How many times do we assign writing in science class only to be exasperated by our students’ lack of writing skills? They often have difficulty making claims and using evidence; instead of explaining their reasoning, they state, “Just because.” But teaching writing isn’t just for English/language arts (ELA) class. Over the past two years, our seventh-grade team of teachers has taught writing across the curriculum, used common terminology, and assessed writing using a shared rubric, providing our students with the skills to go beyond “just because” and provide evidence and reasoning to back up their claims. Students’ writing has improved as they learn a basic writing structure that helps support all of their writing, independent of the subject. Students who feel stronger in science than in English gain confidence in their writing in science class and are able to transfer their newfound skills to ELA class.

**Driving factors**

During the past year, we participated in an inquiry cycle driven by a school-wide emphasis on writing across the curriculum. Our team of seventh-grade teachers was eager to dive into this investigation, and we maintained a consistent dialogue and collection of observational data throughout the year.

Several factors shaped our inquiry. In science, professional development around teaching writing using the framework of claim, evidence, and reasoning (McNeill and Krajcik 2012) influenced the implementation...
of this process. In addition, Content Standard A of the National Science Education Standards maintains that “students in grades 5–8 can begin to recognize the relationship between explanation and evidence” (NRC 1996, p. 143). The structure of claim, evidence, and reasoning (CER) tied in well with our inquiry and seemed to mirror the organization structure in ELA class.

At the same time, the English department was looking to reinstitute the use of the 6 + 1 writing traits (Culham 2010) to guide vertical alignment of the writing curriculum. The traits were designed to be used regardless of content or audience and are made up of ideas, organization, voice, word choice, sentence fluency, conventions, and presentation. This framework influenced the creation of our writing rubric. In addition, ELA Common Core State Standard W.7.1 asks

**FIGURE 1** The Case of the Missing Meatballs student worksheet

**Directions**
Read the short story below and then answer the questions.

It was a dark and stormy afternoon at our school. Seventh-grade students were returning from lunch. Mr. G sat on his stool with a fresh spaghetti-sauce stain on his shirt, while Ms. S ushered students to their seats.

“Mmmmm, what a delicious lunch I just had!” Mr. G exclaimed. “I’m completely stuffed. How was school lunch today?” His students looked at him as if he were crazy.

Suddenly, Ms. K knocked at the door. She whispered to Ms. S, “Has anyone seen Ms. C’s lunch? She had spaghetti and meatballs, but it seems to have gone missing.”

Ms. S thought for a moment, going back in her memory to think if she had seen anything. She turned to Mr. G and asked, “Mr. G, did you see anything? I think you were in Ms. C’s room just before lunch started.”

Mr. G widened his eyes a little and quickly said, “No.” He stood up quickly, knocking his lunch box off of the table. When it hit the floor, a sandwich and an apple rolled out. Mr. G scanned the room, and then asked students, “Does anyone know anything about Ms. C’s missing lunch?”

Who do you think took Ms. C’s lunch?

List the pieces of evidence from the story that make you think that:

1. ________________________________________________________________

2. ________________________________________________________________

3. ________________________________________________________________

4. ________________________________________________________________

Why do these pieces of evidence make you think that this person took Ms. C’s lunch? Explain:

How confident are you that this person really took Ms. C’s lunch?

How confident would you feel with only one or two pieces of evidence?

In science, why is it important to have more than one piece of evidence to support your claim?

In science, why is it important to explain why the evidence supports your claim?
GETTING PAST “JUST BECAUSE”

students to “write arguments to support claims with clear reasons and relevant evidence” (CCSSO and NGA 2010). ELA teachers were already helping students organize open responses using this format, which mirrored the CER format in science: thesis, evidence 1, explanation 1, evidence 2, explanation 2, evidence 3, explanation 3, conclusion.

State standardized testing was also taken into consideration. In seventh grade, students complete open responses on the math and ELA tests. Open responses are also a component of the eighth-grade science assessment.

Perhaps the most significant and compelling factor guiding our inquiry was our realization that the expectations for writing an open response in ELA class had many similarities with writing in science. Our new awareness of these parallels led us to consider our guiding question: What strategies can we use to teach students how to identify sufficient and appropriate evidence and explain how it supports their thesis?

