



# Instructional Scaffolding to Engage All Learners in Complex Science Text

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National and state standards state that all learners should use informational texts (e.g., *Next Generation Science Standards* [NGSS Lead States 2013]; *Common Core State Standards for English Language Arts* [CCSS-ELA] Reading in Science and Technical Subjects [RST]; NGAC and CCSSO 2010). Further, evidence supports the use of complex text in preparing students for college and careers (e.g., CCSSO 2017). However, engaging our learners in grade-level complex science texts can be an extremely difficult task and, as a result, is avoided in our instruction (Amendum, Conradi, and Hiebert 2018; Fisher

and Frey 2014). Grade-level complex science texts can present significant barriers for many learners, especially students with disabilities. For example, science texts often use technical and unfamiliar vocabulary, lack elaboration through examples, can be conceptually dense and contain abstract ideas, and involve unfamiliar text structures different from those seen in narrative or fiction text (Mason and Hedin 2011).

One approach to addressing barriers that grade-level complex science text may present is via the use of a STEM multimodal text set—a collection of resources from different genres, media, and levels of complexity (i.e., different reading levels) that are strategically organized to build vocabulary, background knowledge, and interest around a particular science topic (Folk et al. 2020). There are many ways of organizing a multimodal text set. For our teacher professional development program, Linking Science and Literacy for All Learners (see Resources), the line of inquiry of a text set is organized around an anchor text. Subsidiary texts, materials, and resources—what we call content scaffolds—are organized around the line of inquiry and are designed to support the learner in developing the necessary content and skills and practices for engaging in the anchor text (see Figure 1 for an overview).

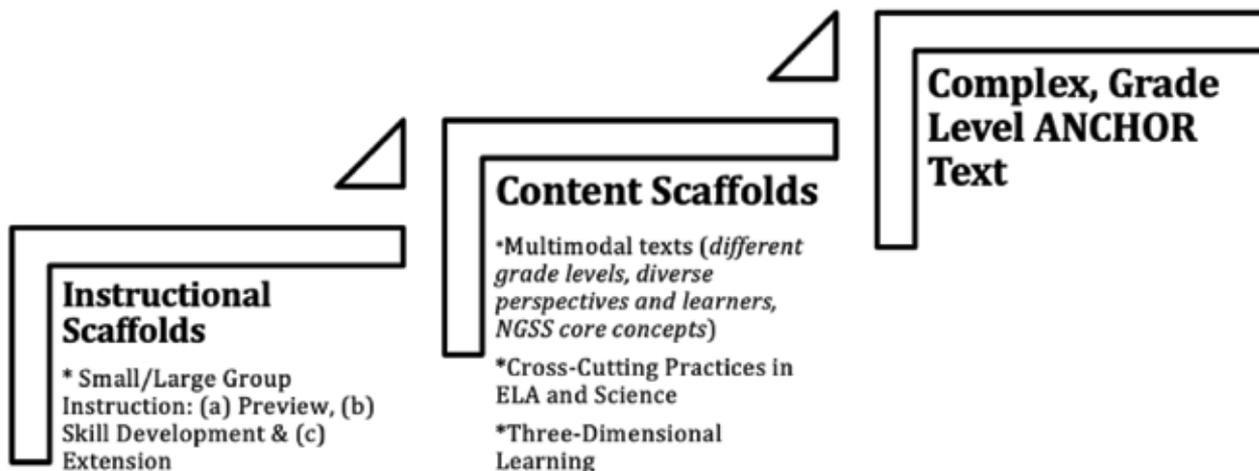
Although a text set is scaffolded by arranging materials to ensure access to content for all learners, we know that simply providing materials leveled to a learner’s reading ability is not necessarily enough of

a scaffold. Some students, even though they can read (or decode) the text, may experience difficulty comprehending the text due to challenges such as lack of background knowledge or skills and practices (e.g., inferencing). Of further concern is that the exclusive use of a text at a lower grade level will lack sufficient complexity that, without exposure, would result in “no opportunity to acquire the knowledge and skills that could enable them to catch up” (Shanahan 2019, p. 22). Therefore, other instructional scaffolds may also be required. In our program, instructional scaffolds are specific learning opportunities designed to help meet the individual needs of learners (e.g., challenges with comprehension) so they can access and understand complex text. The purpose of this article is to describe three forms of instructional scaffolds (adapted from Fisher and Frey 2014) and provide examples, via Ms. Fielder’s eighth-grade science class, of how these scaffolds are used to address some of the barriers students with disabilities might experience as they engage in complex science text.

