



Teaching that Sticks: The Science of Reading Meets the Science of Learning

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Outcomes

- Recall key words the Science of Reading definition.
- Explore the Science of Learning.
- Explain how the Science of Learning informs instructional design and delivery.

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1.0 Science of Reading

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Science of Reading Prevalence

- 42 states and the District of Columbia have either passed legislation or adopted policies supporting legislation for teachers to use evidence-based reading instruction aligned to Science of Reading (Schwartz, 2022, July 20).
- The science of reading focuses on “**what**” educators need to teach to develop skilled readers.

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Science of Reading Definition

- Science of Reading is:
 - A large body of **scientifically-based research** across disciplines about reading and issues related to reading and writing
 - Research conducted over the last **50 years** across the world.
 - Research that includes findings from **studies in learning to read in multiple languages**
 - The Science of Reading means there is substantial **evidence to inform how proficient reading and writing develop, why some have difficulty, and how we can most effectively assess and teach to improve outcomes.**

(The Reading League [TRL, 2022])

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Science of Reading Act

Definition: "An interdisciplinary body of evidence-based research about reading and issues related to reading and writing that

- Identifies instruction in phonemic awareness, phonics, vocabulary, fluency, comprehension, and writing as essential components to skilled reading;
- Demonstrates the importance of background knowledge, oral language, the connection between reading and writing, and strong writing instruction;
- Explains why some students have difficulty with reading and writing; and
- Does not use a three-cueing model.

United States Congress, House of Representatives. (2026, March 12). *Science of Reading Act of 2026*

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The Science of Reading is **NOT**

- **Not** an ideology or philosophy
- **Not** a fad, trend, new idea, or pendulum swing
- **Not** a political agenda
- **Not** a one-size-fits-all approach
- **Not** a program of instruction
- **Not** a single, specific component of instruction, such as phonics

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Activity 1.1

- What are the common misconceptions you encounter about the science of reading?

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2.0 Sciences of Learning and Teaching

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Resources



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Defining the Science of Learning

- The science of learning is an interdisciplinary body of research describing the process for how the human brain acquires, stores, and retrieves information.
- Understanding how learning occurs informs the basis for effective instructional design and delivery principals.

Kirshner and Hendrick (2020)

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Learning Principles

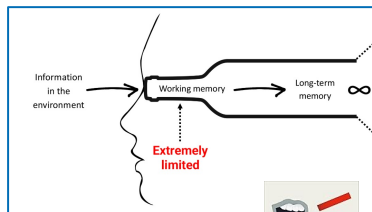
- Our cognitive infrastructure involves sensory, working, and long-term memory. However, working and long-term memory are the relevant for the principles of learning science.
- Prior knowledge influences new learning.
- Learning is a change in long term memory.
- Working memory limits the amount of new information (3-5 things) the brain can process at once.
- Too much information creates cognitive overload.
- Cognitive overload means less information is encoded into long-term memory.

Kirshner and Hendrick (2020)

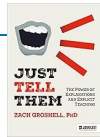
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Cognitive Load Theory



Sweller, 1988; Groshell, 2024

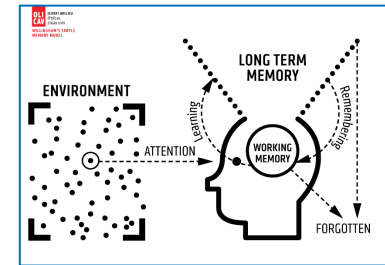


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Manage Cognitive Load

- Highly effective teachers manage students' cognitive load
 - Breaking learning tasks into **bite-sized chunks**
 - Build students' knowledge solidly and in a **sequential manner**
 - Maximize the time spent **explicitly teaching** students
 - Frequent **checks for understanding**



Swain, 2025; Willingham, 2021

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How Learning Informs Teaching

- Explicit, direct instruction takes the cognitive infrastructure into account and increases the likelihood subject matter will be learned.

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Instruction Aligned with Our Cognitive Infrastructure

- Principles of Instruction (Rosenshine, 2010)
 - Begin a lesson with a short review of previous learning.
 - Present new material in small steps with student practice after each step.
 - Ask a large number of questions and check the responses of all students.
 - Provide models.
 - Guide student practice.
 - Check for understanding.
 - Provide scaffolds for difficult learning tasks.
 - Require and monitor independent practice.
 - Engage students in weekly and monthly review.

