

# The Science of Reading

What Research Says About Effective Instruction

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# Introduction

As the world's largest publisher and distributor of children's books, Scholastic has an unwavering commitment to children learning and loving to read. Scholastic believes research and evidence-based practices should inform reading instruction.

Reading is a powerful tool. When reading is enjoyable, children grow in their understanding of the world, their ability to imagine, and their confidence in themselves. Reading is also a critical skill necessary to successfully function in society, as strong literacy skills positively impact academic achievement, socio-economic status, citizen participation, and health outcomes.

The process of learning to read begins early in children's education, with formalized reading instruction commonly starting in prekindergarten. In early elementary school, it is important that young children receive high-quality instruction in learning the alphabet, phonics, decoding, and language comprehension. Yet data show that only 35 percent of U.S. fourth-grade students score as proficient on the National Assessment of Education Progress Reading Assessment (National Center for Education Statistics [NCES], 2019), putting them at risk for learning losses not only in literacy but also in science, social studies, and mathematics. These striving readers may include children with reading disabilities and multilingual learners, who all have unique reading needs and require more tailored support to reach their reading potential.

Children who have not yet mastered the skills for successful reading are at risk for academic underachievement (Lesnick et al., 2010), and they are less likely to experience the delight and satisfaction that comes with reading for pleasure. Fortunately, decades of research on education, psychology, and human development have identified the skills necessary for successful reading and the ways those skills can be taught through explicit instruction.

This report draws on a range of research and evidence to summarize the development of foundational reading skills and best practices in reading instruction from prekindergarten through Grade 3. Through this report, we seek to enhance understanding of the Science of Reading and support educators and caregivers as they foster the next generation of young readers.

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# The Science of Reading

What skills are important for learning to read? When do these skills develop? How should they be taught? These questions have been asked and rigorously studied by scientists for decades. This research on reading development and reading instruction is part of a body of knowledge referred to as *the Science of Reading* (Petscher et al., 2020).

## Learning to Read vs. Learning to Talk

One of the earliest debates related to the Science of Reading addressed whether reading was an innate ability or a learned ability: Can children learn to read without explicit instruction? This debate has often involved comparing a child's development of reading skills to the development of oral language.

### **The brain is wired to develop oral language naturally**

Children are born with brains that are ready for and receptive to learning oral language. In a typical environment where children are exposed to speech, they will automatically acquire the ability to speak without being taught explicitly (e.g., Eimas, 1985). By about age six, children can typically pronounce all speech sounds correctly, speak in detailed sentences, and use correct grammar (American Speech-Language-Hearing Association [ASHA], n.d.b).

### **The brain must be taught to read**

Unlike with oral language, Science of Reading research indicates that the brain is not hardwired from the start for reading. The brain has one region that processes language stimuli and another region that processes visual stimuli. In order to read successfully, a child's brain has to connect these two regions so the child can integrate sound (the language stimuli) and print information (the visual stimuli). Brain imaging studies show that children are not born with these two regions of the brain acting in connection with each other. Rather, children's brains build this connection only as they are taught to read. In addition, children who learn to read also develop their brains' ability to automatically recognize words from sight (Hruby & Goswami, 2011; Shaywitz & Shaywitz, 2008).

Because of all those connections in the brain that need to be developed, reading skills require more time, effort, and instruction than oral language abilities. Children often begin to read when they enter formal schooling, then take several more years before they become proficient readers (ASHA, n.d.a; ASHA, n.d.b).

# Models of Reading Development

So what skills need to be learned in order to read? Researchers have proposed several models of how reading skills can be developed, including the Simple View of Reading, the Reading Rope, and the Active Model of Reading. This section provides an overview of these models and defines the key reading skills identified in them. The section that follows then describes some of the best ways to teach these skills.