### Instructional scaffolding within a multimodal text set

Ms. Fielder teaches eighth-grade science; most classes include some students with disabilities who experience difficulties reading complex text. Many of these students do not enjoy reading and lack the confidence to engage in reading complex science text. Ms. Fielder

**FIGURE 1:** Organization of a multimodal, STEM text set.



is planning on teaching a unit of instruction focused on human thermoregulation that includes ideas related to homeostasis and heat stress. She also plans on developing students' ability to make claims with evidence, a practice shared by NGSS and CCSS-ELA.RST (Lee, Quinn, and Valdés 2013).

To teach this unit of instruction, Ms. Fielder will

be using a STEM multimodal text set titled "Earth and Human Body Systems." The anchor text for this text set was developed from a peer-reviewed published paper (Steinweg and Gutowski 2015; adapted with permission) that was modified for middle school learners taking into consideration the NGSS, state Science and Language Arts Learning Standards

**FIGURE 2:** Sample content scaffolds for multimodal text set.

Title of resource	Link to resource	Grade	Comment
<b>Thermoregulation content scaffolds</b>			
Thermoregulation: definition and vocabulary	<a href="https://wiki.kidzsearch.com/wiki/Thermoregulation;">https://wiki.kidzsearch.com/wiki/Thermoregulation;</a> <a href="https://kids.kiddle.co/Thermoregulation">https://kids.kiddle.co/Thermoregulation</a>	Grades 6–12	Wikipedia and encyclopedia articles on thermoregulation
The Brain	<a href="https://askabiologist.asu.edu/bird-hypothalamus">https://askabiologist.asu.edu/bird-hypothalamus</a>	Grades 6–8	Science text/scaffold of the brain in thermoregulation. <i>Arizona State University</i>
The Amazing Human Body Video	PBS-BBC DVD Segment 2 [Survival] first 14 min.	Grades 6–12	Excellent MP4 video/scaffold of human body systems adapting to thermal stress
<b>Heatstroke/stroke content scaffolds</b>			
Surviving the Playing Field When It Is Too Darn Hot	<a href="https://www.nytimes.com/2005/09/20/health/surviving-the-playing-field-when-its-too-darn-hot.html">https://www.nytimes.com/2005/09/20/health/surviving-the-playing-field-when-its-too-darn-hot.html</a>	Grades 8–9	News article about athletes and sickle cell disease; <i>New York Times</i>
Heat, Energy, and Bicycling in New York City	<a href="https://www.readworks.org/article/Energy-and-Physical-Science/d55cb7f0-e838-46dc-b7b0-3c12bf515f2c# articleTab:content/contentSection:83bb706e-79e6-4173-973f-6fd6f0b62165/">https://www.readworks.org/article/Energy-and-Physical-Science/d55cb7f0-e838-46dc-b7b0-3c12bf515f2c# articleTab:content/contentSection:83bb706e-79e6-4173-973f-6fd6f0b62165/</a>	Grades 6–8	Science text/scaffold that describes human body responses to heat stress; <i>ReadWorks</i>
How Heat Kills	<a href="https://www.sciencenewsforstudents.org/article/explainer-how-heat-kills">https://www.sciencenewsforstudents.org/article/explainer-how-heat-kills</a>	Grades 6–9	Science text/scaffold with description of human body response to heat stress; <i>Science News for Students</i>
What Happens When You Get Heat Stroke?	<a href="https://ed.ted.com/lessons/what-happens-when-you-get-heat-stroke-douglas-j-casa">https://ed.ted.com/lessons/what-happens-when-you-get-heat-stroke-douglas-j-casa</a>	Grades 6–9	Video/Animation of the effects of heat stroke; <i>TedEd</i>
States Take Aim at Heat Stroke	<a href="https://newsela.com/read/heatstroke-students/id/5513/">https://newsela.com/read/heatstroke-students/id/5513/</a>	Grades 4–9	Science text about efforts to reduce heat stroke in athletes; <i>Newsela</i>
Vehicular Heat Stroke	<a href="https://www.youtube.com/watch?v=XNDWN8KDVSM&amp;t=325s">https://www.youtube.com/watch?v=XNDWN8KDVSM&amp;t=325s</a>	—	Safety film about dangers of vehicular heat stroke
Mercury Rising	<a href="https://www.youtube.com/watch?v=u4Y30EDdpJA">https://www.youtube.com/watch?v=u4Y30EDdpJA</a>	Grades 7–12	Series 1 Segment 8 of <i>Years of Living Dangerously</i> video with Matt Damon talking about heat stress in LA [10 min]

