The Science of Reading: From Research to Instruction

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In 1998, the National Research Council wrote that "the demands for higher literacy are ever increasing, creating more grievous consequences for those who fall short." More than twenty years later, this is increasingly true. In addition, too much reading instruction is based on "outdated assumptions about reading and development that make learning to read harder than it needs to be, a sure way to leave many children behind" (Seidenberg, 2014, p. 340).

Despite the fact that 37% of American fourth graders read below a basic level (The Nation's Report Card, 2022), many empirical studies show that "a large proportion of students at risk for reading difficulties, as well as students with severe reading disabilities, can develop and maintain normalized reading skills when provided with the right intervention" (Kilpatrick, 2015). The convergence of brain science with education science allows us to identify the key elements of effective reading instruction that can make the vision of universal literacy a reality. The power to leverage the science is in hand.

MODERN NEUROSCIENCE: HOW THE BRAIN LEARNS TO READ

Learning to speak unfolds naturally through exposure to oral language. By contrast, learning to read requires years of intentional instruction. In other words, the human brain is wired for speech but must be deliberately trained to read (Lyons, 1998).

Today, we are living in the midst of what neuroscientist Stanislas Dehaene calls a "neuroscientific revolution" in which emerging brain imaging technologies increasingly reveal how the brain's reading network is formed and how it functions. Information about how we become readers must inform best practices for instruction. An introductory view of how the brain learns to identify written words in three stages—pictorial, phonological, and orthographic (Frith, 1985)—provides a good starting point.

Pictorial Stage

As they build oral language skills, young children learn the pronunciations and meanings of thousands of words. This information is stored in separate areas of the brain (Willingham, 2017), represented by the meaning and oral language puzzle pieces in Figure 1. As they begin to attend to printed language, and before they have significant knowledge of letter-sound relationships, children enter the pictorial stage of word identification. During this stage, children rely heavily on the brain's visual system, perceiving words as wholes with little or no regard to letters and the sounds they represent.

They learn to identify a limited number of words based on their overall visual appearance, often depending on font, color, and logos typically associated with those words (think environmental print such as *STOP* or *McDonald's*). Students may also identify some high-frequency words (*me*, *the*, etc.)

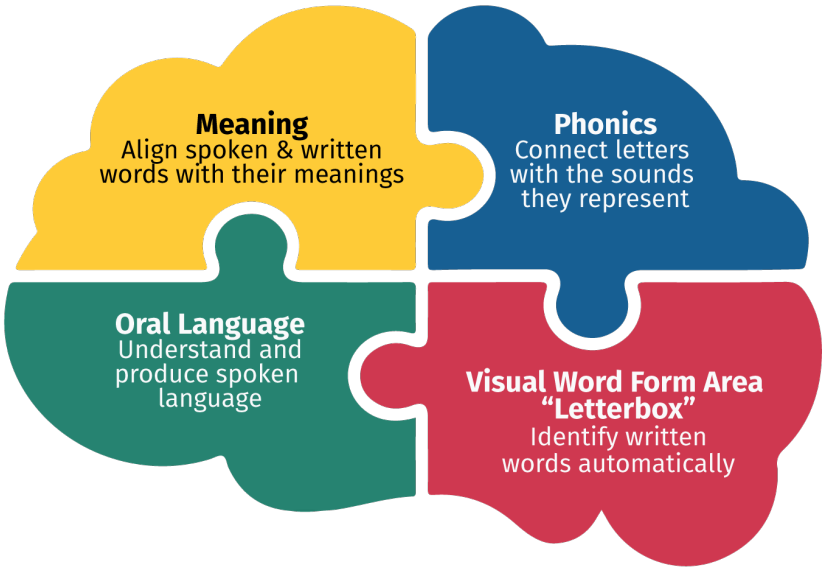

Figure 1: The Brain's Reading Network

or familiar words such as their own name. The word identification processes that characterize the pictorial stage are insufficient for the development of proficient reading. The lack of correlation between visual memory tasks and word-level reading tasks (Kilpatrick, 2015) is evidence that reading is not simply a visual task. Learning to read in an alphabetic system such as English requires the coordination of additional systems within the brain.

Phonological Stage

During the phonological stage, children decode words, isolating individual letters within a word and associating them with speech sounds in grapheme-to-phoneme conversions. This allows the child to identify the pronunciation of the printed word (retrieved from the oral language area of the brain), which then activates its meaning. However, the connections between these areas of the brain are not prewired. Neural pathways must be established through effective instruction and extensive practice. In the phonological stage, the child is beginning to read, but the ability to decode print is not sufficient to produce fluent reading.

Orthographic Stage

Finally, in the orthographic stage, children begin to recognize an increasing number of words automatically, freeing the brain from the cognitive load required for decoding those words letter by letter. What makes this shift from methodical decoding to instant recognition of words possible? The answer is that learning to read literally changes the brain. In response to the unique demands presented by reading acquisition, a specialized area is developed within the brain's visual system—the visual word form area, referred to as the "letterbox" by Stanislas Dehaene (2009). Learning to read "transform[s] some of the visual structures of our brain in order to turn them into a specialized interface between vision and language" (Dehaene, 2011, p. 20).

The brain's letterbox supports the process of orthographic mapping, the process that permanently bonds the speech sounds in a word (phonemes) with the spellings of those sounds (graphemes) and anchors the word's spelling to its pronunciation and meaning. The word is now a sight word for the reader; it is instantly recognizable and no longer requires decoding.

As a result of the orthographic mapping process, a proficient reader can instantly recognize between 30,000 and 80,000 words (Moats, 2010). Again, the necessary neuronal pathways for this process are not pre-paved. They must be forged through instruction and practice. As a student develops reading fluency, activity in the area of the brain that supports decoding decreases as activity in the letterbox (central to the mapping process) increases. It is important to note that orthographic memory is not visual memory. Instead, it is letter-by-letter, sound-symbol memory. Studies reveal that even the most fluent readers still attend to the letter-sound correspondences within words (Kilpatrick, 2015).

In summary, when a reader encounters a novel word, they rely on decoding to identify it. As the word is identified, its pronunciation and then its meaning are activated. When the same reader encounters a word that has already been added to long-term memory through the orthographic mapping process, the word is instantly recognized, automatically activating the pronunciation and meaning of the word. The orthographic mapping process makes fluent reading possible.