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3.0 Science of Learning and Teaching Applied to the SoR: Practical Strategies

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Prioritizing Tier 1 Reading Curriculum Components

- Rule of thumb: Archerism - "Teach the stuff and cut the fluff."
- Unit/module kick-off
- Foundational skills (lower grades)
 - Phonemic awareness, phonics and decoding, dictation (encoding), irregular word reading, decodable text reading, fluency practice
- Oral language and vocabulary
- Reading Texts
- Comprehension Processes
- Instructional Routines within the curriculum resources if they align with the elements of explicit instruction
- A few formative assessments within the curriculum resource

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Caution

- Prioritizing Tier 1 reading curriculum resource components does not mean assuming everything within those components is suitable for use as designed.
- **Teaching and learning are critical variables to consider.**

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Engaging ALL Students During Instruction

- Classroom instruction should be accessible to all students.
- Teachers should design active participation strategies ("opportunities to respond") during daily lessons.
- Note: Curriculum resources may include a prompt a teacher uses to elicit students' responses chorally; however, lesson materials are not designed to include a range of active participation strategies.
- Archerism: "Everyone does Everything."

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Benefits

Active participation strategies (opportunities to respond - OTRs) contributes to a positive learning environment by:

1. Increasing student engagement
2. Increasing on-task behavior
3. Increasing accountability
4. Promoting desired behaviors
5. Reducing inappropriate behaviors
6. Keeping class moving along

Archer, 2011

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OTRs are a Mechanism for Embedded Formative Assessment

- Frequent **checks for understanding**

- Allows the teacher to **monitor** understanding, **adjust** the lesson based on **responses**, and provide **feedback** to students

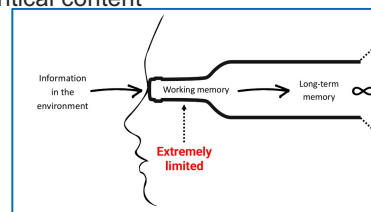
Archer, 2011

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OTRs Promotes Learning

1. Focuses students' attention on critical content
2. Provides practice of skills, strategies, and facts
3. Provides rehearsal of information and concepts
4. Allows for retrieval practice of critical content



Archer, 2011

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Sweller, 1988; Groshell, 2024

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Activity 3.1

- Brain drain:

- In 1 minute, list as many reasons why it is important to utilize OTRs (active participation strategies) and require frequent responses from students
 - Without looking back at your notes!

- Share out:

- Type your reasons in the chat box

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Guidelines for Response Rates

- 70% of responses unison (all say, write, do)
- 30% individual responses (non-volunteers)

Simple Responses	More Complex Responses	Very Complex or Involved Responses
• Unison choral • Gesture • Response cards	• Partner sharing • Written answer • Math problem	• Writing prompt • Completing experiment
3-5 opportunities to respond per minute	At least 1 opportunity to respond per minute	May provide only 1 opportunity to respond every 10-30 minutes

Haydon, et al., 2012; Stevens & Rosenshine, 1981; Mac Suga-Gage & Simonsen, 2015; Simonsen & Myers, 2015

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Verbal Response Procedures	Written Response Procedures	Action Response Procedures	Holdups	Inclusive Passage Reading	Use of Technology
Choral	Short Written responses	Acting out/ Simulations	Whiteboards	Whisper Reading	Computers
Partners	Whiteboards	Touching/ Pointing	Hand Signals	Choral	Tablets
Teams		Gestures	Response Cards	Cloze	Phones
Individual		Facial Expressions	Response Sheets	Partner	
Discussion				Literacy Circles	

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OTR (Active Participation) Essentials

- Essential 1: Request frequent responses from students
- Essential 2: Require overt responses- saying, writing, doing
- Essential 3: Involve all students- no opt out
- Essential 4: Structure active participation procedures
- Essential 5: Provide adequate think time

Archer, 2011

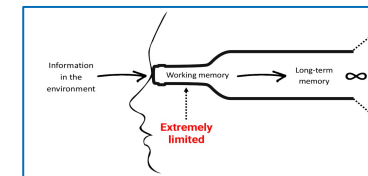
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Revisiting the Cognitive Infrastructure and Learning

- Instructional Hierarchy: phases of learning

1. Acquisition
2. Developing fluency
3. Generalization
4. Adaptation



Sweller, 1988; Groshell, 2024

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Resource to Bridge the Sciences of Learning and Teaching

- Instructional Hierarchy (Haring and Eaton, 1978) is a framework for teachers to match instructional strategies with students' progress through learning phases.
- Resource: 4 phases, with definitions next to each phase. The colored boxes include instructional guidance for the phase.