## The Simple View of Reading

One of the most influential models of reading development is called the Simple View of Reading (Gough & Tunmer, 1986). As shown in Figure 1, the Simple View suggests that reading involves recognizing words in text (*word recognition*) and understanding language (*language comprehension*) (Gough & Tunmer, 1986; Hoover & Tunmer, 2020). According to the Simple View, successful reading comprehension happens when a child can accurately read words and interpret meaning from what they read.

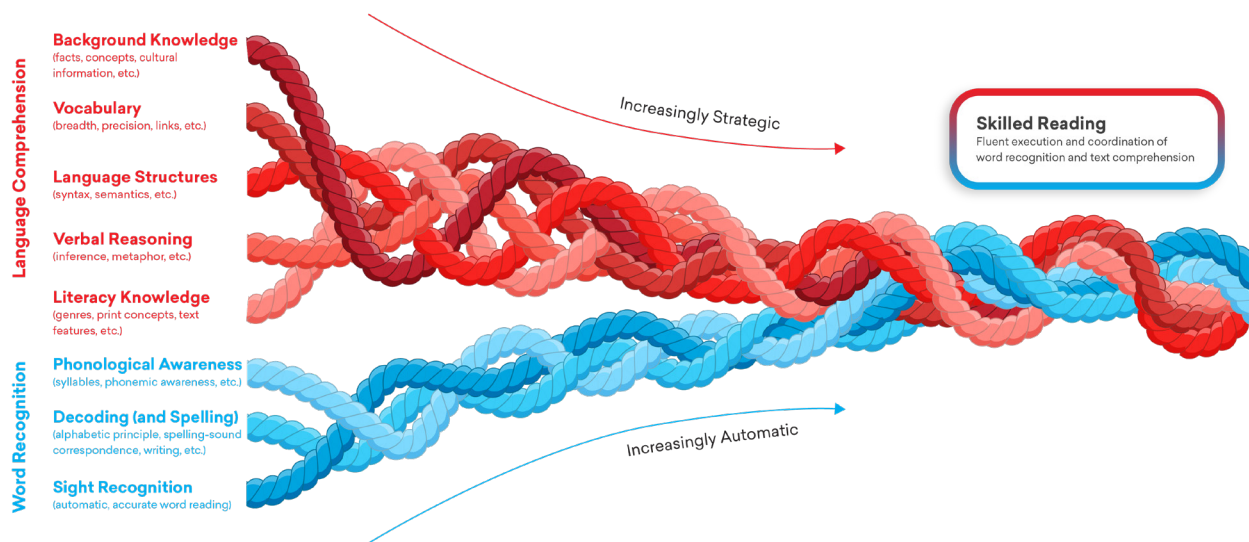
**Figure 1. The Simple View of Reading**



## The Reading Rope

The Reading Rope identifies several processes related to word recognition and language comprehension and explains how these processes become increasingly interwoven, like a rope, over time (Scarborough, 2001). As shown in Figure 2, the rope consists of lower strands and upper strands that weave together. Phonological awareness, decoding, and sight word reading (here referred to as *sight recognition*) are the lower strands of the rope, which weave together to develop effective word recognition. Background knowledge, vocabulary, language structures, verbal reasoning, and literacy knowledge make up the upper strands of the rope that together enable effective language comprehension. The Reading Rope emphasizes that these upper and lower strands develop concurrently and, with time, instruction, and practice, join together and strengthen one another, resulting in skilled reading.

Figure 2. The Reading Rope



Source: Scarborough, 2001.

## Word recognition

The word recognition strands (the lower strands in Figure 2) in the Rope Model are phonological awareness, decoding, and sight recognition. *Phonological awareness* is especially important for learning to read. It is the understanding that the words we hear can be broken down into smaller speech sounds. When children enter kindergarten, they may have an emerging understanding of the speech sounds in spoken words. For example, many preschoolers can recognize words that rhyme and words that share the same onset sounds (Bradley & Bryant, 1983; Carroll & Snowling, 2001). Yet, their knowledge is only partial—during kindergarten, children need high-quality instruction on phonemic awareness to learn how to recognize individual speech sounds, or phonemes, and how to articulate them. Over time and with instruction, children should be able to identify phonemes in words and gain increasing skills to isolate, blend, and segment phonemes. By the end of kindergarten, typically developing children can often recognize phonemes in short words (ASHA, n.d.b).

