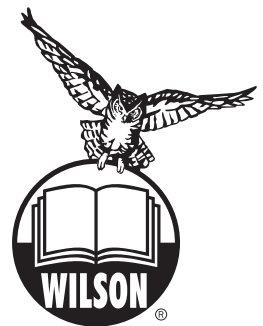
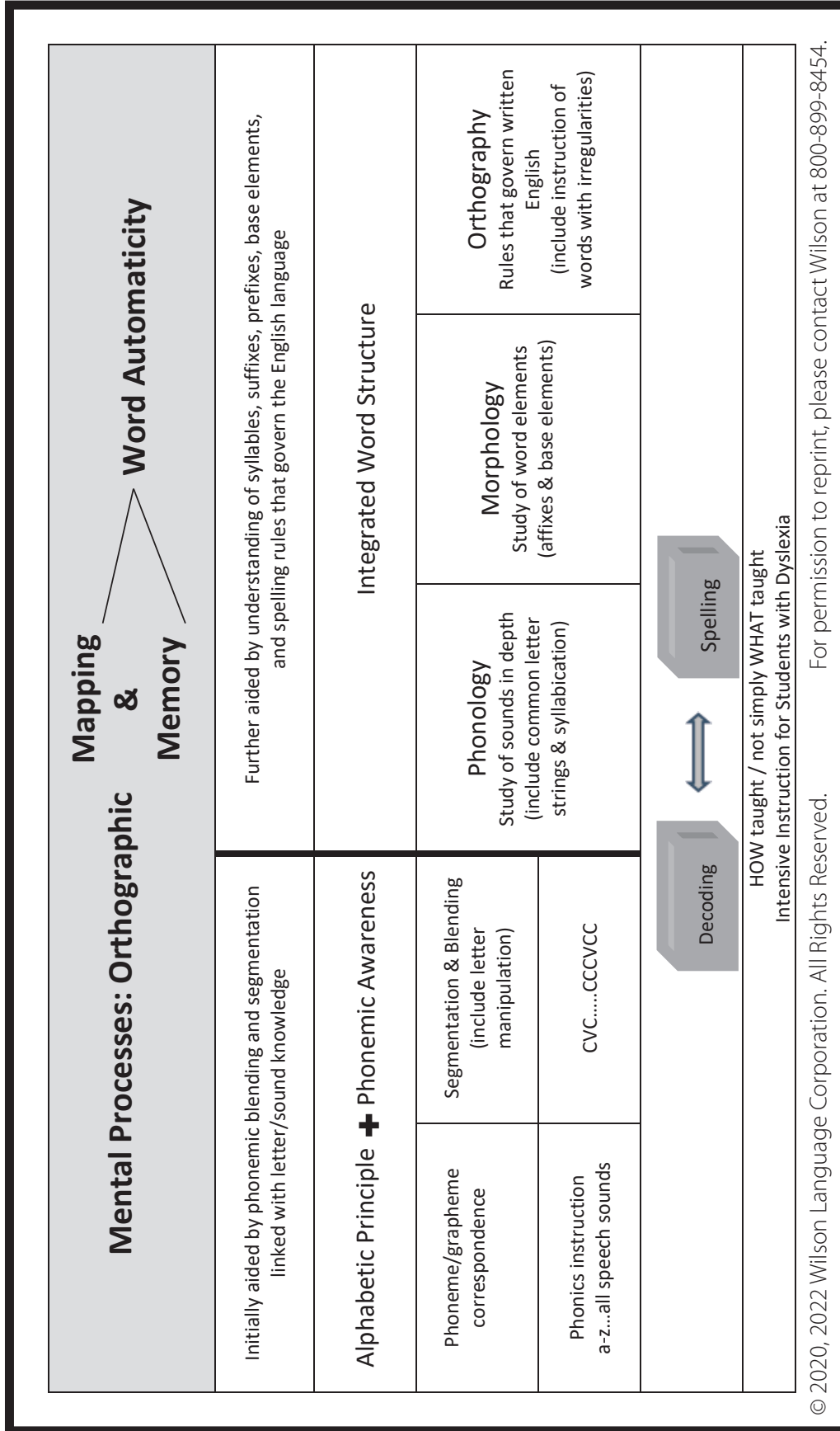


Advanced Orthographic Mapping: How the Science of Reading Informs Foundational Reading Instruction Beyond Phonemic Awareness and Phonics

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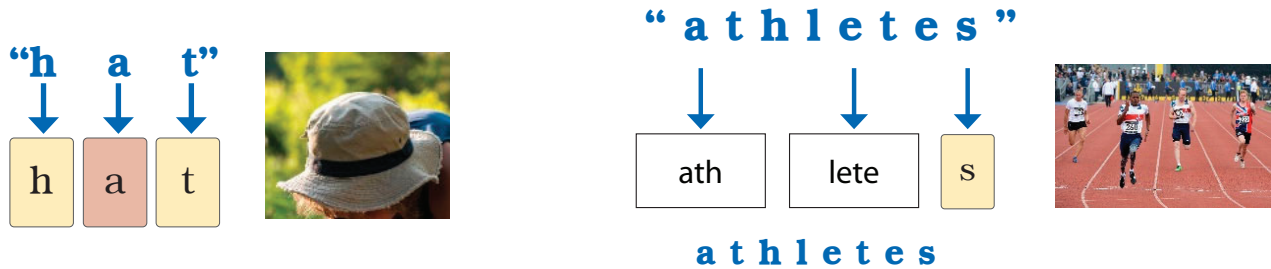
Session Agenda

- ▶ What is Orthographic Mapping and How Does That Occur?
- ▶ What is Orthographic Memory and Why Is It so Important?
- ▶ Ehri's Phases of Reading Acquisition and How These Relate to Orthographic Mapping
- ▶ Keys to Instruction to Facilitate Orthographic Mapping and Memory
 - Getting Underway: Alphabetic Principle, Phonemic Awareness (segmentation and blending with letter manipulation), Phonics Instruction
 - Integrated Phonology, Morphology, Orthography
- ▶ Orthographic Memory Requires Practice
- ▶ Summary... Key Takeaways

WHAT IS ORTHOGRAPHIC MAPPING AND HOW DOES THAT OCCUR?