(MLS), and CCSS-ELA.RST. The Lexile text measure of the anchor text is 1060, which is within the sixth- to eighth-grade band of a Lexile score of 925–1185. (Lexile measure provides information as to how challenging a text is to read; see Resources.)

A primary focus of the anchor text is the concern of increased temperatures leading to heat stress on the human body. Ms. Fielder recognized that many of her learners would not be able to engage in the anchor text without additional instructional support in three specific ways: (1) development of background knowledge and vocabulary to understand the anchor text; (2) skill development to identify claims and evidence in the anchor text; and (3) knowledge of scientific text structures as a way to find information and, subsequently, build knowledge about the content in the anchor text.

### Preview instructional scaffolding

To engage in the anchor text, the students need to understand and have vocabulary about thermoregulation and homeostasis. Knowing that some of her

learners may not have the background knowledge or vocabulary, she uses *previewing* as an instructional scaffold prior to engaging in the anchor text. This type of scaffold can be particularly useful to build background knowledge and/or vocabulary (Fisher and Frey 2014). Texts, videos, simulations, and other resources such as those found within the content scaffolds of the multimodal text sets (see Figure 2 for sample selection) can be used as preview scaffolds to build students' background knowledge and support students' vocabulary development.

Integrated as a part of a learning cycle with her class, Ms. Fielder created two learning opportunities designed as preview instructional scaffolds. First, to build background knowledge, she had her students watch a segment of the PBS video *The Amazing Human Body* (Johnson, Dyas, and Palmer 2018). After they watched the video, she facilitated a whole-group student discussion regarding the main points of thermoregulation and its role in homeostasis. Second, to help develop a deeper understanding of the word *homeostasis*, she divided the class into small groups and assigned articles for them to read. After



reading the articles, the students worked in small groups to complete a Frayer model graphic organizer on homeostasis (see Figure 3). Ms. Fielder organized her groups to include mixed abilities in reading and writing.

### Skill development instructional scaffolding

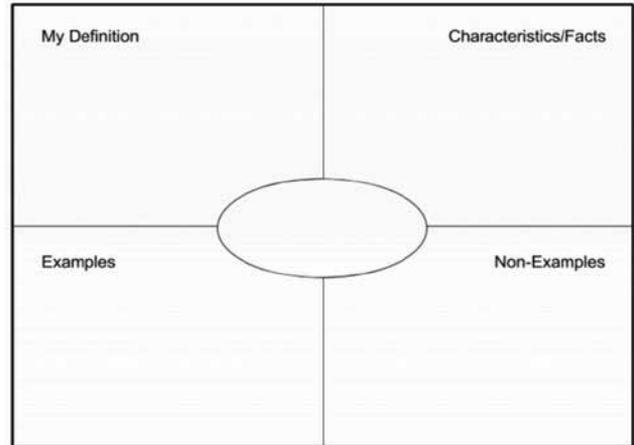
Within the anchor text, claims related to change in weather patterns and heat stress are made that are supported by evidence in graphs. Ms. Fielder noticed that lack of familiarity with the practice of claim, evidence, and reasoning (CER) was another challenge many of her learners experienced during science. To address this concern, Ms. Fielder used *skill development instructional scaffolding* prior to having students engage in the anchor text as a way to build understanding of CER. As its name suggests, skill development instructional scaffolding is focused instruction on building necessary skills (Fisher and Frey 2014).