Phonological awareness lays the foundation for learning phonics, or the correspondence between speech sounds and letters in written words. Over the course of children’s literacy education, children increasingly build skills to *decode*—or sound out—written words. With time, they learn to automatically read familiar words without sounding them out. This *sight recognition* of familiar words helps children become quick and accurate readers.

## Language comprehension

The language comprehension strand of the Rope Model consists of background knowledge, vocabulary, language structures, verbal reasoning, and literacy knowledge. *Comprehension*, or interpreting meaning from text, is the ultimate goal of reading. In addition to the word recognition skills mentioned on the previous page, strong reading comprehension requires knowledge of *language structures*, particularly the rules of grammar that guide formal writing (Cain, 2010; Shanahan et al., 2010a). *Vocabulary* development is the process of acquiring new words. Although most children entering kindergarten can speak in full and detailed sentences, their oral language vocabularies continue to grow through exposure to language in the classroom. In fact, children learn at least 2,000 new words per year in kindergarten through third grade (Nagy & Scott, J., 2000). *Verbal reasoning* refers to the child's ability to move beyond the literal meaning of text. Examples of verbal reasoning include using figurative language, metaphors/ analogies, and inferences (Cain, 2010). Children increasingly build their verbal reasoning through explicit instruction and by having teachers model relevant skills (Shanahan et al., 2010b). Through exposure to more texts, writing styles, and genres, children also increase their *literacy knowledge*, which strengthens their reading comprehension ability (Scarborough, 2001).

