "sounding it out." To do this, readers must visually distinguish one letter from others, hear individual sounds in speech, and know how to connect or map speech sounds onto letters. Humans are not born with the innate ability to hear individual speech sounds - phonemes. And yet, success in learning to read is causally related to the ability to abstract speech sounds from the stream of spoken words we hear every day (Adams, 1994; National Reading Panel, 2000; Petscher, Cabell, Catts, et al., 2020). Contrasted with many other languages, English uses a complicated and somewhat reliable system of mapping speech sounds to letters, reliable enough at least, that most children can learn to do it.

Next, readers need to learn how words look when letters are grouped together into spellings. Spelling or *orthographic patterns* provide another way for humans to code written language into speech by recognizing larger, distinct representations of spoken sounds. Developing the ability to map sounds to specific spellings can also help readers make better use of "working memory" capacity because instead of mapping four individual speech sounds to four individual letters in the following spelling pattern – *ight*- the mind is able to map a single or "chunk" of sound to this particular orthographic pattern. Recognition of spelling patterns occurs through instruction and feedback as well as through volume reading and writing. Proficient readers use both pathways to connect the words they pronounce to meanings stored in long term memory. When readers can use both pathways, it makes reading more efficient by requiring less attention in working memory and thereby making more cognitive resources available for comprehending the meaning of text. In summary, decoding letters to recover speech sounds can occur in two ways – either by sounding out each letter in a word or by recognizing a specific spelling pattern to pronounce a word.

Next, spoken words, recovered through the process of decoding, must then be mapped to one, or more, word meanings stored in long-term memory. With some unknown words, the words around the unfamiliar or unknown word can act as “context clues” for figuring out the potential meaning. This is an effortful process and one that interrupts the flow of reading. Readers can also find meaningful clues within words. Affixes, better known as prefixes and suffixes, are an example of meaningful units that attach to base or root words, also allowing readers to figure out word meanings.

Consequently, when students have access to a large, deep, rich, and broad array of word meanings stored in long term memory coupled with additional information provided by context clues and meaningful word parts, these all combine to give students access to their corpus of known word meanings – meanings for many words, and in some cases, many meanings for a single word. A reader’s vocabulary is developed through a combination of exposure to word meanings in print and in oral language, through direct instruction of word meanings, and through encouraging a curiosity about or interest in words and word meanings. With a large store of word meanings available to the mind, cognitive attention can be directed toward comprehending increasingly larger units of written language to include phrases, sentences, and connections among sentences.

One major contributor to comprehension is the reader’s background knowledge, including knowledge of oral language and oral language structures. Readers who have access to broad, deep, and well-organized world knowledge; have access to large oral language vocabularies; and have been exposed to varied language structures in oral language; are greatly advantaged over readers who do not. Readers comprehend text by accessing three levels of idea representation: 1) sentences, 2) connections among sentences, and 3) a general notion of what the text is about.

Readers use reading comprehension strategies when they engage in effortful construction of meaning in complex texts where their background knowledge may be inadequate, poorly organized, or erroneous, the text genre is unfamiliar, or the text's author(s) requires readers to make a great many inferences. Understanding how the "reading mind" works is thought to provide insights into potential instructional interventions intended to support or scaffold learners as they become increasingly proficient readers.

Figure 1: *Insert a Graphic Here from CA Graphic Artists that Represents this Explanation of How People Learn to Read*

Models and Theories Undergirding the *Science of Reading* (SOR).

There are many and varied explanations about how people read. These explanations are called theories or models of the reading process. Theories and models of the reading process have provided "testable" hypotheses that have led to the research undergirding the *Science of Reading* as we currently understand it.

Theories and models of the reading process have progressed through several waves of development (Alvermann, Unrau, & Ruddell, 2013). Wave 1 produced "Bottom-Up" theories where the reading process originates with the print and progresses to construction of meaning in the mind. One example is the Simple View of Reading (SVM) (Gough & Tunmer, 1986). This well-known and widely tested theory/model describes the process of reading using a simple formula: LC (language comprehension) + D (decoding) = R (reading). This model posits that reading is at first a process of effortful decoding, giving way to fluent or automatic decoding later on, which then opens up opportunity for the mind to access one's language comprehension to complete the reading process. Another example of a Bottom-Up Model of reading is Seidenberg and McClelland's (1989) Distributed, Developmental Model of Word Recognition and Naming. Bottom-Up models developed in Wave 1 are most useful in helping to explain how readers achieve automatic decoding of print-based information.