Introducing the structure to students

In science class, we introduced the CER structure through “The Case of the Missing Meatballs” (see Figure 1 and www.nsta.org/middleschool for the PowerPoint presentation and lesson), our own take on an episode of the television show CSI, in which students used evidence to figure out that their science teacher had stolen their ELA teacher’s lunch. This was a fun way to get students interested in learning the structure for their explanation. Teachers also enjoyed themselves, often telling students, “That’s a pretty serious accusation! I hope you have evidence to back it up.” The kids would roll their eyes, but they got the point: Claims have to be supported by evidence.

### FIGURE 2

Pond-water-quality writing prompt with student response

A group of scientists measured some properties of the water in both Ladybug Pond and Tadpole Pond. Their results are shown in the table below. Use the freshwater environmental conditions to see the range of acceptable conditions for several organisms.

**Water-quality test results**

<table>
<thead>
<tr>
<th></th>
<th>Ladybug Pond</th>
<th>Tadpole Pond</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>7.4</td>
<td>9</td>
</tr>
<tr>
<td><strong>Dissolved oxygen</strong></td>
<td>5 ppm</td>
<td>4 ppm</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>59°F (15°C)</td>
<td>55°F (12.8°C)</td>
</tr>
<tr>
<td><strong>Turbidity</strong></td>
<td>Clear water (low turbidity)</td>
<td>Clear water (low turbidity)</td>
</tr>
</tbody>
</table>

Which pond is a healthier environment for small-mouth bass (a kind of fish)? Use the CER method to help organize your response.

*A typical student response written after an introductory lesson on the CER structure is shown below. This student was asked to explain the concepts of pH, dissolved oxygen, temperature, and turbidity to add to the reasoning section of the next draft.*

**Ladybug or Tadpole pond**

**Small-mouth bass**

The small-mouth bass would not be able to live in Tadpole Pond but he could live in Ladybug Pond. The pH for Ladybug Pond is 7.4, for Tadpole Pond it is 9.0. The dissolved oxygen for Ladybug Pond is 5 ppm and for Tadpole Pond it is 4 ppm. The temperature for Ladybug Pond is 59°F (15°C), for Tadpole Pond it is 55°F (12.8°C). With that being said, the pH range for small-mouth bass is 6–8.5, and 7.4 is in that range, but Tadpole Pond is 9 and that’s too basic for it. The dissolved oxygen has to be 5 ppm and that is what it is for Ladybug Pond but for Tadpole Pond it is 4 ppm and that is too little dissolved oxygen. The temperature for the small-mouth bass has to be in the range of 12.8–20°C. Ladybug Pond is 15°C and that’s OK. For Tadpole it just about makes it, it’s 12.8°. With all of my evidence and reasoning, the small-mouth bass can only live in Ladybug Pond.
Next we asked students to apply the CER structure to a scientific prompt on determining water quality using pH, dissolved oxygen, temperature, and turbidity (Figure 2). The prompt built on recent fieldwork and asked students to use their data to determine which of two local ponds was a healthier environment. Our students’ initial writing samples ranged from a couple of sentences with no evidence to a detailed explanation with sufficient and appropriate evidence.

Our ultimate goal was to create a writing rubric using student language that incorporated the 6 + 1 traits and the CER format that we could use in any academic class to assess student writing. The first step we took was to each select three pieces of student writing and present them anonymously in both science and ELA classes. Students were placed in pairs and for each piece of writing used the think-pair-share method to identify qualities of good writing to use in our rubric. Students’ comments included these statements:

- “Good claim because it answers the question.”
- “Used new vocabulary words correctly.”
- “Specific evidence.”
- “Last sentence restates the claim.”
- “Reasoning is good because it tells why the pond is good for the bass.”

Notice that students indicated that the “last sentence,” or conclusion, helped strengthen the writing. Because of this, we decided to turn our CER structure into a CERC structure (claim, evidence, reasoning, conclusion).

Next, our team met several times to create a rubric (Figure 3). We included all seven writing traits, but we employed student-friendly language, often using students’ words as the criteria to meet expectations for a particular trait. For example, for the “word choice” trait, the rubric asks students to appropriately use new vocabulary from class, which was verbatim from what students had identified in the activity as a quality of good writing. The “ideas” trait seemed to encompass too much, so we broke it down to emphasize each component: thesis/claim, evidence, reasoning/explanation, and conclusion.