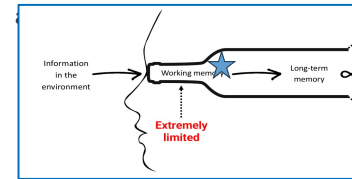
Instructional Hierarchy Resource: Center on Multi-Tiered System of Supports. (2023).



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Acquisition Phase and Designing Instruction

- **Acquisition phase:** Students are initially learning skill(s). The skill is laborious to perform,
- How do you design instruction?
 - Explicit instruction to ensure accurate use of the skill. Provide immediate feedback on accurate or close approximations of the skill.



Sweller, 1988; Groshell, 2024

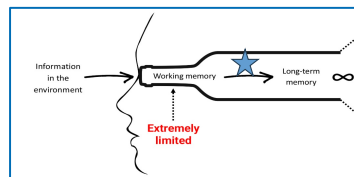


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Fluency Building Phase and Designing Instruction

- **Fluency Building:** Students are developing proficiency with the skill. They can perform it accurately, but not at an acceptable rate.
- How do you design instruction?
 - Provide instruction on building proficiency. Provide feedback for meeting the criteria for fluency. Feedback can be delayed and not provided after each successful performance of the skill.



Sweller, 1988; Groshell, 2024

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Elements of Explicit Instruction Lesson Resource

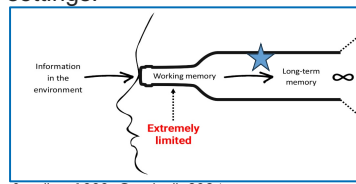
Explicit Instruction	What does it look like?	What does it sound like?
1. Critical Content		
2. Broken down in a sequence		
3. Organized and focused lessons		
4. Goal of lesson		
5. Review		
6. I do		
7. We do		
8. You do		
9. Frequent responses		
10. Monitoring performance		
11. Feedback		
12. Brisk pace		
13. Judicious practice		

Adapted from Anita Archer, Elements of Explicit Instruction

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Generalization Phase and Designing Instruction

- **Generalization:** Students can perform the skill accurately and with proficiency in the instructional setting. They perform it less fluently in novel settings.
- How do you design instruction?
 - Plan for and provide instruction in new or novel settings. Provide feedback on using the skill in new settings.



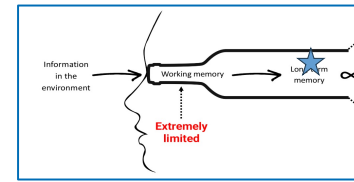
Sweller, 1988; Groshell, 2024



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Adaptation Phase and Designing Instruction

- **Adaptation:** Students perform the skill across settings with accuracy and competency. They are rigid and inflexible with it.
- How do you design instruction?
 - Focus on identifying core features of the skill and modifying it to fit new settings. Provide feedback on attempts to vary or adapt.



Sweller, 1988; Groshell, 2024

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Activity 3.2

- How might you use the Instructional Hierarchy to center student learning when designing and delivering instruction to students (whole group and small group)?
- Share out:
 - Type your reasons in the chat box

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4.0 Purpose and Types of Practice

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Purposes of Practice

- To gain minimum **competency** on a **skill**
- To **improve** and gain **proficiency** on a skill
- To gain **automaticity** on foundation skills **needed** for **higher order** skills
- To **protect** against **forgetting**
- To improve **transfer** of **skills**

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Initial vs. Independent Practice

Initial Practice

- Occurs under the watchful eye of the teacher
- Provides numerous practice opportunities within the teacher-directed lesson to build accuracy
- Provide immediate feedback after each item

Independent Practice

- Extensive monitoring is no longer needed
- Initial acquisition levels are met
 - 85% accuracy
 - 90-95% accuracy full independence
- Delayed feedback is sufficient

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Retrieval Practice

- Strategy in which calling information to mind subsequently enhances and boosts learning
- Improves learning for:
 - Diverse populations
 - Subject areas
 - Developmental stages
- Hattie Effect Size: 0.54

Archer & Hughes (2011) Hughes & Lee (2019)

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Spaced vs. Massed Practice

Spaced practice

- Distributing multiple short practice opportunities overtime
 - Separated by prespecified time intervals
- Hattie Effect Size: 0.60
- Long term retention

Massed Practice

- A new skill or strategy is practiced, in isolation, immediately following instruction (acquisition learning phase)
- Leads to increased short-term retention which fades over time if only practice strategy used.