Orthographic Mapping (Ehri, 2014)

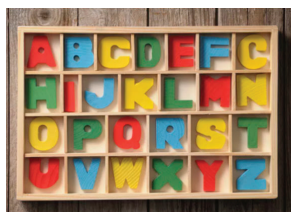
The pronunciation of a word is “mapped” to the specific letters/spelling of the word.



WAYS for Orthographic Mapping to Occur

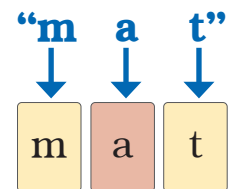
All below require understanding of the alphabetic principle (grapho-phonemic knowledge) and at a more advanced level, knowledge of syllabic and morphemic spelling units.

- **Decoding** (requires phoneme blending) leads to orthographic mapping
- **Encoding** (requires phoneme segmentation)
- **Simultaneously viewing a word and connecting letters and sounds as it is pronounced**



Requires knowledge of Alphabetic Principle...the insight that the visual symbols of the writing system (graphemes) represent the sounds of the language (phonemes)

The letter (grapheme) **m** Represents the phoneme **“/m/”**



“Grapheme-phoneme knowledge and phonemic segmentation are key foundational skills that launch development followed subsequently by knowledge of syllabic and morphemic spelling-sound units.”

unpredicted

Ehri, 2020, p. 45

WAYS for Orthographic Mapping to Occur

Decoding is the process of transforming graphemes into phonemes and blending these from left to right to identify a word.

With the ability to isolate sounds and link them to letters, students can read 70% of regular monosyllabic words (Ziegler et al., 1997).



Encoding is the process of transferring phonemes into graphemes by pulling phonemes apart and identifying each corresponding grapheme as spelled in English orthography.

Requires phoneme segmentation.

“pet” /p/ /e/ /t/



Phonetic Decoding + Spelling

Phoneme Blending (for decoding)

SYNTHETIC

PART → WHOLE

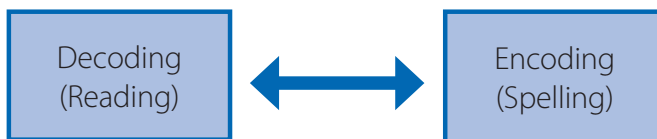
/h/ /a/ /t/ → “hat”

Phoneme Segmentation (for spelling)

ANALYTIC

WHOLE → PART

“hat” → /h/ /a/ /t/



Reading supports spelling (Ehri, 2000, 2014)

Spelling supports “sight reading”

Blachman et al., 2004; Graham & Hebert, 2010; Mathes, 2005; Ouellette et al., 2017; Roberts & Meiring, 2006; Weiser & Mathes, 2011

Simultaneously Viewing a Word and Making Connections



“Orthographic mapping occurs when, in the course of reading specific words, readers **form connections between written units**, either single graphemes or larger spelling patterns, **and spoken units, either phonemes, syllables or morphemes.**”

Ehri, 2014, p. 5

EHRI'S PHASES OF READING ACQUISITION AND HOW THESE RELATE TO ORTHOGRAPHIC MAPPING

Ehri's Phases of Reading

Ehri, L. C., & McCormick, S. (1998). Phases of word learning: Implications for instruction with delayed and disabled readers. *Reading & Writing Quarterly, 14*(2), 135-163.

Pre-alphabetic

- Visual cues (pictures), a logo – would not recognize word without these:



Partial Alphabetic

- Beginning use of letter/sounds ... most often first letter is guesses:



"The dog had a bone."

Full Alphabetic

- Slowly can decode using letter/sound knowledge and blending and with repeated exposure to words, orthographic mapping to begin to occur bonding written word with pronunciation and meaning:



Consolidated Alphabetic

- Readers use word parts (recognized as chunks) to decode rather than individual phonemes:

common letter patterns
ang

prefixes
pre

suffixes
ing

syllables
rupt

- Orthographic mapping continues as these become instantly recognizable

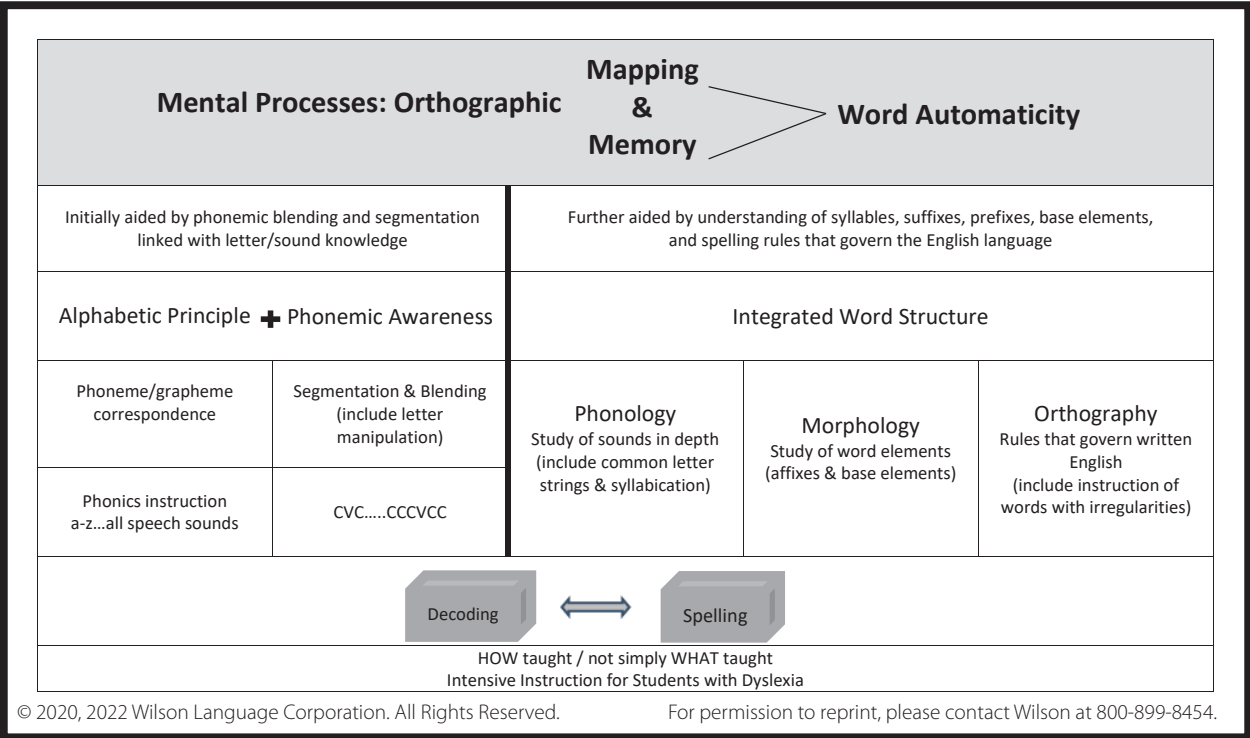


Automatic

- Word recognition effortless – most read instantly on "sight"