Reading theory and model development in Waves 2 & 3 produced “Top-Down” theories and models where the reading process originated first with what readers remember from a text, and second, an explanation of how the background knowledge readers bring to a text influence memory for text. In Wave 2, theories and models of reading described the structure of text and how readers’ memories for text-based ideas mirrored the text’s representation and organization. Examples of Wave 2 “Top-Down” theories or models of reading include Story Grammar Theory (Stein & Glenn, 1979) and Hierarchical Text Structure Theory (Meyer, 1975). In Wave 3, theories and models of reading describe how a reader’s background knowledge influences the construction of meaning from text. Most famously, Wave 3 produced the “Top-Down” theory of reading known as Schema Theory (Anderson & Pearson, 1984). Top-Down models developed in Waves 2 & 3 are most useful in helping to explain what readers remember and how their background knowledge influences what they remember from text.

Wave 4 produced “interactive” models and theories that combined “Bottom-Up and Top-Down” explanations of the reading process. These models and theories explain bottom-up and top-down processes readers use as they move through a text to construct a meaningful representation of the ideas. Examples of Wave 4 interactive models or theories of the reading process include LaBerge and Samuels (1974) Automatic Information Processing Model, Rumelhart’s (1985) Interactive Model, Pavio’s (1971) Dual Coding Theory (DCT), Scarborough’s (2001) Reading Rope Theory, and Kintsch’s (1974) Construction-Integration Model of Text Comprehension. Interactive “Bottom-Up/ Top-Down” models developed in

Wave 4 are most useful in explaining how readers process levels of text-based information and combine this with their background knowledge to construct meaning for text.

Wave 5 further embellished "Bottom-Up/ Top-Down" models/theories of the reading process by adding a sociocultural component. These models and theories situate the reader and the text in social and cultural contexts that influence readers and their responses to texts. Examples of Wave 5 models and theories of the reading process include Kirshner and Whitson's (1997) Situated Cognition Theory, and Ruddell and Unrau's (2013) Reading as a Motivated Meaning-Construction Process, and Cartwright and Duke's (2019) DRIVE model of reading. Wave 5 theories and models are most useful in explaining how readers' cognitive processes are influenced by the cultural and social influences found in their environments.

Each of these theories and models of the reading process have contributed, in their time, to a steady stream of basic, scientific research studies. No single reading model or theory is capable of providing a comprehensive explanation of the complexity of the reading process. Consequently, no one theory or model can be adopted as an authoritative framework for guiding the future work of researchers, publishers, or practitioners. It is, however, important to understand that the *Science of Reading* began with theoretical models that attempted to explain the reading process leading to decades of scientific research studies which have combined to provide a current *Science of Reading* about how people learn to read (Seidenberg, 2020).

Distinguishing Between the terms – *Science of Reading (SOR)* and the *Science of Reading Instruction (SORI)*

We feel it important in this white paper to draw a clear distinction between the terms - *Science of Reading* (SOR) and the implications of that term for reading instruction, the *Science of Reading Instruction* (SORI). Contrary to widely shared information in the popular press, the term SOR has been misappropriated by some to suggest that the ultimate panacea for struggling readers is to provide them with more and a different type of phonics instruction. Rather, the *Science of Reading* (SOR) is far more nuanced and inclusive than to allow any attempt to reduce its findings to a simple, single proposed instructional solution such as adding more or different phonics instruction.

We want to make clear that the term *Science of Reading* is based on basic empirical research studies that validate the processes that underlie how people become proficient readers. Shanahan (2020) asserts, "In current use of the term science of reading, authors often try to make pedagogical and policy claims mainly on the basis of basic research done in the cognitive sciences and neurosciences, particularly with regard to beginning reading (e.g., Seidenberg, 2017). As such, the term is a bit of a misnomer because those using it today tend to reason directly from basic research to the prescription of instruction; the conversation seems to be less about a science of reading than a science of reading instruction." (pp. S235–S236).

