Science of Reading

The phrase "science of reading" signifies a growing understanding of how we learn to read, based on countless studies conducted in many languages all over the world. The research reinforces the effectiveness of teaching phonics systematically, explicitly, and cumulatively. Early instruction in phonemic awareness is critical to reading success. Building vocabulary and background knowledge of text, as well as a content-rich curriculum, are key in the development of language and reading comprehension skills. Over the last two decades, there has been an increased focus on research-based early literacy instruction to promote students' reading success (Every Student Succeeds Act [ESSA], 2015; IDEIA, 2004; NELP, 2008; NRP, 2000). This increased focus on early literacy instruction has also been associated with new research supporting the effectiveness of reading interventions with more than one component (e.g., sight word reading) for students with mild to severe intellectual disabilities that address the foundational skills of early reading as identified by the NRP (2000; see Afacan et al., 2018, for a review).

In Attainment's research-based literacy curricula, Browder, Courtade-Little, Wakeman, and Rickelman (2006) and Browder, Ahlgrim-Delzell, Flowers, and Baker (2012) note, sight words are only one component of reading. In fact, students would not be expected to become readers through sight word instruction alone, based on the research compiled by the National Reading Panel (NRP, 2000). The NRP selected 38 experimental and quasi-experimental (meaning a plausibly close approximation to experimental) research studies on reading instruction. Based on a quantitative averaging of the outcomes from these 38 studies, the most important conclusion of the NRP was that there is compelling evidence that systematic, explicit phonics instruction makes a more significant contribution to children's growth in reading than do alternative programs providing unsystematic or no phonics instruction. The NRP report established consensus on the following foundational skills as critical components of beginning reading instruction:

- Phonemic awareness
- Alphabetic understanding (phonics)
- Vocabulary
- Comprehension
- Accuracy and fluency with connected text

The importance of reading success prompted researchers to examine the characteristics of children entering first grade who become successful readers. Research suggests that children entering first grade with phonemic awareness skills will experience more success in learning to read than their peers who enter first grade with little or no phonemic awareness (e.g., Hiebert & Pearson, 2000; Lyon, 1998; Perfetti, Beck, Bell, & Hughes, 1987). Additionally, a meta-analysis conducted by the NRP (2000) showed that phonemic awareness is an essential skill for a variety of children who are beginning to learn to read. As the "Science of reading" has developed, the importance of phonemic awareness as a component of quality reading instruction has been studied further (Fletcher, 2009; Hulme & Snowling, 2013), and the findings of previous researchers, as well as the NPR, have been confirmed.

In contrast, most students with moderate-to-severe disabilities will need instruction to develop phonemic awareness in the elementary grades due to their developmental delay. Since these reviews, there have been several innovative studies on teaching phonics and phonemic awareness to students with developmental disabilities. Researchers (Allor, Mathes, Roberts, Cheatham, & Champlin, 2010; Allor, Mathes, Roberts, Jones, & Champlin, 2010; Flores, Shippen, Alberto, & Crowe 2004; Lemons, Mrachko, Kostewicz, & Paterra, 2012) have found positive outcomes for elementary students with mild-to-moderate intellectual disabilities (ID) who received systematic instruction in a comprehensive phonics-based program.

In addition, since the update to IDEIA in 2004, there have been several randomized controlled trials investigating the efficacy of comprehensive early literacy programs (e.g., Allor et al., 2014; Browder et al., 2012; Hudson & Test, 2011; Hunt et al., 2020). Hudson and Test (2011) evaluated the evidence base of shared story reading interventions to promote literacy for students with extensive support needs.

Attainment's literacy programs are built on the premise that it is not too late to begin promoting phonemic awareness skills for these students at ages 5–10 or older. Instead, the early elementary grades may be an optimal time to promote the skills that can then bridge to reading by later grades.

In an ethnographic study of the school experiences of students with significant disabilities, Kliewer (1998) found a consistent lack of focus on reading. Because of this lack of attention to reading for this population, the amount and pace of progress students will make in a comprehensive early literacy program is largely unknown at this time. The purpose of our literacy curricula is to provide resources that promote new opportunities for this population to learn to read by building on the *science of reading* found effective for students without disabilities or who have mild disabilities.