KEYS TO INSTRUCTION TO FACILITATE ORTHOGRAPHIC MAPPING AND MEMORY



Keys to Instruction: Integrated Word Structure: Foundational Skills for Reading and Writing

Getting Underway

- Alphabetic Principle
- Phonemic Awareness - segmentation and blending (include letter manipulation)
- Phonics instruction ... decoding and spelling

Beyond Phonemic Awareness and Phonics

- Phonology
 - Morphology
 - Orthography
- } Integrated instruction for decoding and spelling (link to meaning)

Keys to Instruction: Getting Underway – The Alphabetic Principle

“The alphabetic principle: child starts treating graphemes as corresponding to phonemes...

This gradual learning process is accelerated by explicit instruction.”

Seidenberg, 2017

Alphabetic Principle

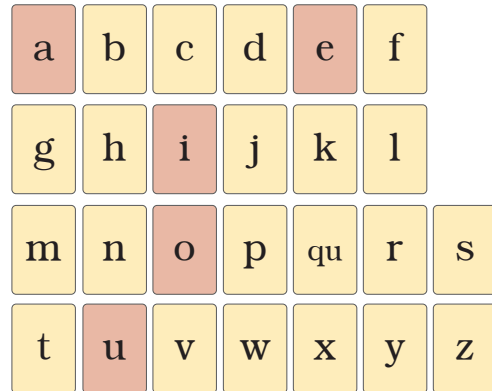
Teach letter name with letter sound **m /m/**

Teaching letter names supports acquisition of sound knowledge.

Levin et al., 2006; Justice et al., 2006; Piasta et al., 2010; Share, 2004

Master in two directions:

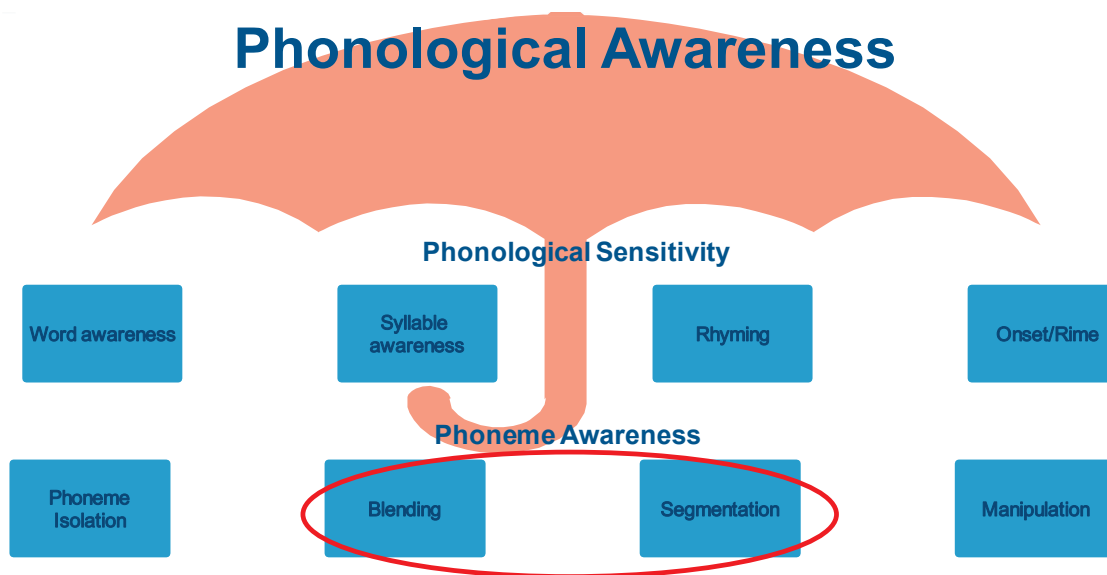
- grapheme to phoneme
- phoneme to grapheme



The ability to decode words requires **both** phonemic awareness and mastery of the alphabetic principle (the linking of sounds to letters).

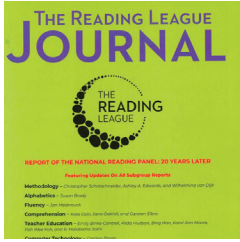
Ehri et al., 2001; Lonigan et al., 2013; NICHD, 2000

Keys to Instruction: Getting Underway – Phonemic Awareness



“The significance of **phoneme** awareness is not overrated. Because it enables learners to penetrate the code that relates speech to print, **phoneme** awareness is key to reading an alphabetic system.”