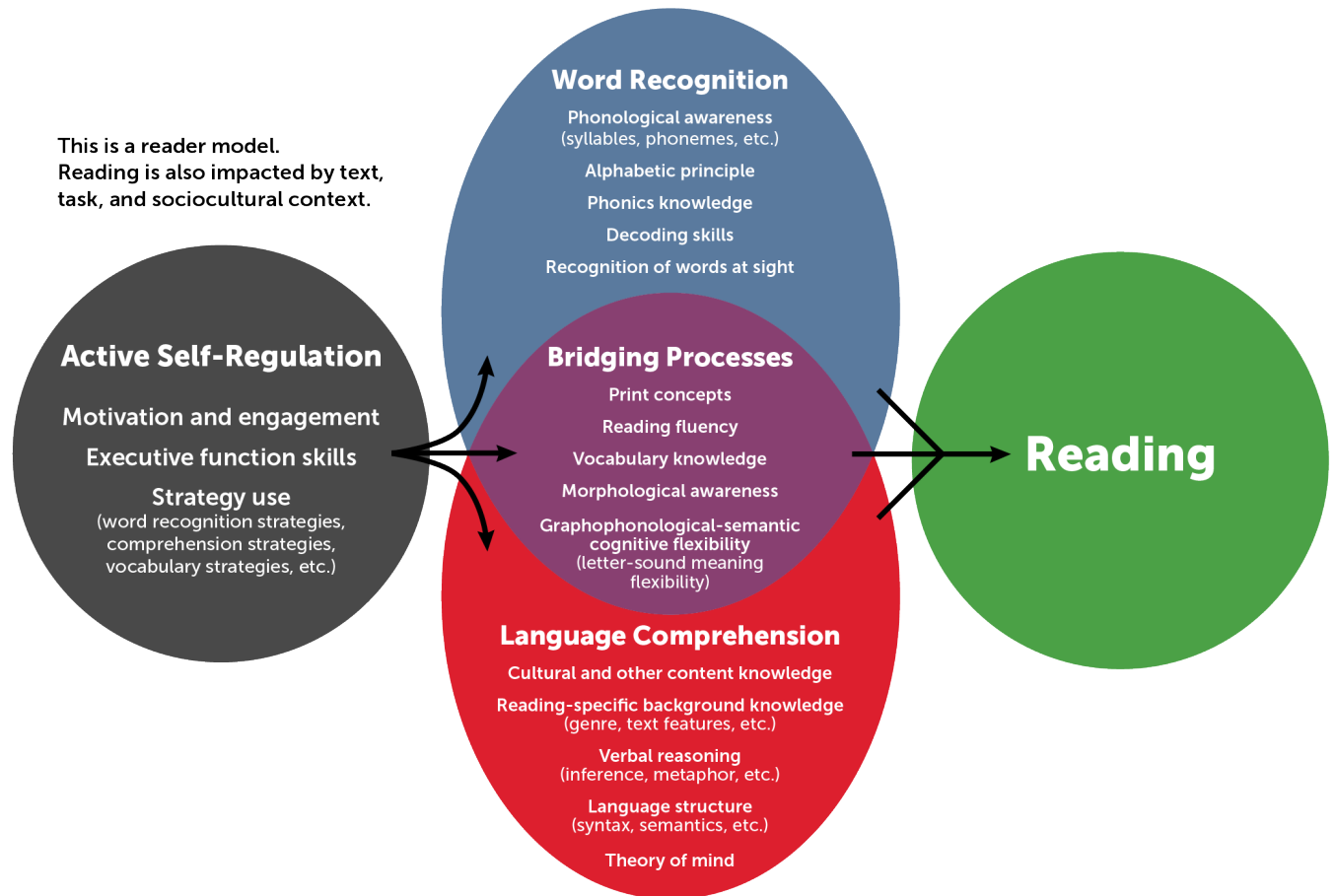
## The Active Model of Reading

Building upon the interconnected nature of the Rope Model, more recent scientific findings further demonstrate that **word recognition** and **language comprehension** are often interwoven, even in young readers (Duke & Cartwright, 2021). While some processes may be unique contributors to word recognition and others to language comprehension, there are many processes that are important to the development of *both* skills. These **bridging processes** that overlap between word recognition and language comprehension have been shown to be stronger predictors of reading ability than either component alone (Cutting & Scarborough, 2006; Lonigan et al., 2018).

Building upon prior models, the Active Model also identifies additional processes that are necessary for language comprehension. These additional processes include children's knowledge built through engagement in their school and their cultural group (*cultural and other content knowledge*), as well as their knowledge about content-relevant information (*reading-specific background knowledge*). Children's *theory of mind*, or his or her ability to understand their own and others' mental states (e.g., characters' thoughts and feelings), also enhances their comprehension of text.



**Figure 3. The Active Model of Reading**



As illustrated in Figure 3, the Active Model of Reading (Duke & Cartwright, 2021) incorporates the latest research findings from the fields of education and psychology to explain the interactive and interdependent relations between word recognition and language comprehension. The Active Model also emphasizes the “bridging processes” that account for the overlap between word recognition and language comprehension.

Source: Duke & Cartwright, 2021

### **Bridging processes**

Looking at the bridging processes, we can see that a successful reader must understand that print conveys a message (*print concepts*), be able to interpret the smallest units of meaning in words (*morphological awareness*), read with speed and accuracy (*fluency*), have a strong *vocabulary*, and be able to simultaneously process the sound and language information contained in words (*graphophonological-semantic cognitive flexibility*). In this model, vocabulary also has an important connection to word recognition because the child must know the meaning of words in order to recognize them in print (Mitchell & Brady, 2013).

## Active self-regulation

One of the seminal features of the Active Model is its emphasis on broad learning skills (referred to in this model as *active self-regulation*), in addition to reading-specific skills, that are crucial for effective reading. Prior studies have found that approximately 10 to 30 percent of children in their samples who have grade-level decoding and listening comprehension abilities *still* have difficulties comprehending text (Catts et al., 2003; Catts et al., 2005; Ebert & Scott, 2016; Aaron et al., 1999; Morris et al., 2017). So why do children who have the necessary reading-specific skills still struggle? It may be because reading is an effortful task that requires sustained *motivation* and *engagement*. Reading also requires strong *executive function*, or higher-order thinking skills, to plan and execute behaviors that serve the goal of reading, such as good *strategy use*. Without these important self-regulatory skills, children will face barriers to reaching their reading potential. Thus, the Active Model encourages educators to support the development of children’s self-regulation.