In medicine, basic research about the circulatory system and how the heart functions within that system would never be considered sufficient evidence to recommend specific interventions or protocols for treating heart attacks. The point here is that although basic scientific research about how people read has been accumulating for well over a century around the world, the findings of basic scientific research about how people read are insufficient in and of themselves to make scientifically sound instructional recommendations for the teaching of reading. The problems inherent in translating basic research findings into instructional recommendations for how to teach reading effectively, a *Science of Reading Instruction*, is both a complex and a very tricky business (Solori, Terry, Gaab, Hogan, et al., 2020; Seidenberg, 2020; Shanahan, 2020).

Shanahan (2020) explains the problem of translating basic research findings of a *Science of Reading* into instructional practices supported by findings of applied research to support a *Science of Reading Instruction* as follows, “No matter how scientific basic research may be, ultimately any science of [reading] instruction will have to depend on applied studies of teaching, that is, those studies that require smaller inferences to application…No matter how sound the studies of neural processing, perception, and memory, we must recognize the possibility that they, at least in some cases, could be irrelevant, inconsequential, or misleading with regard to teaching.” (p. S239). In short, no matter how well supported the *Science of Reading* is in the corpus of findings supported by basic research, recommendations for instruction must be tried out and studied in the intended context of their use and with the intended recipients of their assumed benefits. Making instructional recommendations directly from the findings of basic research used to support a *Science of Reading* is an enterprise fraught with peril. Only when instructional studies designed to meet the standards of scientific research demonstrate tangible improvement in students’ reading abilities should they become part of the “corpus of objective investigation and accumulation of reliable evidence about how reading should be taught” in order to support a *Science of Reading Instruction* (Shanahan, 2020).

In addition to the problem of research translation, another danger lurks when attempting to frame a *Science of Reading Instruction*. Duke and Martin (2011) draw another distinction about “scientific” research that may influence a *Science of Reading Instruction.* When invoking the term research, they find it useful to distinguish between the terms – *research-based* and *research-tested*. *Research-tested* means that “one or more research studies tested the impact of that particular practice, approach or product” (p. 17). *Research-based* means “that the particular practice, approach, or product has not been tested in a research study but has been designed to be consistent with [other] research findings" (p. 17). In view of this distinction, a *Science of Reading Instruction* must rest upon research-tested rather than research-based empirical findings.

In order to claim that an instructional practice, approach or product is scientifically supported or *research-tested*, the research conducted and reported must meet clear and broadly accepted scientific research evidentiary standards. Consequently, we feel it useful here to describe these evidentiary standards that *research-tested* practices, approaches, and products must meet to support a *Science of Reading Instruction*.

Evidentiary standards for Research Used to Support a *Science of Reading Instruction* (SORI)

The emphasis on the word, *science*, is important because "science" or "scientific" are terms that describe the design and conduct of research and research review processes. The *Institute of Education Sciences* (IES, 2019) has published descriptions of four ESSA tiers of research evidence: ***Tier 1: Strong Evidence, Tier 2: Moderate Evidence, Tier 3: Promising Evidence,*** and ***Tier 4: Demonstrates a Rationale.***

An intervention, protocol, practice, or approach is considered to provide **Tier 1** evidence of impact, when it is backed by *strong* evidence of effectiveness. Strong evidence of effectiveness is derived from a collection of well-designed and implemented randomized controlled trials (RCTs) or experiments. These studies show statistically significant positive effects on a relevant outcome, show no strong negative findings reported in other experimental or quasi-experimental studies, have at least 350 participants, and the evidence collected was obtained in two or more typical school or district settings, and include at least one setting that is comparable to the one where the findings are to be implemented. Evidence from "meta-analyses" or a quantitative study of studies, is considered *strong* only when the studies analyzed in the meta-analysis are drawn from well-designed and implemented studies meeting Tier 1 criteria.