Shankweiler & Fowler, 2004, p. 488



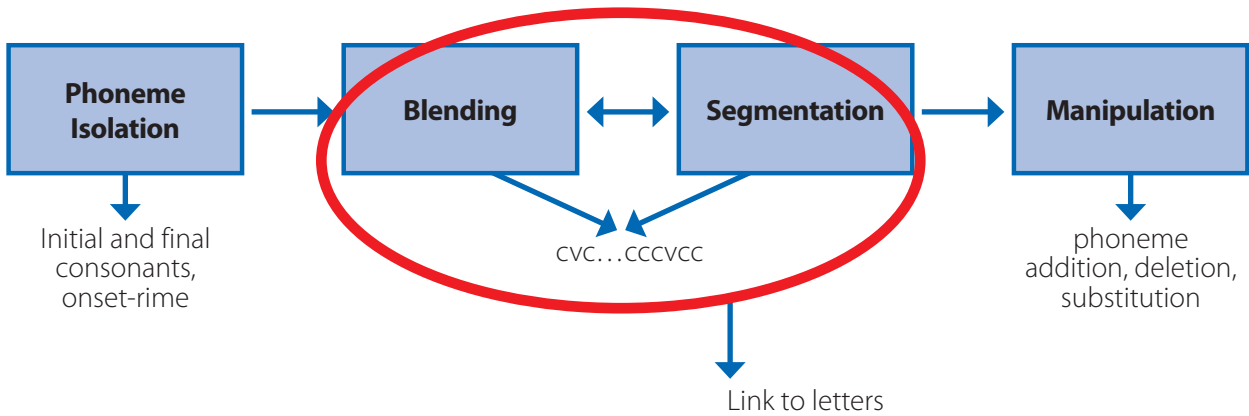
“The ultimate goal of phonological awareness instruction is to assist beginners in building the kind of complete, precise orthographic mappings required for fluent word recognition and, ultimately, reading comprehension” (Brown et al., 2021, p. 13).

“Make no mistake: it is phoneme-level awareness skills that directly support learning to read and spell.”

Brady, 2020

“It is the segmenting and blending of phonemes that has functional value in reading.”

Shanahan, 2015



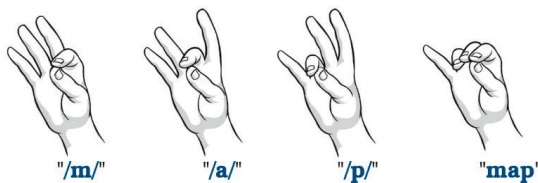
Mapping Phonemic Awareness to the Alphabetic Principle

Although there are many different skills within phonemic awareness that require explicit teaching, *blending and segmenting at the phoneme level* are the most important skills as they lead directly to decoding (e.g., sounding out simple words) and encoding (e.g., spelling simple words). (Al Otaiba et al., 2019)

“Phoneme segmentation, the ability to pull apart the sounds in a given word, is a critical phonemic awareness skill for reading and spelling success. Poor readers often need direct teaching of this because of the coarticulation of sounds in spoken words. Direct instruction in this skill helps these students unlock the alphabetic code that forms the basis of the written form of the English language.” (Ehri et al., 2001)



Provide direct instruction in phoneme segmentation to unlock the alphabetic code.



Keys to Instruction: Getting Underway – Phonemic Awareness

“Phonemic awareness instruction is most effective when children are taught to manipulate phonemes by using the letters of the alphabet” (NICHD, 2000).



Letters, which are concrete, help students with abstract spoken phonemes.

Craig, 2006; Morris et al., 2003; Murray, 2006

“Most importantly, letters should be part and parcel of phonemic awareness instruction” (Brown et al., 2021, p.16).

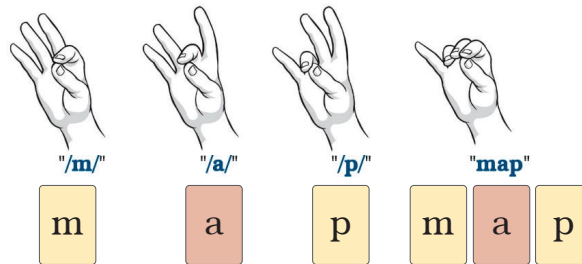
“Teaching children to **manipulate letters representing phonemes** in spoken words was especially effective in teaching phonemic awareness and its transfer to reading and spelling tasks.”

Ehri, 2020

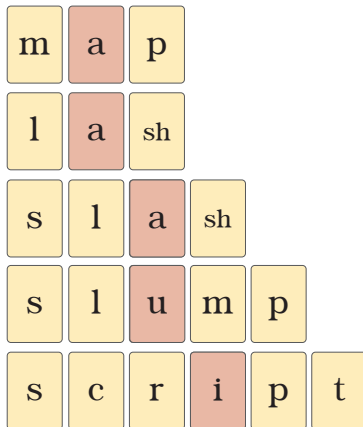


“Phoneme awareness instruction should be integrated with letter instruction.”

Brady, 2020



Phoneme segmentation + blending...Map sounds to letters cvc...CCCVCC (Brady, 2020)



Keys to Instruction: Getting Underway – Phonics Instruction

Systematic phonics programs, **necessary for students with reading deficits**, are characterized by explicit teaching of an identified, sequential set of grapheme to phoneme correspondences.

Mathes et al., 2005; Torgesen et al., 2001

Research supports **explicit** phonemic awareness and phonics instruction for both beginning readers and students who struggle. (NICHD, 2000; NELP, 2008; Barnes, et al., 2020; Fuchs et al, 2002; Scarborough, 2001; Torgesen, 2007)

Provide Explicit Phonics and Decoding Instruction

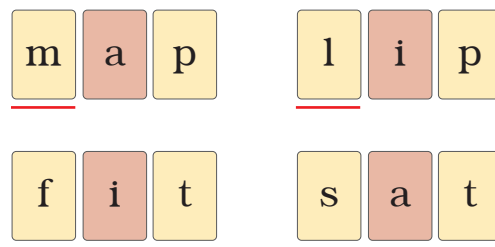
“Most children need to have phoneme structure pointed out to them in order to make sense of the mappings between phoneme segments and corresponding letters” (Shankweiler & Fowler, 2004, p. 489).

Beginning readers (early kindergarten, struggling readers):

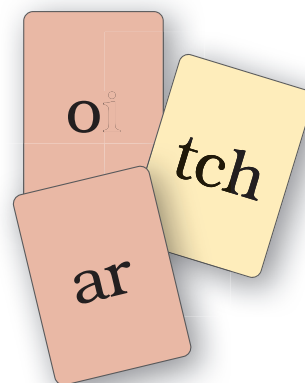
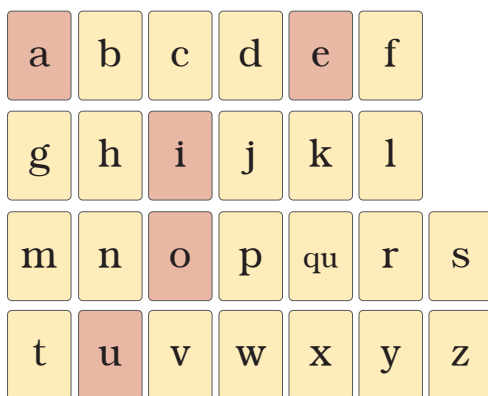
Focus on names and sounds of continuant consonants in initial position of CVC words.