**Scaffolding for all students**

Ongoing observations of student work prompted us to craft scaffolds (Figure 4) to help every student be a successful writer. Students sometimes forgot the components or the order of the CERC structure, so we used mnemonics in all subjects, constructing posters to remind them. We noticed that students needed to plan out their ideas before writing, so we created graphic organizers (Figure 5) to help them structure their thoughts before writing. Students sometimes
had difficulties incorporating our feedback into their revisions, so we produced a writing action plan (Figure 6) for students to fill out before starting their revisions to help them navigate the revision process. Even so, students often left out high-quality sections of their previous drafts, so we generated a conferencing checklist for teachers that included having students highlight good writing that should be included in the next draft. We also collaborated on a consistent writing process for all classes so that it became second nature for students. Finally, we taught focused lessons in each subject on specific writing skills or sections of the structure.

**Student outcomes**

On our state’s ELA test, fully two-thirds of our students scored proficient or advanced this year. In addition to scores, Massachusetts reports a “student growth percentile” (SGP), which compares an individual’s yearly progress to the progress of all other students in the state with the same sixth-grade score. For example, students in the warning category have their progress compared with other students in the warning category, and so on. Specifically, the SGP is the percentage of students with the same score on the sixth-grade test whom a student outperformed in seventh grade. An SGP of 50 means that a student made an average gain, outperforming half of his or her peers in seventh grade. An SGP of 90 means that a student made an average gain, outperforming 90% of their peers. And 72% of our students earned an SGP of at least 50, making at least average progress. Our median SGP was 66, meaning that, on average, our students made more progress in seventh grade than two-thirds of all seventh-grade students in the state.

One particular strength our students now have is the skill of writing a claim that not only answers the question but also includes a preview of the reasoning...
that will follow. The preview of the reasoning parallels what students learn in ELA and provides a good hook that will encourage the reader to keep reading.

Another unexpected benefit from our work is that we helped students understand how to formally write for science. One of the 6 + 1 traits is a voice that is appropriate for the audience. Although this was never the main focus of our teaching, students pushed themselves to remove the pronouns “I” and “me” from their writing, holding brainstorming sessions to figure out what to write instead.

<table>
<thead>
<tr>
<th>Category</th>
<th>Beginning (1)</th>
<th>Approaching (2)</th>
<th>Meeting (3)</th>
<th>Exceeding (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice (3 points)</td>
<td>The tone is inappropriate for the purpose of the writing.</td>
<td>Attempted to show why the reader should care; tone of the message is somewhat interesting or somewhat inappropriate for the purpose of the writing.</td>
<td>Writing reflects a strong commitment to the topic by showing why readers need to know this and why they should care. Tone adds interest to the message and is appropriate for the purpose and audience.</td>
<td>“Meeting” plus voice is exceptional.</td>
</tr>
<tr>
<td>Word choice (3 points)</td>
<td>Very little detail or inappropriate imagery for the audience. Vocabulary words are used inaccurately.</td>
<td>Uses some descriptive details, and most are appropriate. Some vocabulary words from class are used accurately.</td>
<td>Uses descriptive details and visual imagery appropriate for the audience; words are specific and accurate, appropriately using new vocabulary from class.</td>
<td>“Meeting” plus it is clear that the writing has been revised to use descriptive words.</td>
</tr>
<tr>
<td>Sentence fluency (3 points)</td>
<td>Sentences are incomplete or run-on sentences.</td>
<td>Sentences are complete but simple or structure is repetitive.</td>
<td>Uses some complex sentences and variations.</td>
<td></td>
</tr>
<tr>
<td>Conventions (3 points)</td>
<td>More than 6 errors per page.</td>
<td>3–6 errors per page.</td>
<td>Accurate spelling, punctuation, capitalization, grammar, and paragraph structure. Fewer than 3 errors per page.</td>
<td>No errors.</td>
</tr>
<tr>
<td>Presentation (3 points)</td>
<td>Handwriting is difficult to read; not in ink; font is unacceptable; there are no paragraphs; title is missing or doesn’t connect to the topic; doodles in margins.</td>
<td>Handwriting is not very neat; font is slightly inappropriate; paragraphs are not indented; title is simplistic.</td>
<td>Neat handwriting in blue or black ink or typed in appropriate fonts; good margins; paragraphs are indented; title is creative and connects to the topic.</td>
<td>“Meeting” plus presentation is exceptional.</td>
</tr>
</tbody>
</table>