Ms. Fielder decided to incorporate two learning opportunities designed as skill development instructional scaffolds into her learning cycles. For all her students, she introduced a bellringer activity that they carried out during the first 10 minutes of class. This learning opportunity often served as an “engage” activity for her learning cycle. For example, in her learning cycle on weather patterns and heat stress, the students were shown a photograph that provides a “scenario” open to interpretation that can serve as a tool to develop CER skills (see Figure 4). In this case, the photograph is of individuals trying to cool off in front of the Eiffel Tower in Paris during a heat wave in 2019. Individually and then via whole-class discussion, students were asked to answer the following questions:

1. What is going on in this picture? (claim)
2. What makes you say this? (evidence and reasoning)

For the second skill development instructional scaffold, Ms. Fielder decided to implement learning in small groups. First, with the whole class, Ms. Fielder defined the terms *claim* (a statement that can be argued based on the study or reading), *evidence* (the information that provides the evidence for the

FIGURE 3: Frayer model example template.



claim), and *reasoning* (the logical explanation connecting the evidence to the claim). After illustrating and providing a model of CER statements, Ms. Fielder gave the students articles and videos from the scaffolds of the multimodal text set that were focused on the topic of heat stroke/stress. For their assigned resource, and in small groups, the students were asked to identify three to five claims along with evidence and reasoning related to the topic on key ideas such as (a) what is heatstroke, (b) causes of heatstroke, (c) signs of heatstroke, and (d) effects of heatstroke on the body. They then created a chart listing the claim along with evidence and reasoning. Once the students had completed the chart, they discussed what they found.

Ms. Fielder varied the activity by using one of the articles (“Explainer: How Heat Kills”; see Resources) and asked the students to read the article and then use highlighter pens in different colors to identify each component of the argument (i.e., green for claim and purple for evidence). Then students compared their results in pairs and groups using the think-pair-share strategy to draw out their own conclusions.

### Extension scaffolded instruction

The anchor text was adapted from the scientific literature, and as such has a variety of organizational structures (e.g., cause and effect) and text features (e.g., method, results, discussion) that vary from narrative

or descriptive texts. Ms. Fielder was concerned that many of her learners would be unfamiliar with the text structure and face challenges in finding information and, subsequently, building meaning while reading. To help the learners engage with the anchor text, Ms. Fielder used an *extension instructional scaffold*. This type of scaffold can be used as a way to extend the students' understanding of the content and support textual analysis of complex text, such as the anchor text, itself (Fisher and Frey 2014).

Ms. Fielder chose to include a learning opportunity within her learning cycle designed to develop student understanding of the text structure and features in the anchor text. After having her students partner read the anchor text (to ensure all could read the text), she developed a scavenger hunt game for the whole class designed to help her learners understand the text structure and features of the anchor text. Her questions included:

1. Where would you find the results?
2. How would you know how the study is carried out?
3. Where would you find definitions of words?
4. Where would you find evidence for a claim?

Knowledge of text structures is important for aiding learners in constructing meaning of the text (Mason and Hedin 2011). Strategically finding answers in the anchor text from questions can help scaffold students' understanding of the structure of anchor text and, more broadly, information text such as research articles.

## Summary

Avoiding the use of grade-level complex science texts with our learners, particularly for students with disabilities, can be detrimental to fulfilling the expectations of the NGSS and CCSS-ELA.RST. Research

**FIGURE 4:** People cool off in front of the Eiffel Tower in Paris during a heat wave in 2019 [<https://commons.wikimedia.org>].



has demonstrated that limiting students with disabilities to text at their instructional level results in no gains (O'Connor, Swanson, and Geraghty 2010). Rather, as Shanahan (2019) pointed out, restricting their access may “serve to isolate these children from their social peers. These students are so aware that they are being relegated to the ‘dumb books,’ with serious consequences for their self-esteem” (p. 22).

Carefully implemented, instructional scaffolds, such as the ones provided in this article, can give students an opportunity to grapple with more difficult text than they perhaps can access on their own (Fisher and Frey 2014). Instructional scaffolds lead to not only stronger knowledge and understanding of the content, but also development of skills to engage in complex science text and improved confidence to do science. ●

## ACKNOWLEDGMENTS

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## RESOURCES

- Anchor text for Earth and Body Systems—<https://scienceandliteracy.missouri.edu/resources-materials/earth-and-human-body-systems/>
- “Explainer: How Heat Kills”—<https://www.sciencenewsforstudents.org/article/explainer-how-heat-kills>
- Lexile text measure—[www.lexile.com](http://www.lexile.com)
- Linking Science and Literacy for All Learners—<https://scienceandliteracy.missouri.edu>

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