Brown 2021; Brady, 2020

Examples



Initially teach phoneme to grapheme correspondence for a-z



Eventually teach all phoneme to grapheme correspondences

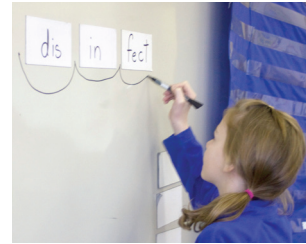
Necessary but not Sufficient

Phonemic awareness + alphabetic principle instruction with a synthetic/analytic and systematic phonics approach is **necessary**, but not **sufficient**.

Keys to Instruction: Integrated Phonology, Morphology, Orthography

Beyond Phonemic Awareness and Phonics

- Phonology (including letter strings and syllabication)
- Morphology (base elements and affixes)
- Orthography (including instruction of irregular words)



Ehri Consolidated Alphabetic Phase:

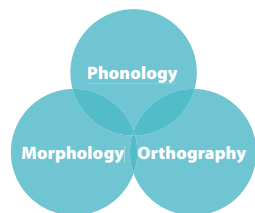
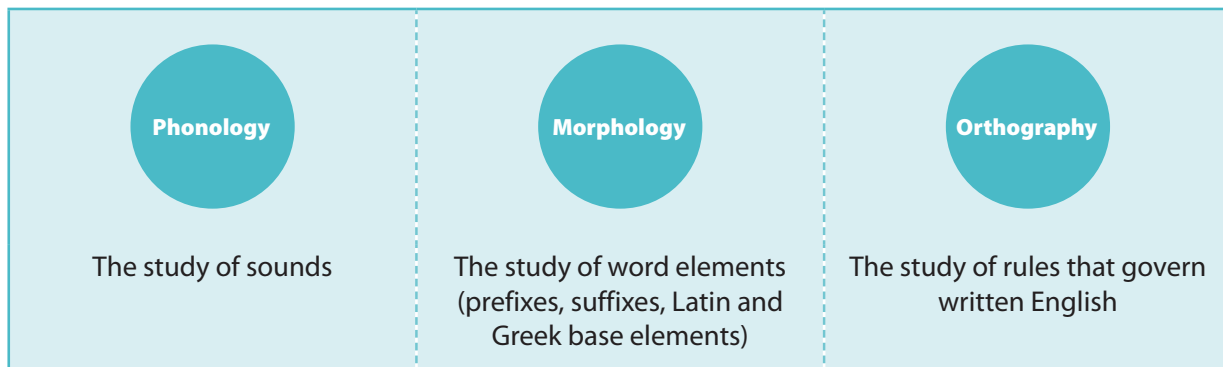
Readers use word parts (common letter patterns, syllables, prefixes, suffixes) recognized as chunks, to decode rather than individual phonemes.

Orthographic mapping continues at this more advanced stage as these parts become instantly recognizable (Ehri & McCormick, 1998)

unpacking

Teach Total Word Structure... Not Just Phonics

The systematic and integrated instruction of **phonology**, **morphology**, and **orthography** provides key foundational skills for word-level mastery for reading. (Ebbers, 2017; Wolter & Collins, 2017)



Direct and explicit instruction in these three overlapping areas of word study have a positive bearing on students' literacy skills (Bowers et al., 2010; Goodwin & Ahn, 2013; Moats, 1995).

To view the Teaching Total Word Structure document visit: <https://tinyurl.com/bdc5kd7b>

Keys to Instruction: Phonology

From beginning, children’s attention should focus on individual phonemes of the word since 2/3 of most common rimes are entirely consistent with phoneme-letter pairings. (Cheyney & Cohen, 2000)

e.g. /c/ /a/ /t/ not c /at/

However, some additional common letter strings can enhance Orthographic Mapping (Ehri)

e.g. **ink, tion**
sink, rink, stink, pink, blink, wink

When teaching sounds, include instruction about the letter(s) environment

- Surrounding Letters: **c**ity, **g**em, **v**isit
- Position in a word: delta **a**
- Syllable Type: **cat** vs **bacon**

In a computer-assisted analysis of 24,000 English words, information about syllable type was the most reliable key to vowel pronunciation (64.9%). (Aronoff & Koch, 1996)

cirpa

Syllable Structure

Closed Syllable	drip c
Vowel-Consonant-e Syllable	brake v-e
Open Syllable	she o
R-Controlled Syllable	bark r
Vowel Digraph/Diphthong Syllable	boat d
Final Stable Syllable	table o -le

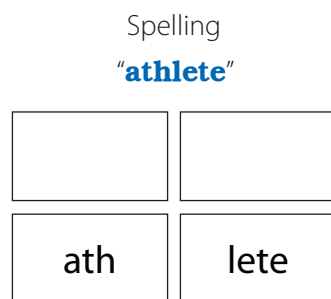
In an analysis of 17,602 words most likely to be encountered by beginning readers, closed syllables make up almost half of all written syllables – with vowel sound correctly predicted in 95% of words. Stanback, 1992

	u	p			
m	a	p			
l	a	sh			
s	l	a	sh		
s	l	u	m	p	
s	c	r	i	p	t

Syllabication training improves poor readers’ ability to decode novel words, to build a sight word vocabulary, and to remember the spellings of words. (Bhattacharya & Ehri, 2004)

disinfect
disinfect

Syllabication for multisyllabic words



Keys to Instruction: Morphology

English is a **morphophonemic** system; that is, spelling **relies on** the smallest units of meaning (**morphemes**) and the smallest units of sound (**phonemes**).

phoneme → grapheme
 morpheme → word element

Study of Morphology →

Study of Word Elements

Phoneme: Smallest unit of sound in a word.

Grapheme: A letter or combination of letters that corresponds to one sound; the written form of a phoneme.

Morpheme: Smallest unit of meaning in a word.

Word Element: Written form of a morpheme; prefixes, Latin bases, and suffixes are examples.