Specifically, our programs offer instruction in the major components of early reading: (1) vocabulary and fluency, (2) comprehension, (3) phonemic awareness, and (4) alphabetic understanding (phonics). Project RAISE (Reading Accommodations and Interventions for Students with Emergent Literacy) at the University of North Carolina, led by Dr. Diane Browder, will continue to evaluate the applications reflected in our literacy curricula through experimental research in the years to come.

Below are excerpts from one of our literacy programs, the **Early Literacy Skills Builder**, highlighting the various National Reading Panel components covered in the curriculum, as well as where each component is addressed in the sequence of the curriculum.

National Reading Panel Components

ELSB goes beyond sight words by integrating the key reading components recommended by the NRP.

	ELSB TARGET SKILLS		
NRP Component	Early-Sequence	Mid-Sequence	Late-Sequence
Phonemic Awareness	Identify the concept of word Introduce initial consonant sounds	Identify initial and final consonant sounds	Segment and blend phonemes (phonemic awareness skills that will be used in beginning reading program)
Alphabetic Principle (Phonics)	Identify words using picture symbols Identify letter-sound correspondences	Identify letter-sound correspondences	Use pictures to demonstrate understanding when seeing letters and hearing letter sounds
Comprehension	Select a picture symbol/word for a repeated story line Answer basic wh questions	Select a word for a repeated story line Answer wh, prediction, and main idea questions	Answer inferential questions and questions relating to the sequence of the story
Vocabulary	Read some high-frequency sight words Read new vocabulary words using picture symbols and/or text	Read more high-frequency sight words Read new vocabulary words using picture symbols and/or text	Read more high-frequency sight words Read new vocabulary words using picture symbols and/or text

**** NRP components chart from our **Early Literacy Skills Builder Curriculum***

Furthermore, below is a table that highlights the earlier **ELSB** objectives, the rationale for including the objectives in the curriculum, as well as the methods used to teach these objectives. In looking specifically at the rationale for **ELSB** objectives (specifically objectives 2 and 3), one can see a clear connection between teaching students to know the word on sight and then reading the word in a sentence.

Table 2. Rationale for the 14 Objectives in Levels 1 to 7

Objective	Rationale/NRP Component	Increasing Difficulty across Lessons and Levels	Method Used to Teach Objective
1 Read sight words using time-delay instruction	Some words are irregular and must be learned on sight; students benefit from early word mastery so they can participate in reading the stories. NRP Vocabulary	New words are introduced across lessons and levels.	Flashcard drill using the constant time-delay procedure (one round at 0-second time delay; one at 5-second time delay)
2 Point to sight words to complete sentences	Students use sight words from Goal 1 to fill in a blank in a sentence; promotes comprehension of the sight words. NRP Vocabulary	Students are given more distractors in answer choices as levels progress.	System of least prompts: (a) wait for the student to point without help; (b) if needed, model pointing and have the student imitate; (c) if needed, physically guide the student to point. (Students who respond using eye-gaze can be guided to the correct answer using a prompt such as a light pointer or a colored frame.) If needed, words may be enlarged.
3 Point to text as it is read	Text pointing is used to promote the concept of word. It teaches that text moves from left-to-right and top-to-bottom and that each printed word can be spoken. For nonverbal students, it may build toward the use of technology support to read text aloud. Concept of Print	Students progress from pointing left-to-right to a phrase, to a sentence, to moving down the page to a second line of text, as the teacher reads. In the upper levels, students point to each word individually within the sentence as the teacher reads the text.	System of least prompts (same as above).
4 Say and/or point to a word to complete a repeated story line	This skill promotes the concept of word and listening comprehension as students fill in words that are covered and then complete a repeated story line. NRP Comprehension Concept of Print	Placement of the covered word in the sentence varies (last word, middle word). At the early levels, the covered word is highlighted. In later levels, words change across lessons and levels.	System of least prompts (same as above).

*** *Sight words are more commonly referred to as high-frequency words.*

Scan the QR code to learn more about the *Research Foundations* of the **Early Literacy Skills Builder Curriculum**.

In addition to the **Early Literacy Skills Builder Curriculum**, the table below highlights the activities, goals, tasks, and instructional procedures used in our **Early Reading Skills Builder Curriculum**, which all support the *science of reading*.

