

Claims and Evidence

Creating opportunities for students to practice speaking and writing about science

By Julie Jackson, Annie Durham, Sabrina Dowell, Jessica Sockel, and Irene Boynton

Scientists ask questions about the natural world and provide evidence-based explanations. Scientific explanations include making a claim, then using evidence and scientific reasoning to support the claim. The process of teaching students to use claims, evidence, and reasoning to support scientific explanations is referred to as the claim, evidence, and reasoning (CER) framework (Zemal-Saul, McNeill, and Hershberger 2013). In this article we describe what counts as evidence, consider the connection between scientific claims and evidence, and explore the role of scientific reasoning in elementary science instruction. Then, we demonstrate how teachers create opportunities for their students to analyze and interpret data to construct and communicate scientific explanations.

Scientific Evidence and Data

Using scientific evidence and data to support a scientific explanation is a fundamental skill and central to the practices of science. Giving priority to evidence is also an essential feature of inquiry instruction. The *Next Generation Science Standards* (NGSS) suggest that engaging students in scientific practices includes planning and carrying out investigations so that students can generate

data to provide evidence to support claims they make. Elementary school students are expected to use scientific evidence and data. According to the NGSS, students in grades K–2 can produce, collect, or provide data to serve as evidence to answer a question, make a comparison, or support explanations. In addition, students in grades 3–5 should produce data to serve as the basis for evidence, evaluate appropriate methods and/or tools for collecting evidence, and make observations and/or measurements to produce data to serve as the basis for evidence (NGSS Lead States 2013). Students transform data into evidence when they link their evidence (data) to a claim statement. Many teachers use sentence stems to help students construct claim statements. Students usually begin a scientific explanation with the sentence stem “*I claim* ____ (what the student knows/answer to a question or address a problem).”

Scientific Claims

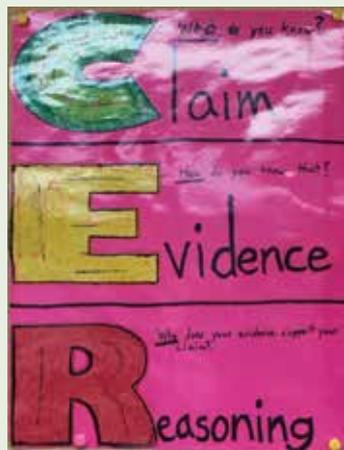
A *scientific claim* is a knowledge statement, either a response to answer a question or a solution to address a problem. We strengthen the scientific explanation framework by supporting claims with evidence. The sentence stem “*I claim* ____ (what the student knows/answer to a question or address a problem) *because* _____

(evidence/data) _____” provides students with a structure they can use to organize their thinking. The word *because* invites students to use evidence (data) to justify or support their claim.

A first-grade teacher explained that *because* is her favorite word and she uses it across all content areas. “I used to use the word *why* to get students to extend or explain their thinking, but this year I’ve been using the word *because*, and I use it as a question.” *Because?* was introduced the first day of school, written on a word strip, and placed in the front of the class. *Why?* is seldom used. The response *Because?* prompts students to finish their sentences or complete their thoughts. When asked *Why?* students typically respond “Oh, I’m sorry,” “Oh, I’m wrong,” or “Oh no, I meant this!” The children interpret “*Why?*” as a challenge to their response because they thought they were correct and did not expect to add details or justify their ideas. They get flustered and concerned. “I have to explain that I’m asking *Why?* because they were right and I want them to tell me more. *Because?* is less threatening. It prompts further discussion. It invites the child to tell me more, to elaborate upon ideas, to support claim statements with evidence.” *Because?* is less stressful. *Because?* simply asks students to finish a sentence, not answer a question.

FIGURE 1.

A color-coded Claim, Evidence, Reasoning anchor chart.



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cate like scientists when they state a claim and then support that claim with evidence. They think like scientists when they evaluate the claims and evidence statements proposed by other students, identify claim statements that go beyond the evidence, and suggest alternative explanations. Zohar and Nemet (2002) found that student content knowledge increased when they created, supported, and evaluated claim statements. Teachers use anchor charts to help students remember the CER framework and support writing. A fifth-grade teacher color coded his CER anchor chart to help students navigate writing CER statements (Figure 1). A green “C” for claim means keep writing; a yellow “E” for evidence indicates they are almost there; a red “R” for reasoning signals that they are nearly finished.