Morphology: The study of morphemes, the smallest units of meaning.

Morphological awareness (MA) refers to students' ability to understand, analyze, and manipulate morphemes within words, contributing greatly to their ability to decode, spell, and comprehend.

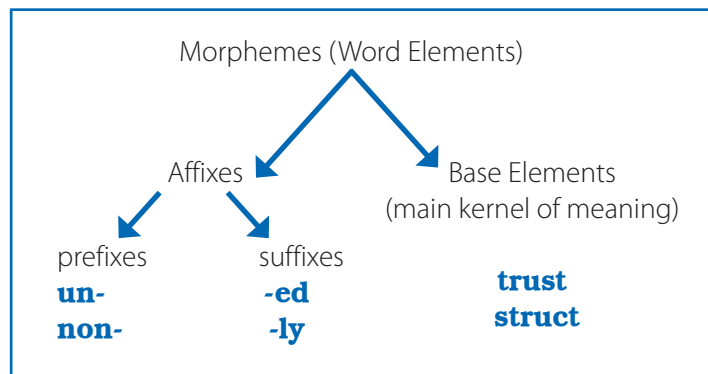
Carlisle, 2010; Keiffer & Lesaux, 2008; Kruk & Bergman, 2013; Nagy, 2007; Pacheco & Goodwin, 2013; Wolter & Dilworth, 2014

A large body of research supports the efficacy of morphological instruction. (Carlisle, 2003, 2010)

Morphological instruction is positive for **both** spelling and reading. (Goodwin & Ahn, 2010, 2013)

Morphological awareness aids accurate and automatic word recognition as students learn to recognize a string of letters with meaning. (Verhoeven & Perfetti, 2011)

non struct ful



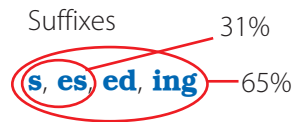
Affix instruction should initially be restricted to words in which the affix removal results in an intact stand-alone English word. (Graves 2004)

bugs **dis**trust

Even with only three-sound words, the concept of a suffix can be introduced with non-changing bases:

bug - bugs **box - boxes**

In a computer-assisted analysis of 24,000 English words, information about syllable type was the most reliable key to vowel pronunciation (64.9%). Information about morphological prefixes and suffixes accounted for an additional 32.3%. (Aronoff & Koch, 1996)



Begin with the suffixes **-s, -es** which are the most common and account for **31%** of words with a suffix. Then add the suffixes (**-ed, -ing**).

These first 4 suffixes (**-s, -es, -ed, -ing**) account for **65%** of suffixed words. Initially, add these to non-changing base words.

Initially, add these to non-changing base words.

Most Common Suffixes			(White et al., 1989)
Suffix	% of Suffixed Words	Meaning	Part of Speech
s, es	31%	more than one verb tense	noun verb
ed	20%	happened in past	verb
ing	14%	is happening	verb

Complex Word: A word made up of **a base element** and **at least one other** word element.

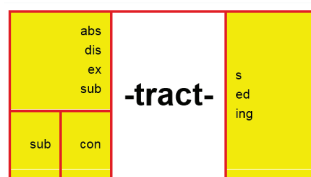
Often called a Latin root but its etymology is **derived** from the Latin roots “rupere” and “ruptus” which mean to break.

-rupt-

disrupt	consult
improve	insect

Complex words (containing more than one word element) account for approximately 60% of the vocabulary students above a fourth-grade level encounter while reading.

Egan & Pring, 2004; Nagy, et al., 1989



abs+tract	abs+tract+s	abs+tract+ed	abs+tract+ing
dis+tract	dis+tract+s	dis+tract+ed	dis+tract+ing
ex+tract	ex+tract+s	ex+tract+ed	ex+tract+ing
sub+tract	sub+tract+s	sub+tract+ed	sub+tract+ing
con+tract	con+tract+s	con+tract+ed	con+tract+ing
sub+con+tract	sub+con+tract+s	sub+con+tract+ed	sub+con+tract+ing

Mini Matrix Maker:
<http://www.neilramdsen.co.uk/spelling/matrix/>

“Greater word reading gains were found after readers were taught to analyze word origins, create word sums with morphemes, extract common base words from morphological relatives, use flexible syllable division and assign primary syllable stress” (Gray et al., 2017, p. 94).

Keys to Instruction: Orthography

Students with dyslexia benefit from instruction that helps them coordinate phonological, orthographic, and morphological word forms.

Berninger et al., 2008; Richards et al., 2006

Integrate phonology, morphology and orthography right from the beginning of instruction.

bug - bugs unpredicted

Orthography: The study of rules that govern written language (spelling).

give not giv
bugs, **bugging**
crushes, crushing, **crushed**
requirement, **requiring**

A **meta-analysis** demonstrated strong support for the direct and explicit instruction of **spelling** as it **improved both spelling performance and** also improved **phonological awareness and reading skills**.

Graham & Santangelo, 2014

Spelling is intimately related to reading and to the relation of letters to sounds. (Shaywitz & Shaywitz, 2020)

fig fog

Spelling (going from sound to letter) strongly reinforces reading (going from letter to sound), and its instruction should be linked to a child's reading lesson. (Shaywitz & Shaywitz, 2020)

"English spelling is largely systematic, although the systematicities extend beyond single grapheme-phoneme mappings. It is therefore highly worthwhile to teach spelling patterns explicitly."

Shankweiler & Fowler, 2004, p. 495

- Initially, instruction should be limited to easier patterns such as adding suffixes to unchanging base words (**bug-bugs; sing-singing; help-helpful; ship-shipment**)
- Eventually students should learn how to add suffixes to base words that change when the suffix is added (**ship-shipping; exhale-exhaling; empty-emptied**).

Phonologically and Semantically Transparent
the base word pronunciation *remains intact* in the
derived form of the word

blended
dressing
requirement
constructive

Phonologically and Semantically Opaque

finality
majority
precision
natural

What About Irregular Words?

Terminology:

Irregular Words

High Frequency Words

Sight Words

Approximately 80% of English monosyllables can be pronounced using a relatively small set of rules relating graphemes to phonemes. In the remaining 20% of cases, typically only one grapheme deviates from its most frequent pronunciation(e.g., **what**)

Coltheart et al., 2001; Perry et al., 2010

what

For instruction:

Be sure students know what is “regular” or decodable about the word, and then identify the irregular part or parts.