When young children begin to read, their brains are maximally plastic. With the "right type of training" (Shaywitz & Shaywitz, 2020), the process of learning to read creates neural pathways between the visual areas and language areas in the brain's left hemisphere. In the words of Maryann Wolf, "We can learn to read only because the brain has this capacity to change" (Wolf, 2007).

Neuroscience sheds light on the reading process within the brain. But what does education research that aligns with the findings of neuroscience tell us about the nature of effective reading instruction? Next, we will examine two instructional frameworks that explain the reading process from the viewpoint of educators.

TWO FRAMEWORKS THAT ALIGN WITH THE SCIENCE

Two frameworks, the Simple View of Reading and Scarborough's Reading Rope, are particularly helpful. These frameworks align well with modern neuroscience research despite the fact that they pre-date much of that research.

Developed by Gough & Tunmer (1986), the Simple View of Reading states that reading comprehension is the product of word recognition and language comprehension. Struggles in either or both of these areas will negatively affect reading comprehension. The Simple View framework is referenced widely by those who seek to align instruction with the science of reading. Recent research has confirmed that word recognition and language comprehension account for almost all variance in reading comprehension (Lonigan et al., 2018). Word recognition skills help students lift words from the page, answering the question, "What do the words SAY?" Language comprehension skills help students answer the question, "What do the words MEAN?" When students can answer these questions in connection with a particular text, reading comprehension is the product.

Scarborough's Reading Rope (Scarborough, 2001) elaborates on the Simple View by identifying component skills within the two domains of word recognition and language comprehension. Foundational word recognition skills are woven together to support increasingly automatic reading, while language comprehension skills work together so that reading can become increasingly strategic.

Figure 2: The Simple View of Reading

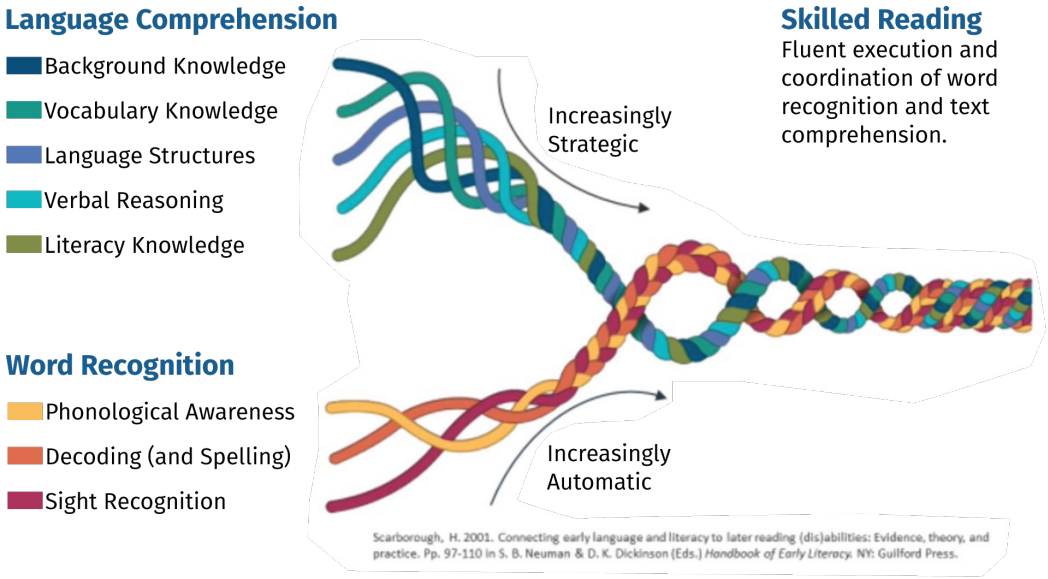

Figure 3: Scarborough's Reading Rope

WATERFORD.ORG: EQUITY & ACCESS

Waterford.org, a national not-for-profit organization that was founded in 1976 as Waterford Research Institute, is driven by the mission to achieve universal literacy by fostering equity and providing access to quality research-based early literacy instruction. The Waterford Early Learning program, developed beginning in the early 1990s, was first released in 1998 and provides a comprehensive, adaptive digital reading curriculum for pre-kindergarten through second-grade students.

The initial content for Waterford Early Learning was developed in consultation with Dr. Marilyn Jager Adams and in alignment with the principles set forth in her landmark book *Beginning to Read: Thinking and Learning About Print* (1990). In addition, recommendations from the National Research Council (1998), the National Reading Panel (2000), the National Early Literacy Panel (2008), and the What Works Clearinghouse (WWC) K–3 Reading Practice Guide (Foorman et al., 2016) have guided Waterford's curriculum development. These major research syntheses emphasize the importance of phonological awareness, phonics, vocabulary, fluency, and comprehension as critical components of effective reading instruction. Through the years, Waterford has relied on the work of many experts in the field of education, including Ehri, Torgersen, Stanovich, Snow, Beck, Moats, and Kilpatrick.

Today, the model is the same—providing children with effective instruction while empowering the educators and families that support them in their learning journeys through learning science, innovative technologies, and home, school, and community partnerships that deliver excellence and equity for all learners.

WATERFORD CURRICULUM: RESEARCH IN ACTION

An Overview

In alignment with Scarborough's Reading Rope, Waterford's curriculum provides carefully sequenced learning experiences that lead to proficient *word recognition*. Students develop phonological awareness and phonics skills; they combine those skills to develop reading fluency through the process of orthographic mapping. In parallel, the program fosters *language comprehension* through the development of vocabulary and background knowledge. Frequent opportunities to read interactive, connected texts (decodable, narrative, and informational) support the development of literacy knowledge and verbal reasoning as well as familiarity with language structures.

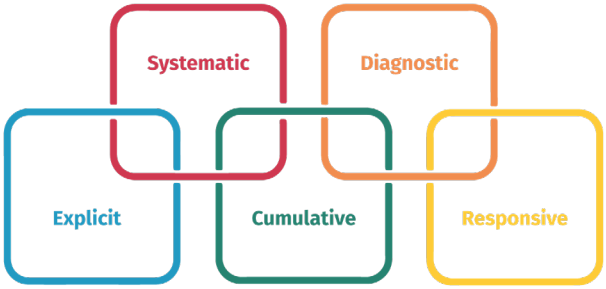

Figure 4: Principles of Effective Instruction

Waterford's instruction is explicit, systematic, cumulative, diagnostic, and responsive (National Reading Panel, 2000). The program provides direct instruction, guided and independent practice, prompt feedback, scaffolding, distributed practice, and ongoing review (Spear-Swerling, 2018). Instruction is carefully ordered and is delivered at a pace that is tailored to individual needs. Student responses are elicited frequently to maximize engagement. Progression is proficiency-based, and embedded assessment drives adaptive learning pathways for individual students. Actionable data highlights achievements and identifies areas of struggle, allowing educators and caregivers to provide targeted support.