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# Pillars That Are Essential to Reading Instruction

With high-quality instruction, typically developing children can successfully build the core skills needed for successful reading over the course of K–3 education and beyond. But which reading skills need to be emphasized? And when?

For several decades, scientists have assessed the effectiveness of different approaches for teaching children to read, which has led to greater knowledge of best practices in reading instruction. Drawing from this research on reading instruction, the National Reading Panel (NRP) identified five components, which they refer to as pillars, that are essential to reading instruction: Phonemic Awareness, Phonics, Fluent Text Reading, Vocabulary, and Comprehension (National Institute of Child Health and Human Development [NICHD], 2000).

This section summarizes recommendations from researchers and educators on how to implement each NRP pillar in K–3 education. Additionally, given the importance of active self-regulation to reading (Duke & Cartwright, 2021), this section also outlines strategies for increasing students’ executive function skills and motivation and engagement.

# Phonemic Awareness

Phonemic awareness is the understanding that words can be broken down into smaller speech sounds. Teaching phonemic awareness involves helping students recognize and manipulate different speech sounds. Recommendations for phonemic awareness instruction include teaching children to identify words that begin with the same sounds and words that rhyme, having children practice assembling different speech sounds into words, and having children practice omitting or replacing specific speech sounds in words (NICHD, 2000; Shanahan et al., 2010a). Children who struggle with phonemic awareness will benefit from instruction on only a few specific tasks at a time (Brown et al., 2021), explicit instruction, and continued practice.

## Phonics

Phonics refers to the knowledge of the correspondence between letters and sounds. While instruction in phonemic awareness is auditory, instruction in phonics includes both auditory and visual components. Research indicates that phonics should be systematically and explicitly taught at an early age—before Grade 1 (Castles et al., 2018; NICHD, 2000). Phonics instruction includes teaching tasks such as identifying letters and their sounds, blending, and recognizing words (Castles et al., 2018; NICHD, 2000).

Preschool children may have partial phonics knowledge. For example, they may know some letters' names and corresponding speech sounds and recognize familiar sounds and letters at the beginnings or ends of words (Ehri, 2005). During kindergarten and Grade 1, children receiving phonics instruction will typically master the alphabetic principle, which includes learning the names of all letters of the alphabet and the common speech sounds they represent (Shanahan et al., 2010a). Providing children with letter tiles or magnetic letters that can be added or removed from words can help make phonics lessons more concrete and less abstract (Brown et al., 2021; Shanahan et al., 2010a). Finally, children who struggle with phonemic awareness will benefit from instruction on only a few specific tasks at a time (Brown et al., 2021).

An essential part of phonics education is teaching morphological awareness or recognizing the smallest units of meaningful speech. Throughout kindergarten to Grade 3, children will learn to recognize increasing numbers of morphemes and the letter combinations that represent them (Shanahan et al., 2010a). During these years, children will also learn to use their phonics knowledge to sound out, or decode, increasingly longer and unfamiliar words (Ehri, 2014). Children's decoding abilities become more and more fluid with time and practice. By the end of Grade 3, typically developing children who have received adequate instruction are likely proficient at decoding and can successfully read grade-level material with few mistakes (ASHA, n.d.a).

## Fluent Text Reading

One way for children to learn to read effectively is by listening to their teachers read text aloud. Once children have adequate word recognition skills, they can also follow along in a text as they listen to their teachers read aloud or to a corresponding audiotape. Providing children with opportunities to read aloud has been shown to improve their reading accuracy and speed, as well as their voice intonation and rhythm. Generally, by the second and third grades, children can practice reading text aloud, either with their class or with a partner. Repeated readings of text and direct feedback have also been shown to be beneficial to reading fluency in elementary school (Hudson et al., 2005; Rasinski, 2006).