Scientific Reasoning

The reasoning section of a scientific explanation highlights the connection between claims and evidence. It usually restates a scientific concept, scientific rule, or scientific principle that describes why the evidence supports the claim. Reasoning statements connect data gathered during scientific explorations with basic scientific concepts, rules, or principles. The sentence stem “I claim ____ (what the student knows/answer to a question or solution to a problem) ____ because ____ (evidence/data) ____.” *I know I am right because ____ (scientific concept, rule, or principle) ____”* adds a scientific rationale that links scientific evidence to a claim statement. Some teachers create CER sentence stem anchor charts to scaffold student writing (see Figure 2).

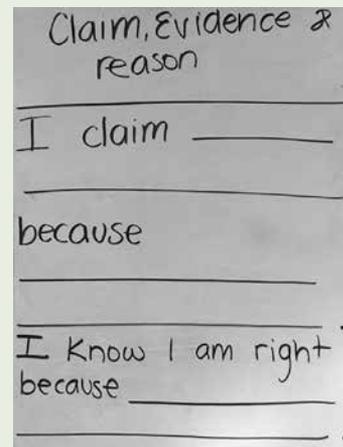
Answering a question can be stressful. Continuing a conversation is far more friendly.

Because? also encourages English language learners (ELLs) and special education students to use oral language. It helps scaffold their writing. The way students speak guides the way they write. This is why we hear a person’s voice in their writing. If one speaks in a certain way, their writing naturally flows in a similar way. Students are comfortable writing explanations that include *because* and providing evidence “because we speak that way every day, in class, on the playground, in the library, in the cafeteria, wherever we are. We use *because* all day long.”

Claims and evidence statements highlight the role of evidence in scientific discourse. Students produce domain-specific text and communi-

FIGURE 2.

CER sentence stems.



Lower elementary teachers report that writing reasoning statements is challenging. Using the sentence stem “I know I am right because ____” helps students construct scientific reasoning statements. A first-grade student stated that *claim* was his favorite word. He liked using *claim* to tell others that he “was right.”

Scientific reasoning statements are powerful formative assessments. They make student thinking public and allow teachers to identify faulty reasoning or clarify possible misconceptions. The following CER statement demonstrates that a first-grade student, studying seasons, understands that it is cold in winter.

Question: What will the weather be like today?

Claim: It is going to be cold today

Evidence: because it is December

Reasoning: I know I am right because December is in the winter and it is cold in the winter. This reasoning statement is a formative assess-



A student adds vocabulary to the interactive word wall.

ment. It is clear that the student knows that December is a winter month and that the weather is generally cold during winter.

Interactive Word Walls

Interactive word walls are visual displays that organize science concepts and academic vocabulary in meaningful ways (Jackson and Durham 2016). They are large graphic organizers or data tables that are planned by teachers but assembled by students. Interactive word walls are an accessible classroom reference that students use to read, speak, and write about science. A fifth-grade teacher has her students create their interactive word walls. Each time they study a new concept, they discuss ways to represent the major academic vocabulary or sci-

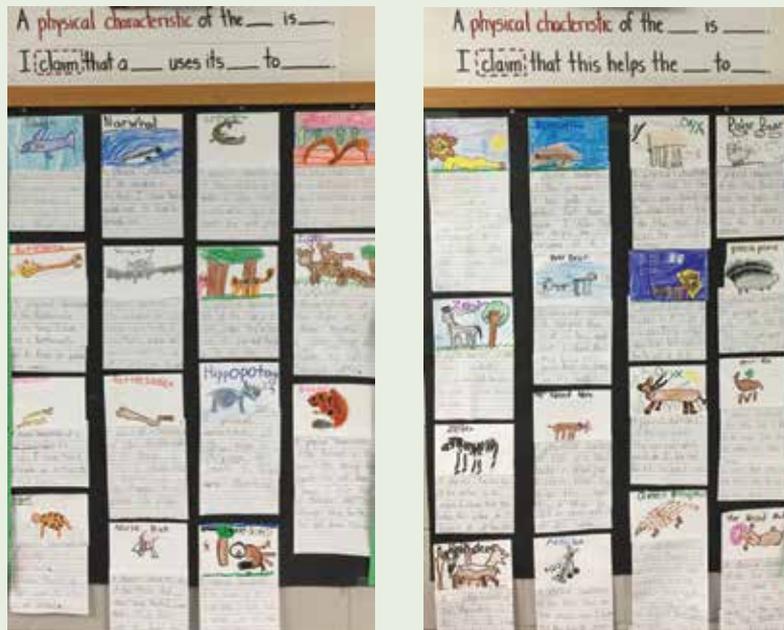
ence concepts creatively on their word wall. “Students help design the word walls and love using it on a daily basis.” Another fifth-grade teacher shared that students in her class “utilize a variety of graphic organizers, charts, graphs, and data tables to organize information from classroom investigations that is displayed on interactive word walls.” She found that students were able to interpret information and over time became skilled in interpreting tables, diagrams, charts, and graphs because they “organized and built the interactive word walls and helped decide how and why the information is organized in a certain way.” A first-grade teacher stated “I love that interactive word walls resemble graphic organizers. We use T-charts for comparing, tree maps for sorting and classifying, Venn diagrams for finding similarities and differences,