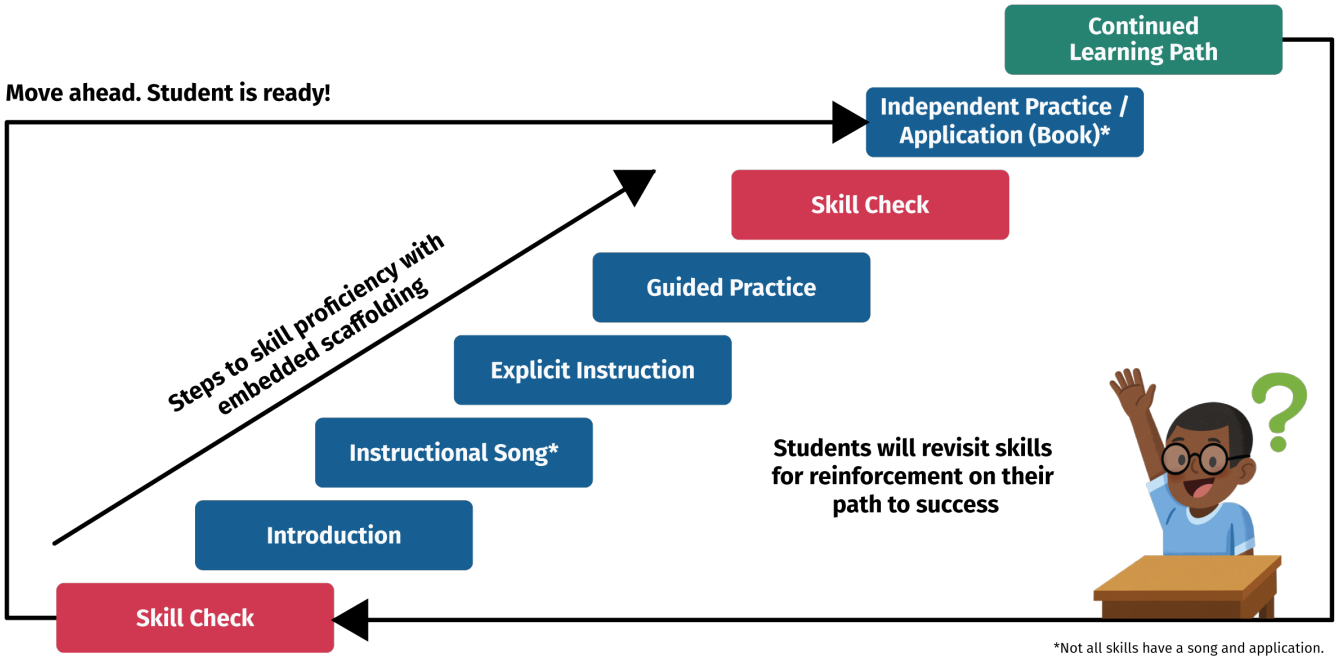

Figure 5: Waterford's Proficiency-Based Adaptive Learning Path

Waterford's curriculum is infused with content that supports the development of healthy Mindset Skills—executive function, social-emotional learning, and growth mindset.

Figure 6: Waterford's Instructional Strands for Mindset Skills

WATERFORD'S SIX INSTRUCTIONAL STRANDS FOR LITERACY

Waterford's six instructional strands for literacy incorporate the essential components of reading as identified by the National Reading Panel (2000).

- Phonemic Awareness (Waterford's Phonological Awareness strand encompasses a broader range of skills.)
- Phonics
- Fluency
- Vocabulary
- Comprehension

Two additional strands help students understand how written language is organized and develop their writing, speaking, and listening skills:

- Language Concepts
- Communication

Waterford's Instructional Strands for Literacy align with the Simple View of Reading and Scarborough's Reading Rope.

Figure 7: Waterford's Instructional Strands for Literacy Aligned With the Simple View of Reading

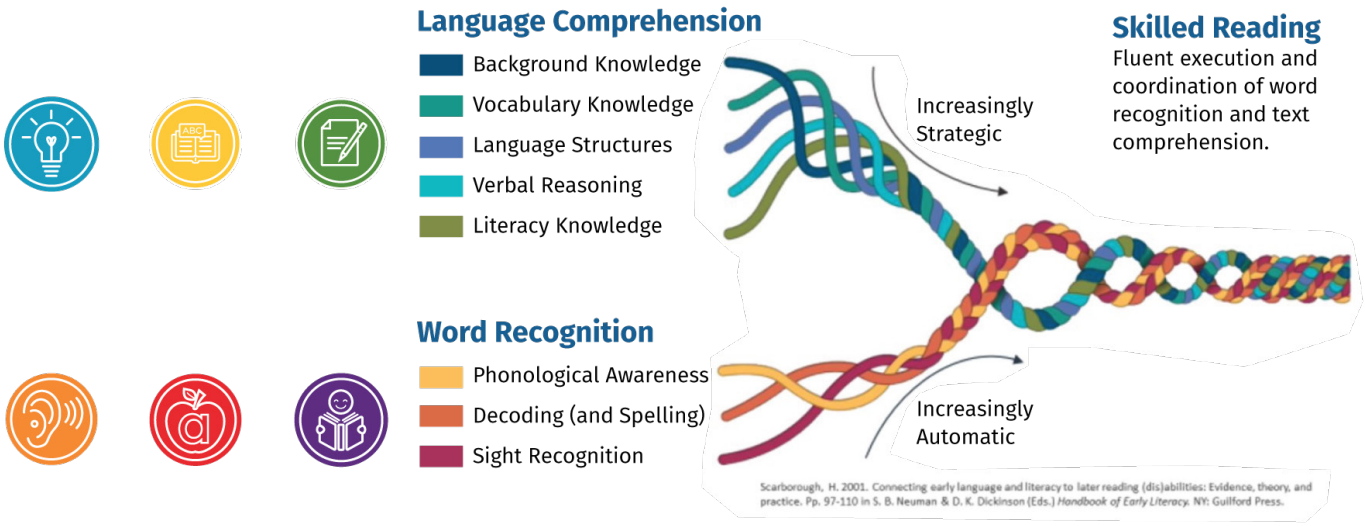

Figure 8: Waterford's Instructional Strands for Literacy Aligned With the Scarborough's Reading Rope