An intervention, protocol, practice, or approach is considered to provide Tier 2 evidence, when it is backed by *moderate* evidence of effectiveness. Moderate evidence of effectiveness is derived from a collection of well-designed and implemented RCTs or experiments whose design and implementation meet WWC standards, but fall short of those studies considered to be rigorously designed. These studies may include comparison-group studies (quasi-experiments) in which the intervention and comparison groups are very closely matched in academic achievement, demographics, and other characteristics. Results show a statistically significant positive effect on a relevant outcome, report no strong negative findings from other experimental or quasi-experimental studies, have at least 350 participants, and evidence was collected in two or more typical school or district settings, and include at least one setting that is comparable to the one where the findings are to be implemented. Evidence from "meta-analyses" or a quantitative study of studies, is considered *moderate* only when the studies analyzed in the meta-analysis are from well-designed and implemented studies that meet WWC standards with reservations.

An intervention, protocol, practice, or approach is considered to provide Tier 3 evidence, when it is backed by *promising* evidence of effectiveness. Moderate evidence of effectiveness is derived from a collection of well-designed and implemented correlational studies with statistical controls for selection bias. Results show a statistically significant positive effect on a relevant outcome and show no strong negative findings from experimental or quasi-experimental studies.

An intervention, protocol, practice, or approach is considered to provide Tier 4 evidence, *demonstrates a rationale*, when a rationale for a practice, product or approach is based on a well-defined logic model grounded in rigorous, related research and there is an effort to study the effects planned or currently under way. To conclude, instructional interventions, protocols, products, practices or approaches should strive to conduct and report research that meets Tier 1 or 2 levels of ESSA evidence to be considered meeting the "gold standard" for effectiveness. Not all reading instruction practices, approaches, or products provide *strong* or even *moderate* evidence of efficacy as described by the Institute of Education Sciences (IES), U.S. Department of Education.

For teachers and school leaders who are committed to selecting and deploying instructional resources in their schools and classrooms that are backed by *strong* or *moderate* evidence of effectiveness, we suggest consulting the *whatworksclearinghouse* website as a good first step [https://ies.ed.gov/ncee/wwc/FWW/Results?filters=,Literacy]. The WW clearinghouse website contains information about practices, approaches and programs of reading instruction and the currently available evidence, if any, for effectiveness.

Another good step is to request published reports from a vendor's company. A word of caution is warranted with the recommendation of this step. Research sponsored by the maker of a product can reflect a confirmation bias in favor of the product since the company sponsoring the research has an inherent interest in the outcome. Teachers and school leaders should expect, at the very least, to find converging evidence from a variety of sources to support the adoption and use of instructional practices, products, or approaches when *strong* or *moderate* evidence is currently unavailable.

A *Science of Reading Instruction*: What Works in Teaching Reading

The scientific findings about reading instruction are often clustered into two broad instructional categories: 1) teaching reading foundation skills, and 2) teaching reading comprehension. Students need to develop rock solid reading foundation skills coupled with substantial background knowledge and the ability to strategically deploy a collection of scientifically supported comprehension strategies that allow them to construct meaning when reading complex texts. Both the Report of the National Reading Panel (NICHD, 2000) and the Report of the Early Literacy Panel (NIL, 2008) provide a synthesis of strong scientific evidence for teaching a collection of reading foundation skills to young students as well as activating background knowledge and the teaching of comprehension strategies leading to proficient reading ability. In addition to these sources, we highly recommend the following recent compilation of *Science of Reading Instruction* findings - Petscher, Y., Cabell, S. Q., Catts, H. W., Compton, D. L., Foorman, B. R., Hart, S. A., ... & Wagner, R. K. (2020). How the Science of Reading Informs 21st-Century Education. *Reading Research Quarterly*, *55*, S267-S282.

Teaching Reading Foundation

The reading foundation skill instructional category includes:

- ***Concepts about print*** – Learn how print works including directionality (L_>R, Top to Bottom), print not picture, punctuation, number of words and letters, and ordinal concepts such as first, last and middle (Reutzel, Oda & Moore, 1989; National Early Literacy Panel, 2008).
- ***Phonological awareness*** – Learn to hear, identify, and manipulate units of oral language larger than a single sound or phoneme including onsets, rimes, syllables, and words. For example, a kindergarten student can tap three times to count the number of words in the spoken sentence – The dog ran. She can clap twice for the number of syllables in the word “window”: win-dow. She can segment and say the onset, /k/, and the rime, /an/ in

the syllable “can” (National Reading Panel, 2000; Early Literacy Panel, 2008; Petscher, Cabell, Catts, Compton, et al., 2020).