Archer & Hughes (2011); Hughes & Lee (2019); Datchuk & Heir (2019)

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Spaced Practice

- Providing spaced intervals between practice attempts increases the number of unique practice sessions completed
 - Equal or expanding intervals
- Forgetting helps remembering
 - Time gaps between practice sessions allow time to forget some of what was learned.
 - Embedded retrieval practice
 - The amount of information forgotten between sessions gradually decreases, as do effort and frustration

Archer & Hughes (2011); Hughes & Lee (2019)

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Cumulative Practice

- Adding related skills that were previously acquired and practiced, in such a way that all of the skills are practiced together in one practice activity (set) or session
- Teach skill A to initial acquisition
 - Practice Skill A
- Teach skill B to initial acquisition
 - Add skill B to skill A practice
- Teach skill C to initial acquisition
 - Add skill C to skill A and B practice

Hughes & Lee (2019)

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Interleaved Practiced

- Mixing the practice order of sequenced skills previously taught.
- The related skills are mixed up for students to practice (e.g., a different skill is practiced after they have practiced another).
- The sequence of the practice activities varies.
- Example skill practice sequence:
 - Skills: ABC ACB CBA
- To fully benefit from interleaved practice, students need to have a high level of accuracy in the content they are learning

(Hughes & Lee, 2019)

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5.0 Application to Tier 1 Literacy Curriculum

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- Review the routine against the explicit instruction elements.

Pre-plan (annotate) things missing (e.g., error correction procedures).

Based on students' responses during instruction, consider their learning (instructional hierarchy).

Adjust the instruction (e.g., practice categories, feedback) accordingly.

ROUTINE STEP	MODEL LANGUAGE
1. Review the words, phrases, and sentences that children will read. Use a copy of the Decodable Text. Have children highlight or circle words with sound spellings they have learned.	We will read a story called “A Fish for Chaz.” In this story, we will read words with digraphs sh and ch, irregular words, and other words with sound spellings we have learned. Review the sounds digraphs ch and sh make. Now let’s look at some of the phrases and sentences we’ll be reading. Choose a few target skill words and irregular words to review in isolation with children.
2. Preview the text and discuss background knowledge. Have children partner up and discuss what they already know about the topic.	The title is “A Fish for Chaz.” What do you think this story may be about? Think and tell your partner. Partner 1, go first. Partner 2, go next. Make connections to the story as applicable. Have you ever had a pet fish or gone to a pet shop?
3. Read the text together. Guide the group to read together. Start at the same time and read at the same rate.	Let’s read together. Point and read out loud with me.
4. Have children read the text. Have children individually whisper-read one line or paragraph at a time. If children make mistakes, prompt them to sound out the word. Allow children to correct errors for words they should know, but don’t let them struggle beyond a second attempt.	Now you will read “A Fish for Chaz.” Put your finger under the first word. Read the first line to yourself in a whisper voice. Point to the words as you read.
5. Reflect on reading. Ask text-based questions. Have children partner up and point to the word or words that support their answer.	Which fish did Chaz want? Point to the sentence that shows which fish Chaz wanted. Turn and tell your partner where Chaz went to get a fish. Say: Chaz went _____.
6. Vary approaches to text reading. Do several readings to help build fluency.	SEMO-READING PARTNER READING
7. After children have read the text two or more times, have children partner up and retell the story to each other.	Now you will take turns retelling the story to each other. Partner 1, go first. Partner 2, go next. Then use the box provided to illustrate what you read in the text.

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6.0 Wrap-Up

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Summary

- The Science of Reading informs what to teach, while the science of learning informs how information is stored in long-term memory.
- The science of instruction informs how to teach so that subject matter moves from working memory into long-term memory.
- Explicit, direct instruction takes the cognitive infrastructure into account and increases the likelihood subject matter will be learned.
- Active participation strategies (opportunities to respond - OTRs) contribute to a positive learning environment and promote learning.
- The Instructional Hierarchy can be used to categorize student learning and to inform instruction.

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Activity 6.0

- Tell your elbow partner: "One thing I learned today that I commit to incorporating in conversations is..."

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Thank YOU!

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