PHONOLOGICAL AWARENESS

- Waterford.org Phonological Awareness Fact Sheet
- Examples of Waterford.org Phonological Awareness Activities
- How To Build Phonological Awareness Skills

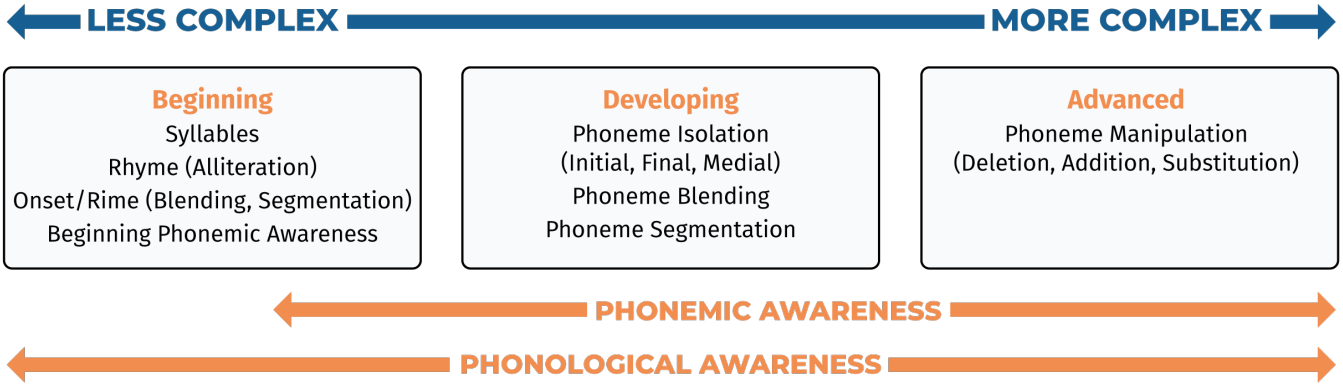

Figure 9: Developmental Overview—Phonological Awareness

The foundational importance of phonological awareness—and phonemic awareness, the subset of skills that involve phonemes, the smallest units of sound in spoken language—is clear (see Adams, 1990; National Reading Panel, 2000; National Early Literacy Panel, 2008; Kilpatrick, 2015; Foorman et al., 2016). English is an alphabetic system in which speech sounds are represented by letters. To break the reading code, children must be able to hear units of sounds within speech and connect these sounds with the letters that represent them. "Just as proteins must first be broken down into their underlying amino acids before they can be digested, words must first be broken down into their underlying phonemes before they can be processed by the language system" (Shaywitz & Shaywitz, 2020, p. 42). Studies have shown that even for high school students, phonemic awareness is the best predictor of students' ability to identify words quickly and accurately (Shaywitz & Shaywitz, 2020).

Because oral language is experienced as a continuous stream of speech, breaking it into smaller units of sound is not intuitive—these skills must be taught explicitly to support the development of literacy. The challenge is significant. Phonemes overlap in speech, and individual sounds can be altered slightly by the sounds that come before and after them (Castles et al., 2018; Willingham, 2017; Moats, 2010). Solid phonological awareness skills are a critical support on the path to proficient reading. Many older readers who struggle can benefit from foundational instruction in phonological awareness (Kilpatrick, 2015).

PHONICS

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- Waterford.org Phonics Fact Sheet
- Examples of Waterford.org Phonics Activities
- How to Teach Phonics and Decoding Skills

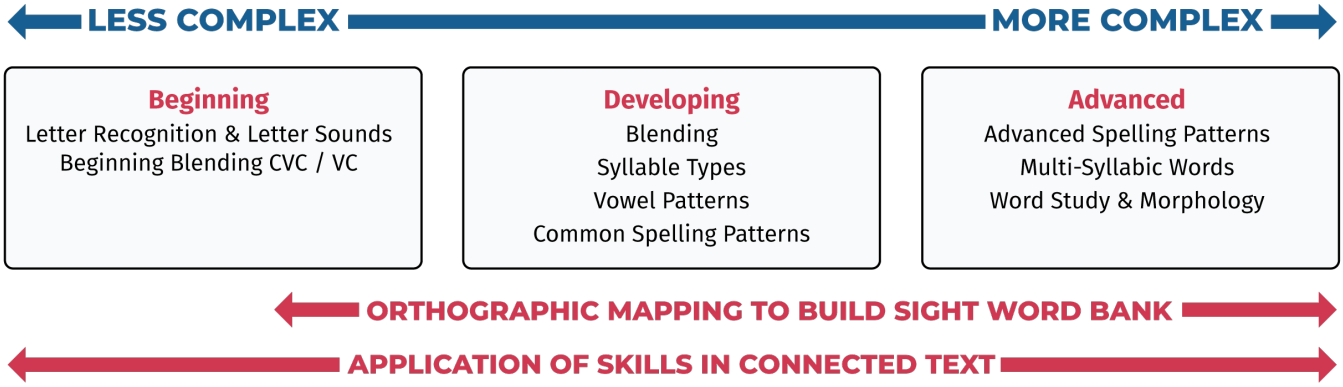

Figure 10: Developmental Overview—Phonics

"Phonics is crucial because it gives children the skills to translate orthography into phonology" (Castles et al., 2018, p. 15). Early phonics instruction focuses on alphabet knowledge, the development of automatic letter recognition, and the understanding of basic letter-sound correspondences. Alphabet knowledge was identified by the National Early Literacy Panel as a key predictor of later reading outcomes (2008). To make sense of alphabet knowledge, students must understand the underlying alphabetic principle—the idea that speech sounds are represented by letters in systematic and predictable ways. This principle is not intuitive; most children do not discover it independently (Willingham, 2017). Beginning readers must be taught "how to relate a new code, written script, to an existing code, spoken language" (Seidenberg, 2014, p. 331).

As soon as they know several letter-sound correspondences, students can begin to blend sounds to decode words. Word-building practice should be an integral part of instruction as students acquire knowledge of simple and complex phonics patterns, syllable types, and rules for syllable division. Throughout, students need frequent opportunities to apply and reinforce their learning by reading decodable texts.

Because readers do not process words as whole visual units but instead process all the information represented by individual letters (Adams, 1990), explicit and systematic phonics instruction is central to learning to read. Although English orthography is complex, Solity and Vousden (2009) reported that knowledge of the 64 most common letter-sound correspondences, along with the ability to identify approximately 100 of the most common words, enables young readers to identify 90% of words they tend to see in texts.