## Vocabulary

Explicit instruction in vocabulary is also important for helping children learn to read. This instruction should include words that are not only important for communicating with others in everyday conversation but also essential to learning effectively in school. *Academic vocabulary* refers to words that are common in formal writing and classroom settings. Academic vocabulary often appears in instructions for assignments and includes words such as *define*, *compare*, or *select*. Children benefit when they are provided with clear and concise definitions for new academic vocabulary being introduced to them and are given examples of how to use these new words (Beck et al., 2013). Additionally, students benefit when they are taught content-specific vocabulary to help them understand new words they may encounter in literacy, science, social studies, and math texts.

Teachers can also enhance students' vocabularies by helping them draw connections between new words and known words and by connecting vocabulary to students' real-world experiences (Shanahan et al., 2010a). Ultimately, expanding children's vocabulary enables them to recognize more words in text and understand the words' meanings (Mitchell & Brady, 2013). Thus, vocabulary growth is important to both word recognition and reading comprehension (Duke & Cartwright, 2021).

## Comprehension

Children need to learn a wide array of strategies to comprehend text. Many of these skills can be taught through explicit instruction. Common strategies to enhance students' understanding of what they read include asking questions, retelling stories, and visualizing stories. Teachers are encouraged to model these strategies through guided class discussions on the reading material (Shanahan et al., 2010b). Additionally, students benefit from learning strategies that enhance their *verbal reasoning*, or their ability to go beyond literal interpretations of what is written. Drawing inferences is a key verbal reasoning skill (Cain, 2010; Shanahan et al., 2010b). It is recommended that teachers help children draw information from key words in the text and from their own experiences to make better inferences when reading (Shanahan et al., 2010b).

It is also important to teach strategies for comprehension monitoring. To be successful readers, children must routinely check whether they understand what they read. When something does not make sense, they can take action by rereading text and asking questions (Cain, 2010; Shanahan et al., 2010b). Ultimately, it is crucial that children receive explicit instruction in reading comprehension over the course of K–3 education (Shanahan et al., 2010b), as children’s comprehension strategies in Grade 3 predict later reading comprehension ability (Oakhill & Cain, 2012).

The knowledge that a child brings to the task of reading also plays a vital role in reading comprehension. When children already know information about a specific topic, they use better comprehension strategies and remember more of what they read (Cain, 2010; Moats, 2020). Through class discussions, scaffolded reading materials, and multimedia resources, teachers can provide the necessary content knowledge for a child to understand a given text.

## Executive Function

One reading-specific executive function is called graphophonological-semantic cognitive flexibility (GSF). GSF is “a bridging process that involves the ability to simultaneously consider and actively switch between the letter-sound (graphophonological) and meaning (semantic) features of printed words” (Duke & Cartwright, 2021, p. S31). Education studies have shown that GSF can actually be taught in the classroom and that elementary students’ reading ability is improved after GSF instruction (Duke & Cartwright, 2021). An example of GSF instruction is to have students sort word cards by phoneme and by meaning, thus helping children learn to think flexibly (Cartwright et al., 2020). More generally, students should be taught metacognitive strategies for reading, such as modeling thinking out loud to monitor their own comprehension while reading (MacKenzie, 2019).

## Motivation and Engagement

Independent reading is a measure of a child’s motivation and engagement as well as a driver of reading skills. One way to motivate a child to read is to provide more choice and diversity in the texts that students are offered (Wigfield et al., 2016). Access to a wide variety of high-quality literature ensures that students see themselves and understand others (Bishop, 1990). More broadly, culturally responsive teaching can help integrate students’ cultural experiences and strengths in order to resonate with their lives (Jensen, 2021). Culham (2019) argues that students should be able to see themselves in the text—not just in books about historical firsts or notable people but also in reading materials that reflect students’ everyday experiences.