- ***Phonemic awareness*** - Learn to hear, identify, and manipulate individual spoken sounds (phonemes) in words and syllables. For example, a kindergartener can identify the three sounds in the word *mat*: /m/ /a/ /t/. A first grader can also manipulate sounds in words by replacing the /m/ in mat with /s/ to form the word *sat* (Hulme, Muter, & Snowling, 1998; Nation & Hulme, 1997; National Reading Panel, 2000; National Early Literacy Panel, 2008; Petscher, Cabell, Catts, Compton, et al., 2020)
- ***Phonics*** - Learn the relationships between spoken sounds (phonemes) and the letters that represent these spoken sounds in written language. Students develop the skills of blending sounds of letters in words to read and segment sounds in words to write. Blending and segmenting sounds in words to read and write are often referred to collectively as “sounding out” (Ehri, 2020; National Reading Panel, 2000; National Early Literacy Panel, 2008; Petscher, Cabell, Catts, Compton, et al., 2020).
- ***Morphological Analysis*** – Learn how to determine unknown word meanings by identifying meaningful word parts such as prefixes, suffixes, and other word endings, e.g., possession, plurals, and grammatical tense. Students learn how the addition of word parts to a root or base word changes meaning, e.g., read vs. reread (Carlisle, 2000; Baumann, Edwards, Boland, Olejini, et al., 2003; Beck & McKeown, 2007; Carlisle, 2000; Godwin & Ahn, 2013; Lesaux, Kieffer, Faller, & Kelley, 2010; Levesque, Breadmore, Deacon, 2021; Petscher, Cabell, Catts, Compton, et al., 2020).
- ***Spelling*** - Learn to use knowledge of orthographic or spelling patterns to accurately write the combination of letters to represent the sounds they hear in spoken words. For

example, a second grader knows the spelling pattern of "tion" to represent the sound pattern of /shun/. When hearing the word "nation" and trying to spell it, she will spell it "nation" rather than "nashun" (Ehri, 2020; National Reading Panel, 2000; Petscher, Cabell, Catts, Compton, et al., 2020).

- ***Fluency*** - Learn to read text accurately, with appropriate speed and expression to free up attention to be used to construct meaning from text. Fluency forms a bridge from decoding to comprehension (National Reading Panel, 2000; Rasinski, Reutzel, Chard, & Linan-Thompson, 2011; Foorman, Beyler, et al., 2016; Petscher, Cabell, Catts, Compton, et al., 2020).

These reading foundation skills need to be taught to beginning readers and in some cases, older students who are struggling to read proficiently. Beginning readers need to learn how print works and how letters, sounds, and spelling patterns can be used to recognize and decode words. As important as reading foundations skills are, they cannot produce proficient readers on their own. Students also need instruction to help them build their background knowledge, language comprehension, expand their vocabulary, and deploy comprehension strategies strategically to become proficient readers.

Reading Comprehension

The reading comprehension category includes instruction in:

- Oral language skills – Learn about phrases, sentence structure, connecting terms, and discourse patterns (Silverman, Johnson, Keane, & Khanna, 2020; Petscher, Cabell, Catts, Compton, et al., 2020).
- Vocabulary development – Acquire and use a vast knowledge of words and their meanings (Kamil et al., 2008; Petscher, Cabell, Catts, Compton, et al., 2020).

- Background knowledge – Building and activating knowledge of the world, events, facts, experiences, and information (Cabell & Hwang, 2020; Hattan & Lupo, 2020; Kaefer, 2020).
- Comprehension strategies– Learn a collection of scientifically researched comprehension strategies to use to unlock the meaning of difficult, unfamiliar, or complex texts (National Reading Panel, 2000; Reutzel, Smith, & Fawson, 2005; Shanahan, Callison, Carriere, Duke, Pearson, Schatscheider, & Torgeson, 2010; Petscher, Cabell, Catts, Compton, et al., 2020; Reutzel, Fawson & Smith, 2005).
- Text Discussion – Participation in extended discussions of text with teachers and peers (Kamil et al., 2008; Petscher, Cabell, Catts, Compton, et al., 2020)
- Writing – Write for varied purposes and in differing genres, including writing about what is read to cement comprehension of text (Graham, Bollinger, Olson, D'Aoust, et al., 2012; Graham, 2020).