FLUENCY

- Waterford.org Fluency Fact Sheet
- Examples of Waterford.org Fluency Activities
- Build Reading Fluency with Research-Based Strategies

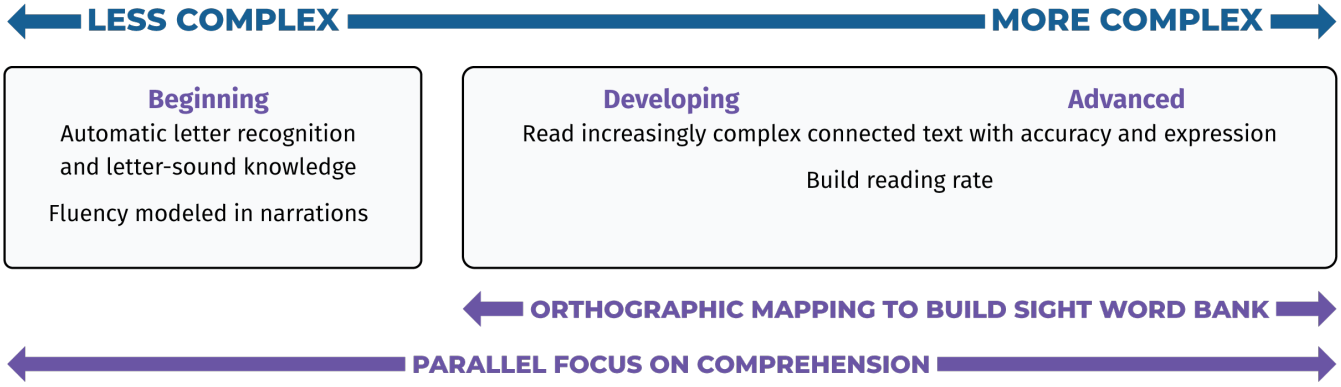

Figure 11: Developmental Overview—Fluency

Proficient readers perceive words in 1/20th of a second and can read at a rate of 150–250 words per minute (Kilpatrick, 2015). This level of fluency is possible only when students have developed a large bank of sight words—words that can be recognized instantly—without the need to decode. Words are added to a student's sight-word bank through the process of orthographic mapping, transforming words from unfamiliar to instantly accessible. Once a word is mapped, its spelling, pronunciation, and meaning are bonded together and anchored in long-term memory. With more information stored in long-term memory, the cognitive load on short-term memory is decreased, allowing a fluent reader to focus on the *meanings* of texts. Reading fluency supports reading comprehension (National Reading Panel, 2000).

A growing body of research (see Share, 1999; Share, 2004; Kilpatrick, 2015) shows that when typically developing readers become reasonably proficient at mapping words, they begin to self-teach. Through repeated exposure to a given word, mapping occurs naturally. Orthographic knowledge related to that word is then available for future encounters with the word and similar words, decreasing the student's reliance on decoding (Castles et al., 2018). Because multiple exposures to words build fluency, asking students to engage in repeated reading of appropriately challenging texts is an effective way to support the word mapping process and the development of a large bank of sight words.

The mapping process works equally well for regularly and irregularly spelled words. New words are typically added to the sight-word bank after one to four exposures. For irregularly spelled words, just one to two extra exposures are needed for typical readers. The brain makes mapping "adjustments" to account for irregularities in letter-sound correspondences.

COMPREHENSION & VOCABULARY

COMPREHENSION & VOCABULARY

- Waterford.org Comprehension & Vocabulary Fact Sheet
- Examples of Waterford.org Comprehension & Vocabulary Activities
- Reading Comprehension Strategies Informed by the Science of Reading

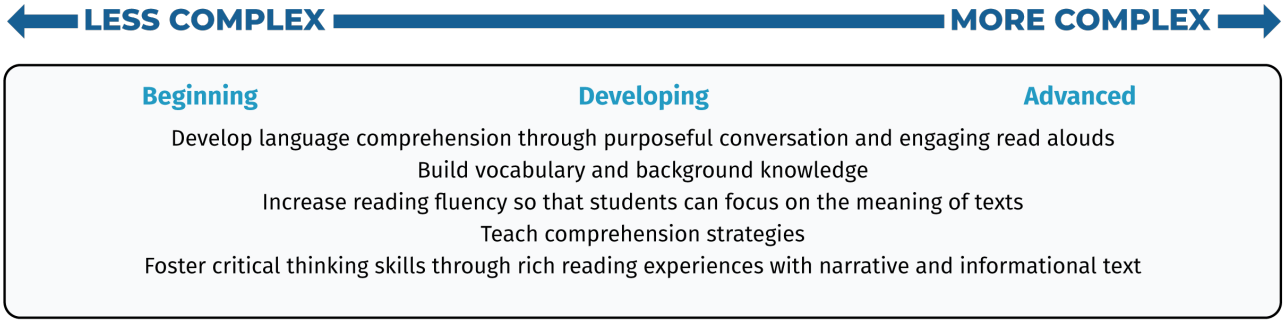

Figure 12: Developmental Overview—Comprehension & Vocabulary

Although some controversy surrounds studies on the issue, the "word gap" describes a disparity between exposure to oral language in the early years of life for children from language-rich home environments as compared with some of their peers (Golinkoff et al., 2019; Sperry et al., 2019; Hart & Risley, 1995). This disparity creates both a vocabulary gap and a background knowledge gap (Snow, 2017). Vocabulary knowledge and background knowledge are closely linked, and they are both key contributing factors for reading comprehension (Adams, 1990; Scarborough, 2001). The issue of early oral language exposure is complex. In addition, the quality of young children's language experience matters as much or more than the quantity (Snow, 2017; Seidenberg & MacDonald, 2018).

To build vocabulary and background knowledge in the classroom, experts recommend combining content instruction and reading instruction (Cabell & Hwang, 2020; Petscher et al., 2020). Content knowledge supports the ability to make inferences, a key component of reading comprehension (Cabell & Hwang, 2020).

Vocabulary instruction should focus on academic vocabulary and "tier 2" words, those words that are commonly seen in narrative and informational texts but whose meanings may not be part of students' oral vocabularies (Beck et al., 2002). New words should be introduced with student-friendly definitions, experienced in multiple contexts, and learned through repeated exposures (Beck et al., 2002). Morphology instruction creates bridges between meaning and spelling (Castles et al., 2018) and supports reading comprehension (Kilpatrick, 2015; Kirby et al., 2012).