It is well established that confidence is a predictor of later success. Students who are confident and see themselves as competent readers are more likely to continue to work hard during difficult tasks and choose the right strategies to conquer those tasks (Wigfield et al., 2016). Teachers can work to foster confidence in students by providing materials that are just right for their independent reading level, engaging students in supported read-alouds, capitalizing on oral storytelling, and using adaptive and engaging digital

tools. Lastly, students who believe that reading is useful, important, and interesting are also more likely to do well (Wigfield et al., 2016). Teachers can choose practices and activities that explain and emphasize how and why reading is useful to students' everyday lives and their futures.

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## Supporting Multilingual Learners in Reading

In the United States, approximately 15 percent of children enrolled in public schools are multilingual learners (sometimes called English learners or English language learners) (NCES, 2022). Most of these students are in English-only classrooms and face additional challenges when learning to read. Not only are they learning to read like their peers, they are also learning to become more proficient in English. Some students may already have some literacy skills in their home languages but must then transfer those skills to a new language that they are also learning to speak and communicate in. Other students may be learning to read for the first time. It is important to understand the unique experiences and needs of multilingual learners and to provide the additional support they may need to set them up for success in their school experience.

Like all students, multilingual learners are also learning to decode words. However, even though they may be successful in decoding a word, they might face the additional challenge of not fully understanding its meaning, as they are simultaneously learning English. This situation makes it harder to verify for themselves whether they have successfully decoded the word.

Research on supporting multilingual learners in reading has yielded important insights for teachers to keep in mind as they instruct and support their students. Teaching multilingual learners to read English is similar to teaching learners who are not multilingual in many important ways, and the basic Science of Reading still applies (Goldenberg, 2020).

Effective instruction benefits both children who are and children who are not multilingual (Goldenberg, 2020). Multilingual learners who are struggling likely need some of the same type of reading support that nonmultilingual learners who are struggling would need. However, evidence from reading interventions shows that it is key that multilingual learners also get good English language development (ELD) instruction and support (Goldenberg, 2020). Interventions for multilingual learners are most effective when they include ELD modifications to ensure that multilingual learners understand key words and directions and can benefit from and understand the reading activities (Gersten et al., 2007). In addition, having a dedicated block set aside for ELD is more beneficial than having it throughout the day or assuming children will simply “pick it up” from their teachers and peers without explicit instruction (Saunders et al., 2006). Research on language and the brain indicates that for multilingual learners, learning to read is more effortful, so ELD is important, particularly as students advance in grades and comprehension demands increase (Goldenberg, 2020).

Researchers such as Noguerón-Liu (2020) argue that it is important to take advantage of and celebrate what multilingual families bring to the table regarding their own views about reading and their home literacy practices. Noguerón-Liu's research with English/Spanish bilingual families in the United States demonstrates that bringing families into lesson-planning stages can support literacy instruction.

Supporting multilingual learners in home-language literacy can help reading and language proficiency in English. Evidence from dual-language immersion programs—where students receive regular school instruction in both English and another language—demonstrates this benefit. Studies have found that students enrolled in dual-language immersion programs show significantly better reading performance (Steele et al., 2017). This evidence demonstrates that a student's home language does not need to be suppressed or sacrificed in order to successfully learn English. Rather, supporting the home language can be beneficial for English reading achievement.

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# Conclusion

Scholastic recognizes that strong literacy skills are needed to succeed and thrive in today's society. Scholastic's mission is to ensure that all students have equal access to literacy. To support this imperative, we are committed to gathering and disseminating the latest Science of Reading research and providing children, teachers, and families with high-quality resources.

Fortunately, a large body of research from the fields of educational psychology, cognitive science, and neuroscience contributes to our understanding of the Science of Reading. To help children become successful readers, education must focus on teaching foundational skills for reading and comprehension. Thankfully, research has identified these necessary skills and how to teach them effectively.