and flow maps for sequencing and noticing patterns.” Interactive word walls provide an overview of a learning experience illustrating how the pieces all fit together.

The CER framework can be used to justify placement of items on an interactive word wall and to help students apply the science and engineering practices: analyze and interpret data, construct explanations, engage in argument from evidence, obtain, evaluate and communicate information. After fifth-grade students conduct an investigation, they always build an interactive word wall to organize their findings, the science content, and vocabulary into an easy-to-follow concept map or graphic organizer. To enhance their ability to speak and write about their science experiences, they use the interactive word wall to compose a CER statement as a class. Next, the students

FIGURE 3.

Interactive word walls created during an animal unit.



write a CER statement with a partner and present their CER statement to the class. The class evaluates the CER statements to determine if the reasoning is sound, faulty, or not supported by the evidence. Then, students write a CER statement by themselves. Finally, they write an expository essay on the science concept.

Expository writing allows students to use evidence to support an idea or argument in a clear and concise way. CER statements and the interactive word wall help the students organize this type of writing. This fifth-grade teacher stated "students who struggle with writing or language have found success using interactive word walls and CER statements to foster their ability to write in science. Writing in science has worked two-

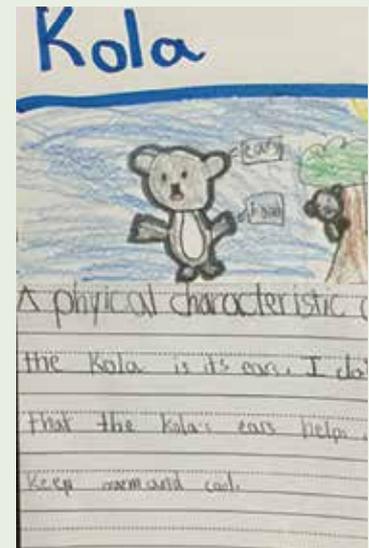
fold for me as the students develop a deeper understanding of the content, and it is a great way for me to assess my students to see where they have gaps in their learning."

Classroom Examples

A first-grade teacher found that when she combined the construction of interactive word walls and CER statements, her students were able to use formal scientific vocabulary to communicate their thinking successfully. The following examples are from a unit that investigated the physical characteristics of animals with an emphasis on how different animals use body parts in different ways and how body parts help animals (see Figure 3). She was surprised by how

FIGURE 4.

A first-grade claims and evidence writing sample.



much her students enjoyed building the interactive word walls and enjoyed watching them proudly contribute writing samples.

Figure 4 illustrates a first-grade CER statement. In this example, the evidence portion of the CER precedes the claim and a reasoning statement was not included. The student used information about the physical characteristics of animals gathered during a class research activity to complete the sentence stems provided by the teacher.

Question: How do the physical characteristic of animals help them survive?

Evidence: A physical characteristic of the koala is its ears.

Claim: I claim that the koala's ears help it keep warm and cool.



This example illustrates that lower elementary school students are capable of writing modified scientific explanations. But they need support. Sentence stems that model age-appropriate scientific discourse help students express their findings and present results during collaborative conversations and when writing informative/explanatory text. Sample sentence stems include:

A physical characteristic of the _____ is _____. I claim that a _____ uses its _____ to _____. I claim that this helps the _____ to _____.

An upper elementary school teacher shared “I am very proud of how hard my students worked on our

interdependent relationships in ecosystems word wall.” The CER writing samples are at various levels because all students participated. “The one thing that I have noticed is that ALL of my students got it! Even my special education kids grasped the concept!” (see Figure 5).

A fifth-grade student used CER to construct an accurate scientific explanation. This student provided a claim statement that answered a question posed by the classroom teacher.

Question: How do living things interact with nonliving elements in an ecosystem to live and survive?

Claim: I claim that cockroaches interact with water by consuming it.

This helps them live and survive. Then the student used evidence to support the claim.