Importantly, comprehension instruction should happen in the context of purposeful reading of high-quality, authentic texts.

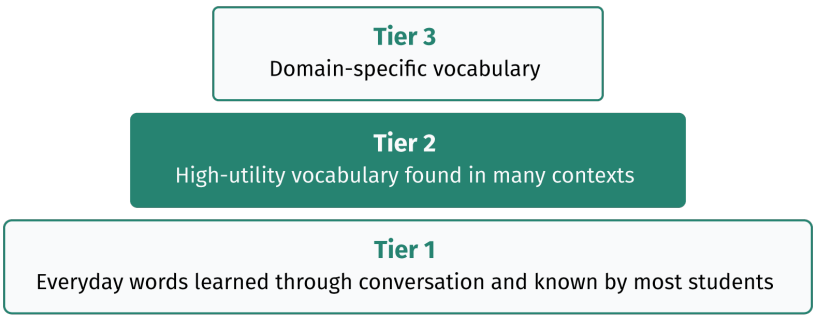

Figure 13: Tier 2 Focus for Vocabulary Instruction (Based on Beck et al., 2002)

LANGUAGE CONCEPTS

- Waterford.org Language Concepts Fact Sheet
- Examples of Waterford.org Language Concepts Activities
- How to Teach Language Concepts Skills

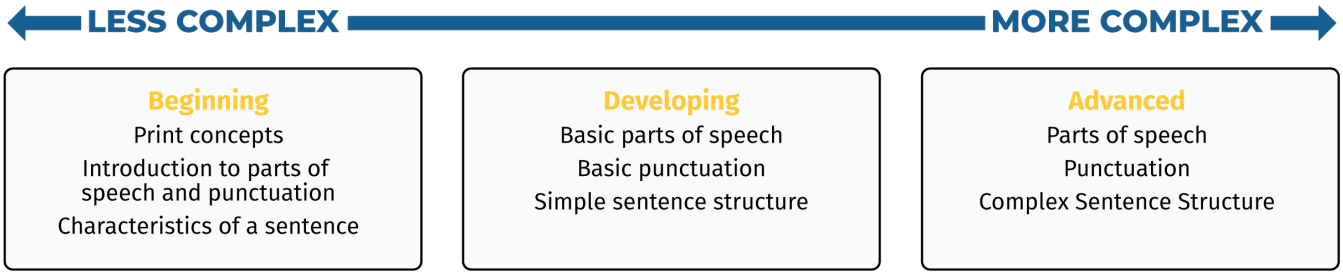

Figure 14: Developmental Overview—Language Concepts

The language concepts strand helps students understand how written language is organized and is roughly aligned with the literary knowledge and language structures strands of the Reading Rope.

As part of a strong foundation for learning to read, students must develop print awareness (Adams, 1990). Through experience with print, its nature and uses are revealed to young learners. They see how written language corresponds to spoken language and that readers follow print from left to right. They learn that spaces separate words and begin to understand how punctuation separates ideas. They become familiar with a variety of genres and types of text. They discover many purposes for reading.

Later, students learn to encode or spell according to the conventions of English orthography. This happens in parallel with the decoding instruction they experience in the phonics strand. In the words of Linnea Ehri, spelling and reading are "mutually facilitative and reciprocal" (2000, p. 34). There is also a clear overlap here with the fluency strand—decoding and encoding are both part of the orthographic mapping process that supports the development of a large sight-word bank.

As developing readers, students build knowledge of grammar, including knowledge about how sentences are constructed and how to identify parts of speech. Research shows that an understanding of grammar supports reading comprehension (Silva & Cain, 2015).

COMMUNICATION

COMMUNICATION

- Waterford.org Communication Fact Sheet
- Examples of Waterford.org Communication Activities
- Teach Communication Skills with the Science of Reading as Your Guide

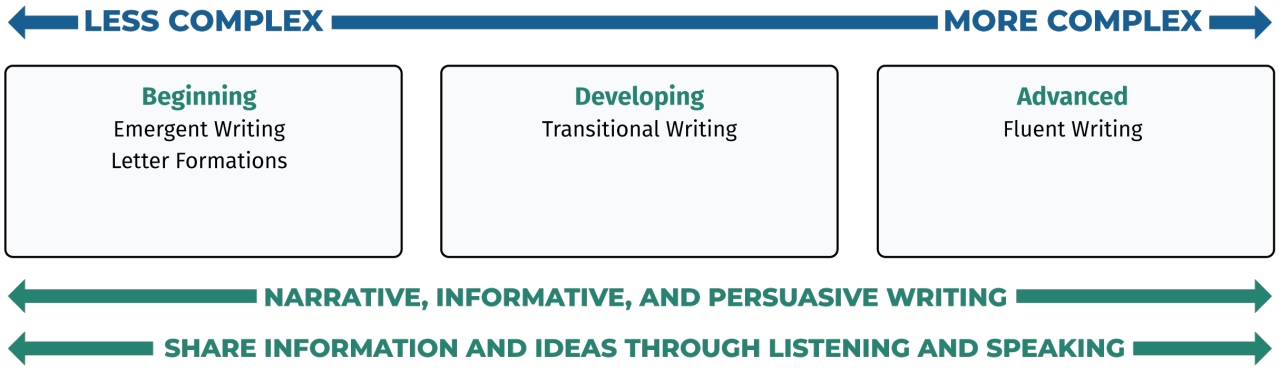

Figure 15: Developmental Overview—Communication

The National Literacy Trust defines literacy as "the ability to read, write, speak and listen in a way that lets us communicate effectively and make sense of the world." Waterford's Communication strand focuses on the convergence of the four domains of language—reading, writing, speaking, and listening. Proficiency in these domains enables students to receive information (through reading and listening) and share information (through writing and speaking). Below are some observations about how speaking, listening, and writing relate to each other and to the development of skilled reading.

Speaking

Early oral language skills are a strong predictor of later outcomes related to reading comprehension (e.g., Hart & Risley, 1995; National Early Literacy Panel, 2008). Students need oral communication experiences in which "language is linked to content, in which knowledge structures are built and elaborated and in which, because they get answers to the questions they pose, children become increasingly curious" (Snow, 2017). Extensive oral language experience builds verbal reasoning, one of the strands in Scarborough's Rope (2001), and supports students' ability to make inferences. The relationship between oral language and reading is reciprocal. Oral language skills play a role in learning to read, and reading plays a role in the development of oral language skills (Seidenberg, 2014).