High-quality instruction in phonological awareness, phonics, reading fluency, vocabulary, and comprehension can help children develop their brains' capacity for reading. Such instruction is especially important for multilingual learners, who benefit from ELD instruction that enhances their oral language proficiency in conjunction with good reading instruction. For all students, learning to read successfully requires not just mastery of reading-specific skills but also skills to regulate their thinking and attention. By providing additional support for children's executive function and interests, teachers can help students become strategic and motivated readers.

Parents, teachers, and administrators should ensure that curricula and strategies used in reading instruction include those supported by the Science of Reading, as described in this paper. Evidence-based reading instruction is important to prepare children for success not only in school but also in life—providing them with more opportunities to learn about and engage with the world around them.



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# Glossary

**Academic Vocabulary:** Words that are common in formal writing and classroom settings, often appearing in instructions for assignments and including words such as *define*, *compare*, or *select*.

**Active Self-Regulation:** One of the seminal features of the Active View of Reading that influences other features of the model, including word recognition, bridging processes, and language comprehension. This feature emphasizes the use of broad learning skills in helping children develop their reading skills, including motivation and engagement, executive function skills, and strategy use.

**Alphabetic Principle:** Understanding that letters and combinations of letters form the common speech sounds of a language.

**Chronology:** Arrangement of events in the order in which they occurred.

**Content-Specific Vocabulary:** Vocabulary specific to a content/subject area (such as words specific to science, social studies, and math texts).

**Culturally Responsive Teaching:** Integrating students' cultural experiences and customs into the classroom through content, instructional strategies, and other methods.

**Decoding:** Ability to use one's knowledge of letter-sound relationships to translate written text into speech.

**Dual-Language Immersion Programs:** Programs that provide native English speakers and English learners with regular school instruction in both English and another language.

**Executive Function:** Higher-order thinking skills to plan, execute behaviors, and achieve goals.

**Fluency:** Ability to read with speed (i.e., at a conversational rate) and with accuracy.

**Graphophonological-Semantic Cognitive Flexibility:** "A bridging process that involves the ability to simultaneously consider and actively switch between the letter-sound (graphophonological) and meaning (semantic) features of printed words" (Duke & Cartwright, 2021, p. S31).

**Language Structures:** Specific features of a language, such as syntax and semantics, that are needed to develop effective language comprehension skills.

**Literacy Knowledge:** Knowledge about a language and its text structures and concepts built through exposure to texts, writing styles, and genres.

**Metacognitive Strategies:** Strategies used by readers to monitor their own thoughts and assess comprehension of text (e.g., thinking out loud).

**Morpheme:** Smallest unit of a word that is meaningful.

**Morphological Awareness:** Ability to recognize and manipulate the smallest units of meaningful speech (i.e., morphemes).

**Multilingual Learners** (also referred to as **English Learners** or **English Language Learners**): Students who speak a non-English language in their households.

**Phoneme:** Smallest unit of sound in a language that is capable of distinguishing one word from another.

**Phonemic Awareness:** Understanding that words can be broken down into smaller individual speech sounds (phonemes) and the ability to identify and manipulate those sounds.

**Phonics:** Knowledge of the correspondences between letters and sounds (i.e., that sounds match letters or groups of letters).

**Phonological Awareness:** Understanding that words can be broken down into smaller components and ability to identify and manipulate those components to determine things such as rhyming words and syllables.

**Print Concepts:** Understanding of the use of print (e.g., that print conveys a message).

**Semantics:** Meaning and interpretation of words in a language.

**Sight Word Reading** (also referred to as **Sight Recognition**): Ability to recognize and read familiar words without sounding them out or breaking them into smaller components.

**Syntax:** Positioning of words and/or phrases to form a sentence.

**Theory of Mind:** Refers to one's ability to understand one's own and others' mental states (e.g., characters' thoughts and feelings).

**Verbal Reasoning:** Ability to move beyond the literal meaning of text (e.g., by making inferences or using metaphors).

**Voice Intonation:** Change in a person's pitch or tone as he or she reads aloud.

**Word Recognition:** Ability to recognize familiar words in text and decode unfamiliar or novel words.