ORTHOGRAPHIC MEMORY REQUIRES PRACTICE

Ehri's Automatic Phase

Word recognition is effortless – most words read “on sight”

“Automaticity is recognizing the pronunciations and meanings of written words immediately upon seeing them without expending any attention or effort decoding the words.” (Ehri, 2004)

“Use of alphabetic knowledge to connect spellings to pronunciations and retain sight words in memory is an internal process that is activated spontaneously when words are seen and their pronunciations are produced or heard” (Ehri, 2014, p. 19).



Instruction entails teaching students the knowledge and skills **that enable connections to be activated** when words are seen and read. (Ehri, 2014)

Connections can be made if students have had direct instruction that facilitates orthographic mapping including:

- Grapheme-phoneme relations
- Phoneme segmentation
- Teaching a decoding strategy
- Practice using these skills to read and spell words

Ehri, 2014

A synthesis of research studies demonstrates that interventions with the largest impact on students with reading disabilities or struggling readers were those that emphasized both phonics instruction and provided opportunities to apply phonics skills when reading connected text. (Wanzek & Vaughn, 2007)

“Practice may involve repeatedly reading sets of multisyllabic words by segmenting them into their grapho-syllabic units.”

Bhattacharya & Ehri, 2004; Ehri 2014, p. 19

complex word (all taught elements)

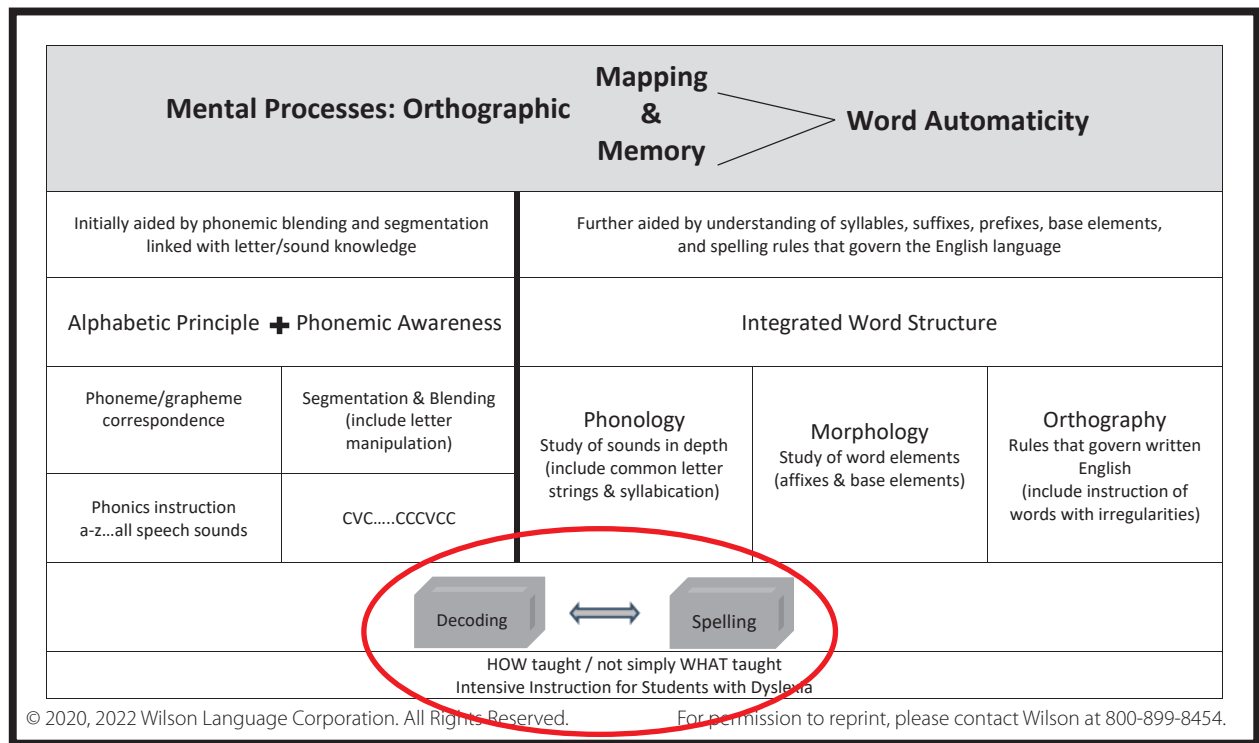
<u>contact</u>	instruct	impact
insect	subject	conduct
construct	intact	infect

Practice may involve having students decode and pronounce unfamiliar words aloud during independent reading of text. (Rosenthal & Ehri, 2011)

Reading ↔ Spelling

Reading supports spelling (Ehri, 2000, 2014)

Spelling supports “sight reading” (Blachman et al., 2004; Graham & Hebert, 2010; Mathes, 2005; Ouellette et al., 2017; Roberts & Meiring, 2006; Weiser & Mathes, 2011)



“... a meta-analysis conducted by Graham and Hebert (2010) summarizing the effects of instructional practices in writing on reading outcomes found that teaching **spelling had a strong effect on reading fluency** among students in grades one to seven (effect size = 0.79) and **word reading skills** in grades one to five (effect size = 0.68).”

Reed, D. K. (2012). *Why teach spelling?* RMC Research Corporation, Center on Instruction. <https://www.centeroninstruction.org/files/Why%20Teach%20Spelling.pdf>

“Learners with dyslexia who take part in a spelling intervention show better reading and spelling performance compared with children who received regular school practice or no spelling instruction.”

Galuschka et al., 2020

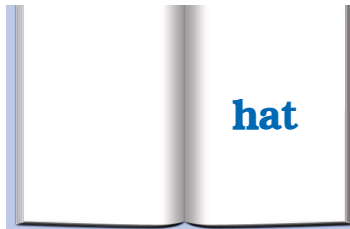
Evidence-based spelling interventions involve:

- ✓ Application of phonics
- ✓ Morphological instruction
- ✓ Explicit instruction of orthographic-phonological spelling rules

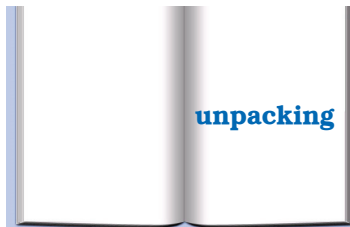
Galuschka, et al, 2020

Link to Meaning from the beginning

Orthographic mapping meaning



“hat”



“unpacking”



Word Level

Right from beginning...