Listening

Listening is the mirror of speaking. Together, listening and speaking create meaningful conversation. The connection between listening comprehension and reading comprehension is clear (Hogan et al., 2014). Read-aloud experiences provide students with opportunities to build their listening and comprehension skills and act as models for fluent reading.

Writing

The National Early Literacy Panel identified "the ability to write letters in isolation on request or to write one's own name" as an early literacy skill that is predictive of later reading outcomes (National Early Literacy Panel, 2008). Dehaene explains that "teaching the gestures of writing can improve reading, perhaps because it helps store view-specific memories of the letters and their corresponding phonemes" (2011, p. 28). Transcription skills are essential for the development of writing fluency, which allows students to focus on ideation (Berninger & Amtmann, 2003).

Studies show that reading and writing require many of the same cognitive processes and types of knowledge (Shanahan, 2016). Good readers tend to be better writers, and good writers tend to be better readers.

TOWARD UNIVERSAL LITERACY

Cognitive scientist Mark Seidenberg observes that "there is remarkable consensus about the basic theory of how reading works and the causes of reading successes and failures" (2014, p. 332). This consensus among experts in brain science and education research provides a solid foundation on which we must build effective instruction. We know what happens inside the brains of developing and proficient readers. We understand the processes and skills required for automatic and strategic reading. We have identified the types of instruction that are most effective. Universal literacy is necessitated by today's society, and it is within reach.

BIBLIOGRAPHY

Adams, M.J. (1990). Beginning to read: Thinking and learning about print. Cambridge, MA: MIT Press.

Archer, A. L., & Hughes, C. A. (2011). Explicit instruction: Effective and efficient teaching. New York, NY: Guilford Press.

Beck, I. L., McKeown, M. G., & Kucan, L. (2002). Bringing words to life: Robust vocabulary instruction. New York, NY: Guilford Publications.

Berninger V. & Amtmann D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In: Swanson H, Harris K, Graham S, editors. *Handbook of Learning Disabilities.* New York: The Guilford Press.

Cabell, S.Q., & Hwang, H. (2020). Building content knowledge to boost comprehension in the primary grades. Reading Research Quarterly, 55 (Suppl. 1).

Castles, A., Rastle, K., & Nation, K. (2018, January 11). Ending the reading wars: reading acquisition from novice to expert. Psychological Science in the Public Interest, 19, 5-51.

Chall, J. S. (1967). Learning to read: The great debate. New York: McGraw-Hill.

Chall, J. S. (1983). The stages of reading development. New York: McGraw-Hill.

Chiang, H., Walsh, E., Shanahan, T., Gentile, C., Maccarone, A., Waits, T., Carlson, B., & Rikoon, S. (2017). An exploration of instructional practices that foster language development and comprehension: Evidence from prekindergarten through grade 3 in title I schools (NCEE 2017-4024). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

Cutting, L. E., Materek, A., Cole, C., Levine, T. M., & Mahone, E. M. (2009). Effects of fluency, oral language, and executive function on reading comprehension performance. Annals of Dyslexia, 59, 34-54.

Dehaene, S. (2009). Reading in the brain. New York, NY: Penguin Viking.

Dehaene, S. (2011). The massive impact of literacy on the brain and its consequences for education. Human Neuroplasticity and Education, 117, 19–32, 237–238. Retrieved from https://www.semanticscholar.org/paper/The-Massive-Impact-of-Literacy-on-the-Brain-and-its Dehaene/cff456fd014295ce33eec5692e24b832f9d1e7bd

Ecalle, J., Dujardin, E., Gomes, C., Cros, L., & Magnan, A. (2021). Decoding, fluency and reading comprehension: Examining the nature of their relationships in a large scale study with first graders. Reading and Writing Quarterly, 37(5), 444-461.

Ehri, L. C. (2000). Learning to read and learning to spell: Two sides of a coin. Topics in Learning Disorders, 20, 19– 49.

Ehri, L. C. (2005). Learning to read words: Theory, findings, and issues. Scientific Studies of Reading, 9, 167–188.

Foorman, B., Coyne, M., Denton, C., Dimino, J., Hayes, L., Justice, L., Lewis, W., Wagner, R. (2019). Foundational skills to support reading for understanding in kindergarten through 3rd grade. Retrieved from Institute of Education Sciences: What Works Clearinghouse: https://ies.ed.gov/ncee/wwc/practiceguide/21

Foulin, J. N. (2005). Why is letter-name knowledge such a good predictor of learning to read? Reading and Writing, 18, 129-155.

Frith, U. (1985). Beneath the surface of developmental dyslexia. In K. Patterson, J. Marshall, & M. Coltheart (Eds.), Surface dyslexia: Neurological and cognitive studies of phonological reading (pp. 301- 330). Hillsdale, NJ: Lawrence Erlbaum.

Golinkoff, R.M., Hoff, E., Rowe, M.L., Tamis-LeMonda, C.S., Hirsh-Pasek, K. (2019). Language matters: Denying the existence of the 30-million-word gap has serious consequences. Child Development, 90(3), 985-992.

Gough, P. B. & Tunmer, W. E. (1986). Decoding, reading, and reading disability. Remedial and Special Education, 7, 6-10. http://dx.doi.org/10.1177/074193258600700104

Graham, S., Liu, X., Aitken, A., Ng, C., Bartlett, B., Harris, K., & Holzapfel, J. (2017). Effectiveness of literacy programs balancing reading and writing instruction: A meta-analysis. Reading Research Quarterly, 53(3), 279-304.

Hart, B. & Risley, T. (1995). Meaningful differences in the everyday lives of American children. Baltimore, MD: Brookes Publishing.

Hebert, M., Bohaty, J. J., Nelson, J. R., & Brown, J. (2016). The effects of text structure instruction on expository reading comprehension: a meta-analysis. Journal of Educational Psychology, 108(5), 609–629.

Hjetland, H. N., Brinchmann, E. I., Scherer, R., Hulme, C., & Melby-Lervåg, M. (2020). Preschool pathways to reading comprehension: A systematic meta-analytic review. Educational Research Review, 30, Article 100323.

Hogan, T. P., Adlof, S. M., & Alonzo, C. N. (2014). On the importance of listening comprehension. International Journal of Speech-Language Pathology, 16(3), 19.