Building background knowledge is an essential element of evidence-based reading comprehension instruction (Cabell & Hwang, 2020; Cervetti, Jaynes, & Hiebert, 2009; Kaefer, Neuman & Pinkham, 2015). It needs to be a focus for both beginning readers and for all students throughout life. Readers benefit from acquiring background knowledge and the word meanings and language and text structures that are used to represent that knowledge. Paris (2005) pointed out that reading comprehension is considered an "unconstrained" skill domain - meaning the number of word meanings, facts, information, text genres, and language structures are continually growing and changing and are essentially infinite. As a result, reading comprehension is a lifelong pursuit.

Knowing what to teach, reading foundation skills and reading comprehension, from the accumulated evidence base of scientific findings about reading is only part of the instructional puzzle. Knowing how to teach these is also supported by scientific research on reading. We turn our attention now to that very task, understanding what scientific findings tell us about how to effectively teach reading foundation skills and reading comprehension.

Instructional Practices Supported and Not Supported by a *Science of Reading Instruction*.

From decades of research, the scientific findings about reading have confirmed which, of the many general instructional practices and approaches available, are demonstrably effective in helping students become proficient readers. What we discuss here is not meant to be a comprehensive treatment of this topic, but we will highlight some of the most consistently supported instructional practices for teaching reading effectively based on the scientific evidence-base.

Just as a competent physician would never prescribe a treatment regimen without conducting appropriate tests, effective reading instruction is predicated upon the systematic collection of valid, reliable, and meaningful assessment data (Afflerbach, 2018). Single assessments or test scores are never sufficient for making informed instructional decisions about reading instruction.

Assessment should drive instruction. Too much instructional time is wasted teaching skills or concepts students may already know or failing to teach skills or concepts they do not know and need to learn in order to progress toward proficient reading. Assessment tools need to be selected to screen, progress monitor, and diagnose how well students are doing in acquiring the reading foundation skills, background knowledge, and comprehension skills necessary to promote engaged and proficient reading.

Instruction in reading foundation skills, building background knowledge, and acquiring comprehension skills should begin early in schooling. Instruction should be *systematic*. This means instruction should proceed according to a defined scope of skills, strategies, and knowledge concepts and domains to be taught, a planned sequence for teaching these, and a periodic review and re-teaching cycle that assures students have acquired and are retaining requisite reading skills and knowledge.

Research has also determined that the teaching of reading skills and strategies is best supported, with some exceptions, through the use of *explicit* instruction. Explicit instruction begins with a statement and an explanation of a learning objective focused on a requisite reading skill, concept, knowledge domain or strategy. This is followed by teacher modeling of the cognitive processes involved in learning or using the skill, strategy, or knowledge. Next, teachers guide student practice of the skill, strategy, or knowledge and gradually release more responsibility from the teacher to the students in using the skill, strategy, or knowledge to encourage independence. Throughout these guided practice sessions, students are monitored and provided corrective feedback. Once teachers are satisfied students can benefit from independent practice, they are given opportunity to use the skills, knowledge, or strategies on their own. Finally, students are assessed and re-taught, if necessary, to assure efficacy of the instruction and practice. Instruction is best if it proceeds at an intensive pace and is followed up on regularly and relentlessly in a multi-tiered system of support (MTSS) until students achieve proficiency.

Effective reading instruction based on scientific findings also assures that students engage with a variety of grade-level and challenging or complex texts. We know that students evidence greater growth in reading when they read somewhat challenging texts (Morgan, Wilcox & Eldredge, 2000; Brown, Mohr, Wilcox & Barrett, 2017). Selecting texts that align with student interests and allowing students to choose texts produces positive motivation and a desire by students to read both in school and out (Guthrie & Humenik, 2004; Fraumeni-McBride, 2017). Students benefit from explicit instruction in metacognitive monitoring of their own understanding of text during reading (National Reading Panel, 2000; Shanahan, Callison, Carriere, Duke, Pearson, Schatscheider, & Torgeson, 2010). Monitoring comprehension helps readers to take appropriate “fix up” actions to repair faltering comprehension in a timely manner.