Evidence: It (water) keeps them hydrated.

Finally, the reasoning statement provided the scientific concept/principle that described how the evidence supported the claim.

Reasoning: I know I am right because all organisms need water.

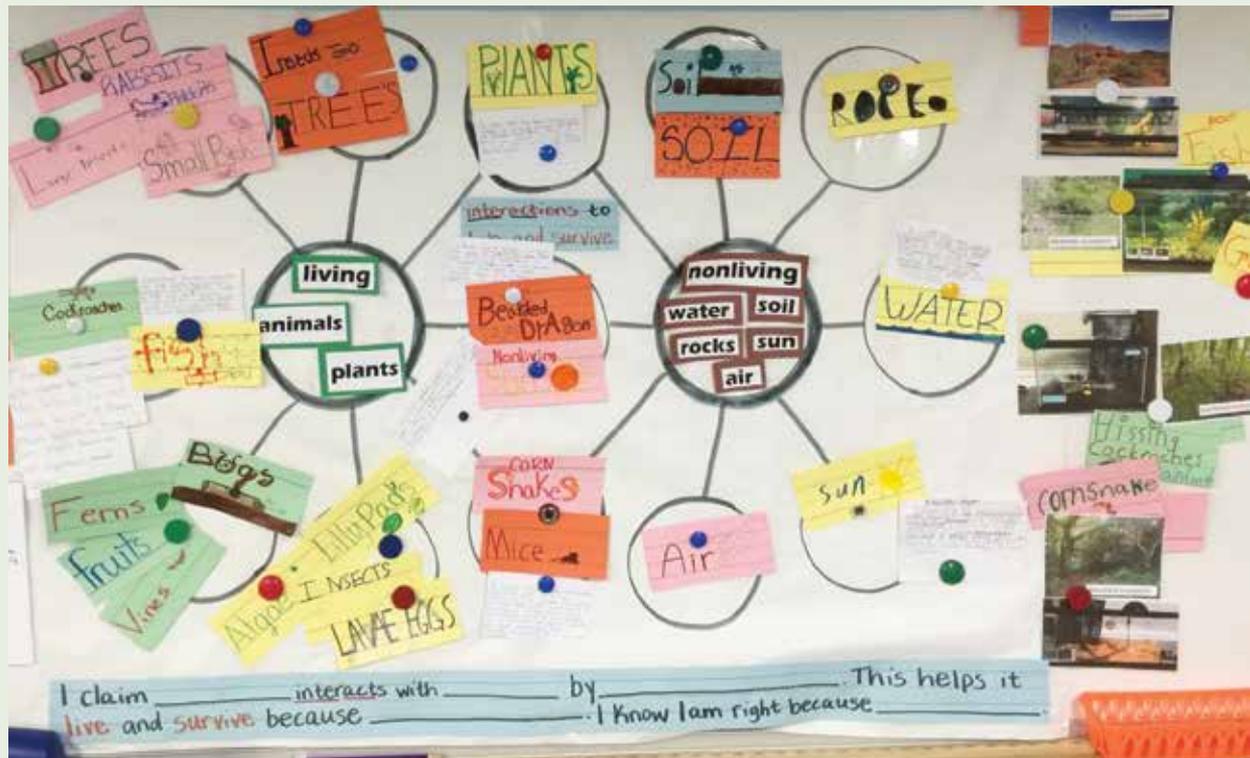
This student used the sentence stems and the information on the interactive word wall to develop a scientific explanation. CER sentence stems help students become familiar with and comfortable using the scientific discourse they will encounter when speaking, reading, or writing about science. An analysis of scientific discourse in elementary classrooms concluded that higher reasoning levels among students were associated with teacher prompts that promoted a culture that productively used evidence in classroom discussion (Hardy et al. 2010). Student comments confirm this observation. When asked what they thought about using interactive word walls, they replied “It’s the first word wall I actually notice.” “It’s the first word wall you can actually play with.” “It’s a great way to organize everything you have learned.” “It is a more interesting, different way to understand the learning.” “The interactive word wall is my sidekick on tests.”

Conclusion

The CER framework supports creating and using scientific explanations in elementary school classrooms. It provides a template that teachers and students may use to structure science talk and science writing. Interactive word walls, anchor charts, sentence

FIGURE 5.

Ecosystem interactions interactive word wall with CER sentence stems.



stems, and teacher prompts (*Because?*) are powerful learning strategies that create opportunities for students to apply CER and practice speaking and writing about their science experiences. ■

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