HyeJin Hwang, Sonia Q. Cabell & Rachel E. Joyner (2023) Does cultivating content knowledge during literacy instruction support vocabulary and comprehension in the elementary school years? A systematic review. Reading Psychology, 44:2, 145-174, DOI: 10.1080/02702711.2022.2141397

Kilpatrick, D. A. (2015). Essentials of assessing, preventing, and overcoming reading difficulties. Hoboken, NJ: John Wiley & Sons.

Kirby, J. R., Deacon, S. H., Bowers, P. N., Izenberg, L., Wade-Woolley, L., & Parrila, R. (2012). Children's morphological awareness and reading ability. Reading and Writing, 25(2), 389–410.

Lonigan, C.J., Burgess, S.R., & Schatschneider, C. (2018). Examining the simple view of reading with elementary school children: Still simple after all these years. Remedial and Special Education, 39(5), 260–273. https://doi.org/10.1177/0741932518764833

Lyon, G. R. (1998). Why reading is not a natural process. Educational Leadership, 55(6), 14-18.

McArthur, G., Castles, A., Kohnen, S., Larsen, L., Jones, K., Anandakumar, T., & Banales, E. (2015). Sight word and phonics training in children with dyslexia. Journal of Learning Disabilities, 48(4), 391–407.

Moats, L.C. (2010). Speech to print: Language essentials for teachers. Baltimore, MD: Brookes Publishing.

Moats, L. C. (2017). Can prevailing approaches to reading instruction accomplish the goals of RTI? Perspectives on Language and Literacy, 43, 15–22.

National Early Literacy Panel. (2008). Developing early literacy: Report of the National Early Literacy Panel. Washington, DC: National Institute for Literacy.

National Literacy Trust. What is literacy? Retrieved from https://literacytrust.org.uk/information/what-is-literacy/

National Reading Panel. (2000). Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction (NIH Publication No. 00-4769). National Institute of Child Health & Development. Retrieved from https://www1.nichd.nih.gov/publications/pubs/nrp/Documents/report.pdf

National Research Council. (1998). Preventing reading difficulties in young children. Washington, DC: The National Academies Press.

Perfetti, C. A. (2007). Reading ability: Lexical quality to comprehension. Scientific Studies of Reading, 11, 357–383. doi:10.1080/10888430701530730

Petscher, Y., Cabel, S., Catts, H.W., Compton, D.L., Foorman, B.R., Hart, S.A., Lonigan, C.J., Phillips, B.M., Schatschneider, C., Steacy, L., Terry, N.P., & Wagner, R.K. (2020). How the science of reading informs 21st-century education. The Reading Teacher, (55)S1, S267-S282. doi: 10.1002/rrq.352

Scarborough, H. S. (2001). Connecting early language and literacy to later reading (dis)abilities: Evidence, theory, and practice. In S. Neuman & D. Dickinson (Eds.), Handbook for research in early literacy (pp. 97–110). New York, NY: Guilford Press.

Seidenberg, M. (2014). The science of reading and its educational implications. Language Learning and Development, 9(4), 331-360.

Seidenberg, M. (2017). Language at the speed of sight: how we read, why so many can't, and what can be done about it. New York, NY: Basic Books.

Seidenberg, M. & MacDonald, M. (2018). The impact of language experience on language and reading. Topics in Language Disorders (38)1, 66-83.

Shanahan, T., Callison, K., Carriere, C., Duke, N. K., Pearson, P. D., Schatschneider, C., & Torgesen, J. (2010). Improving reading comprehension in kindergarten through 3rd grade: A practice guide (NCEE 2010-4038). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education.

Share, D. L. (1999). Phonological recoding and orthographic learning: A direct test of the self-teaching hypothesis. Journal of Experimental Child Psychology, 72, 95–129. doi:10.1006/jecp.1998.2481

Share, D. L. (2004). Orthographic learning at a glance: On the time course and developmental onset of self teaching. Journal of Experimental Child Psychology, 87, 267–298. doi:10.1016/j.jecp.2004.01.001

Shaywitz, S. & Shaywitz, J. (2020). Overcoming dyslexia. New York, NY: Alfred A. Knopf.

Shanahan, T. (2016). Relationships between reading and writing development. In C.A. McArthur, S. Graham, & J. Fitzgerald (Eds.), Handbook of writing research. The Guilford Press.

Silva, M. & Cain, K. (2015). The relations between lower and high level comprehension skills and their role in prediction of early reading comprehension. Journal of Educational Psychology, 107(2), 321-331.

Snow, C. E. (2017). The role of vocabulary versus knowledge on children's language learning: A fifty-year perspective. Journal for the Study of Education and Development, 40, 1–18.

Spear-Swerling, L. (2018). Structured literacy and typical literacy practices: Understanding differences to create instructional opportunities. Teaching Exceptional Children, 20(10), 1-11.

Sperry, D.E., Sperry, L.L., & Miller, P.J. (2019). Reexamining verbal environments of children from different socioeconomic backgrounds. Child Development, 90(4), 1303-1318.

Stanovich, K. E., & West, R. F. (1989). Exposure to print and orthographic processing. Reading Research Quarterly, 24, 402–433. doi:10.2307/747605

Steacy, L. M., Wade-Woolley, L., Rueckl, J. G., Pugh, K. R., Elliott, J. D., & Compton, D. L. (2019). The role of set for variability in irregular word reading: Word and child predictors in typically developing readers and students at-risk for reading disabilities. Scientific Studies of Reading, 23(6), 523–532. https://doi.org/10.1080/10888438.2019.1620749

The Nation's Report Card. (2022). National achievement-level results. Retrieved from NAEP Reading Report Card: https://www.nationsreportcard.gov/highlights/reading/2022/

Tunmer, W. E., & Chapman, J. W. (2012). Does set for variability mediate the influence of vocabulary knowledge on the development of word recognition skills? Scientific Studies of Reading, 16, 122–140. doi:10.1080/10888438.2010.542527

Willingham, D.T. (2017). The reading mind: A cognitive approach to understanding how the mind reads. John Wiley & Sons.

Wolf, M. (2007). Proust and the squid: The story and science of the reading brain. New York, NY: Harper Collins.

World Literacy Foundation. (2015). The economic and social cost of illiteracy: A snapshot of illiteracy in a global context. Retrieved from https://worldliteracyfoundation.org/wp-content/uploads/2022/08/The-Economic-Social-Cost-of-Illiteracy-2022.pdf

Wright, T. S., & Cervetti, G. N. (2017). A systematic review of the research on vocabulary instruction that impacts text comprehension. Reading Research Quarterly, 52(2), 203– 226.