Table 1 ERSB activities, goals, and tasks

Activity	Goal	Description of task	Instructional procedure
Letter/sound identification	Identify letters and sounds.	The student selects the grapheme (letter) that corresponds to the phoneme (sound) spoken, "What letter says /m/?" or "Which of these says /m/?"	Lesson 1: 0-second time delay Lessons 2–5: 4-second time delay
Blending	Blend sounds to form words.	A word containing the letters/sounds learned (or being reviewed) is segmented for the student. The student blends the sounds together and then chooses the corresponding word.	Lesson 1: 0–second time delay Lessons 2–5: 4-second time delay
Segmenting I	Segment the first, middle, or last sounds in words.	A word containing the letters/sounds learned (or being reviewed) is spoken and the student begins to learn to segment by identifying the first sound(s) of the word. Later levels require the student to listen for the last sound(s), and eventually, for the middle sound(s) in a word. Note that this is a listening task, rather than a spelling task, and the student is simply choosing the letter(s) of the sound heard.	Lesson 1: 0-second time delay Lessons 2–5: 4-second time delay
Segmenting II	Segment the individual sounds in words.	This is a true segmentation task. The student "sounds out" a word by choosing the letters that correspond to the sounds he or she hears in the word spoken. The student must choose the letters corresponding to the sounds heard in the word in the correct order. . The student does not need to correctly spell the word; the software will automatically spell the word correctly (e.g., adding a silent e when needed, doubling the consonants, using s when /z/ is the sound in the word, capitalizing proper nouns) when the correct letters/sounds are chosen. . The student does need to choose the letters/sounds in the correct sequence. When all letters/sounds have been chosen in the correct order, the sounds are blended together by the instructor (software) and the blended word is spoken. . Early levels begin with CVC words, but the word patterns get progressively more difficult by including words with consonant blends, silent letters, and r-controlled vowels as the student advances through the levels.	Lesson 1: 0-second time delay Lessons 2–5: 4-second time delay
Decoding	Decode words and identify their meanings.	The student decodes the written word given and then selects the picture that represents the word. This activity begins by naming each picture. It is crucial that the student knows the name of each picture before beginning so decoding of the text is the focus. . For Levels 1 and 2, decoding (sounding out) is modeled. Each letter in the word is highlighted (or pointed to) and the corresponding sound is spoken. . In Level 3, decoding prompts begin to be faded. The letters in the word are highlighted and the letter's sound is whispered as a reminder to sound out the word. . In Level 4, the decoding model is completely faded and the student reads the word silently.	Lesson 1: 0-second time delay Lessons 2–5: 4-second time delay
Sight words	Read sight words.	Sight words are irregular words that are not decodable. In early levels, the sight words may include some "decodable words" because the words contain some sounds that have not been taught yet, but are needed to create the passage. The student selects the word that corresponds to the spoken word.	Lesson 1: 0-second time delay Lessons 2–5: 4-second time delay
Reading text	Read connected text.	Each level is accompanied by a short passage to read. One page is read at the culmination of every lesson. The passages increase in length as the student advances through the levels. As in the decoding objective, prompts are faded to teach silent reading. . In Levels 1 and 2, the student selects the word to read it; upon selecting a word, it is fully voiced. . In Level 3, this prompt begins to be faded and the student is told to read silently in his or her head. If the student needs support, he or she can select a word and hear the text whisper read. . Beginning in Level 4, the student should not be selecting the words to hear them read unless he or she misses the comprehension question. For remaining levels, the student reads the passage silently (in his or her head) without selecting the words.	Least intrusive prompting . In Levels 1 and 2, if the student does not begin to read by selecting the words or stops reading, the least amount of guidance needed to prompt the student to continue to read is used. . Error correction includes interrupting the selecting (reading) of words in the incorrect sequence, followed by guiding the student to words in the correct sequence.
Comprehension questions	Answer comprehension questions about connected text.	The student answers a literal question about the passage just read. If the student does not respond with the correct answer to the question, the sentence containing the answer is highlighted and the student can read it again. If the student does not respond correctly after the second reading, the correct answer is modeled. Error correction includes interrupting choosing the incorrect response, followed by guiding the student to the correct answer.	Least intrusive prompting
Writing	Write responses to activities that review the level's objectives.	The student completes activities that review the lesson's objectives.	Assistance and adaptations as required.

To hear more about the science of reading and the research foundations of the **Early Reading Skills Builder**, please scan the QR code.

In moving forward, Attainment Company is committed to creating and publishing research-based literacy curricula that reinforces the *science of reading* for all students in their quest to become readers.

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