The goal of reading instruction is to accelerate student reading growth, whether students are reading below, at, or above proficient levels for their grade (Fielding, Kerr, & Rosier, 2007). A year’s growth for a year’s instruction will never help those students to catch up who are lagging behind grade level expectations. Acceleration of reading growth is best assured by using what we know from the scientific findings about reading and reading instruction.

The U.S. has been awakening to literacy as a core social justice issue, but recent events including the worldwide COVID 19 pandemic have heightened this realization. Gibbons (2019, p. 5) emphasizes this point in the following, “…there is another social justice issue that deserves equal attention: the ability to read. Each year, over one million fourth grade students are added to the list of nonreaders in our country.” Inadequate reading skills impact not only students’ academic aspirations but they are also associated with increased risk for dropping out of school, later incarceration, low self-esteem, and depression and anxiety leading often to attempted suicide. We simply must do better at incorporating the scientific findings about reading and reading instruction in classrooms and schools in the U.S. to assure that all students develop the skills necessary to animate a life filled with opportunity. As such, teachers and school leaders need to have a broad and nuanced understanding of what scientific findings about reading and reading instruction reveal about how reading works in the human mind and how to teach humans to read proficiently.

Conversely, there are a number of recommended instructional practices, programs and approaches that DO NOT currently enjoy sufficient scientific evidence, *strong* or *moderate*, to recommend their use. For example, there are no current basal or core reading programs available in the U.S. that evidence strong or moderate support. Petscher et al. (2020) note, **"**As a consequence, it is currently impossible for schools to select basal reading programs that adhere to strict evidence-based standards (e.g., ESSA, 2015). As an alternative, schools must develop selection criteria for choosing classroom reading programs informed by the growing scientific evidence on instructional factors that support early reading development" (p. S272).

Instructional practices that Do Not currently enjoy *strong*, *moderate*, or *possible* scientific support for use include silent sustained reading (SSR), multi-sensory approaches, the three cueing system, directly improving vocabulary to improve comprehension, and enhancing other cognitive processes such as attention or memory (Petscher, Cabell, Catts, Compton, et al., 2020). Other instructional practices such as decodable texts evidence *possible* evidence of effectiveness (Juel & Roper/Schneider, 1985; Mesmer, 1999, Mesmer, 2005; Mesmer, 2009). Close reading, having provided a demonstrated rationale, has yet to provide evidence of effectiveness at the *possible*, *moderate* or *strong* levels (Fisher & Frey, 2012; Lapp, Grant, Moss, & Johnson 2013; Mesmer & Rose-McCully, 2018).

Finally, teachers must be willing to eliminate or "fix up" instructional programs, practices, activities, and approaches that are not supported by a *Science of Reading Instruction*. If your school or classroom is currently employing popular but unsupported reading instruction in any form, then steps should be taken to either eliminate the use of these or take steps to "fix up" these resources, programs, practices, or approaches to align with the focus and type of reading instruction that the scientific evidence-base supports.

Curriculum Associates' Commitment to *Science of Reading Instruction*?

Curriculum Associates has taken a principled stance about putting the *Science of Reading* and the *Science of Reading Instruction* to work in their published and marketed reading assessment and instruction programs. Careful attention in-house and from a wide array of solicited expert consultants, Curriculum Associates develops their products in a systematic fashion from conception, to design, to review and approval, and thereafter to making timely revisions. No reading product is marketed that is not examined thoroughly through the lens of the scientific findings about reading and reading instruction.

From the *I-Ready* assessment suite and protocols to the blended instruction of *Ready Reading Common Core*, Curriculum Associates is committed to providing products to schools that are aligned with the scientific findings of reading research. In addition, Curriculum Associates reading products are field tested regularly in school settings. The findings of these field tests are used to produce timely revisions that provide a product that is easy to use, up-to-date, cost conscious, and effective. Our CA team's commitment to these values is at the core of our company mission and value system. We hope you will feel free to provide us with your suggestions for how we might improve our literacy assessment and instruction products by contacting:

INSERT CONTACT POINT HERE

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