Make connections between

- a word’s meaning
- its pronunciation (spoken form)
- and its spelling structure (written form)

Text Level

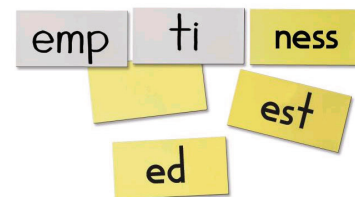
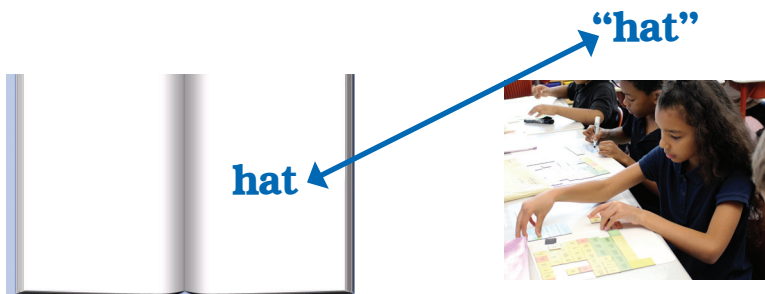
Right from beginning...

Build student’s knowledge



“While researchers have not directed much attention to the practice, decades of practical experience in teaching have suggested that multimodal presentations of letters, word parts, and words may be useful.”

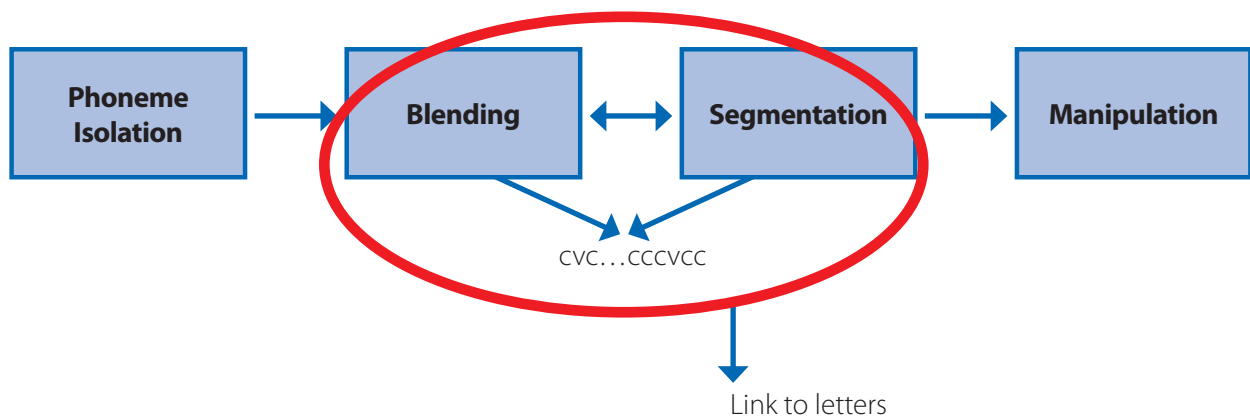
Mather & Jaffe, 2021, p. 22



SUMMARY... KEY TAKEAWAYS

There is an extensive scientific evidence base for teaching children phonemic awareness, especially when combined with letter-sound knowledge and explicit and systematic instruction of the foundational skill of decoding.

Ehri, 2014; Foorman et al., 2016; Gersten et al., 2017; NICHD, 2000



Although there are many different skills within phonemic awareness that require explicit teaching, *blending and segmenting at the phoneme level* are the most important skills as they lead directly to decoding (e.g., sounding out simple words) and encoding (e.g., spelling simple words).

Al Otaiba et al., 2019, p. 11

The systematic and integrated instruction of **phonology**, **morphology**, and **orthography** provides key foundational skills for word-level mastery for reading.

Ebbers, 2017; Wolter & Collins, 2017

Mean effect sizes for spelling instructions involving phonics, orthographic, and morphological interventions are significant. "Phonics, morphological, and orthographic interventions support children by making the spoken and written language transparent. This can help build and automate spoken and written language structure and, in turn, reduce cognitive load."

Galuschka et al., 2020, p. 28

Orthographic mapping is facilitated by **direct** and **systematic integrated instruction** in:

- ▶ the alphabetic principle and phonemic awareness ... specifically phoneme segmentation and blending (from 3 sounds up to 6 sounds in a syllable) linked with letters/sound association
- ▶ phonics, teaching a process for blending and decoding words
- ▶ common letter patterns, syllabication, affixes and word elements
- ▶ practice using above skills to **read and spell** words (in isolation and in context)

Instructional Practices Aligned With the Science of Reading: **Word Recognition**

The following is a *sampling* of instructional practices for word recognition. It is not an exhaustive list. See the Defining Guide eBook at [thereadingleague.org/what-is-the-science-of-reading](https://www.thereadingleague.org/what-is-the-science-of-reading) for more.

Examples of instructional practices aligned with findings from the scientific evidence base:

- Phonemic awareness and letter instruction: Instruction in the identification of phonemes in spoken words and how they link to letters.
- Explicit and systematic instruction in how to decode (read) and encode (spell) words, including word part analysis (e.g., syllables, morphemes).
- Connected text reading to build reading accuracy automaticity, fluency, and comprehension.

Examples of instructional practices **NOT** supported by scientific evidence:

- Emphasis on larger units of speech (syllables, rhyme, onset-rime) rather than individual phonemes.
- Implicit and incidental instruction in word reading, visual memorization of whole words, guessing from context, and picture cues.
- Emphasis on speed or words per minute over accuracy when reading texts (practiced with reading of patterned texts or sustained silent reading for all students).

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Science of Reading: Defining Guide

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Fluent decoding alone will not result in proficient reading, but it is necessary.



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THANK YOU!

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