**Learning from our inquiry cycle**

One drawback most teachers fear with a structure such as CERC is that student writing will seem robotic or formulaic. We actively discouraged this in class by crossing out phrases such as “My first piece of evidence is...” in early drafts. Students should understand that while they have to use evidence and explain it, this is not an inflexible model. One day, when students were writing in response to a science prompt, a student asked us whether he needed to group all of the evidence together and then all of the reasoning, or if he could write a short
piece of reasoning after each piece of evidence. Our response was that it was up to each student to respond using whatever format would lead to a clearer explanation. Students wanted to explore the flexibility in the model, and we encouraged them to do so.

As we gained more confidence teaching writing, we realized that our science prompts fit into two main styles, both of which aimed to engage students. The first was based on data from a science lab, such as predicting the order or layers of liquids with different densities. The other style was about environmental justice, often based on data from research or readings. For example, we asked students to write about whether people should drink tap water or bottled water. Reflecting on the year, we would like to design more prompts based on evidence directly collected by students so that they will see more of a connection between science explanations and science experiments.

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**FIGURE 4** Student writing scaffolds

<table>
<thead>
<tr>
<th>Scaffold</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mnemonic</td>
<td>“Crocodiles Eat Rude Children” stands for claim, evidence, reasoning, conclusion.</td>
</tr>
<tr>
<td>Graphic organizer</td>
<td>Organizer to help students include every section, even splitting up the reasoning section into two parts—one that focuses on how the evidence supports the claim and one that explains the underlying concept.</td>
</tr>
<tr>
<td>Writing action plan</td>
<td>Organizer to help students identify strengths and weaknesses of writing, use the rubric to find specific writing traits to improve on, and plan their revisions.</td>
</tr>
<tr>
<td>Writers conference checklist for teachers</td>
<td>Checklist to streamline the conferencing process for all teachers, including paraprofessionals, learning specialists, and student teachers.</td>
</tr>
<tr>
<td>Writing process</td>
<td>Students always begin with a graphic organizer, then a rough draft, then teacher feedback via written comments and the common rubric, then the writing action plan, and finally a revision.</td>
</tr>
<tr>
<td>Focused practice on individual sections</td>
<td>In ELA class, for example, students practiced how to write a claim that would include key information and stand alone.</td>
</tr>
</tbody>
</table>

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**FIGURE 5** Scientific explanation graphic organizer

Directions: Write notes *only* in the boxes below to help organize your writing—*not* complete sentences!

<table>
<thead>
<tr>
<th>Claim:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence:</td>
</tr>
<tr>
<td>Reasoning, Part 1 (why the evidence supports the thesis):</td>
</tr>
<tr>
<td>Reasoning, Part 2 (explain the underlying concept):</td>
</tr>
<tr>
<td>Conclusion:</td>
</tr>
</tbody>
</table>
In science, we discovered that breaking the revision process into chunks led to more enthusiastic students and higher-quality final drafts. After completing a graphic organizer and a rough draft, we spent one day on each section: claim, evidence, reasoning, and conclusion. Each day, we focused on the components of the section, used our rubric to remind students which qualities would make it high quality, and provided time to write a revision of just that section. After all four days, students simply combined all four of their section revisions to compose the final draft.

As our inquiry progressed, we also revised our own work. One of our best team meetings involved collaborative grading of student writing using the rubric and simultaneous revision of the rubric in order to focus in on performance levels.

Our students still have not completely mastered everything about writing with evidence and reasoning. The most common difficulty they have is identifying what they can use for evidence, especially in science class. Scientific evidence is numerical data or detailed observations, and some of our students try to use generalizations as evidence instead of the results from a lab. In addition, the line between evidence and reasoning can get a little blurry, especially when the prompt is an environmental-justice one.

One of the biggest challenges of teaching writing, or any other subject, especially when teaching children who struggle, is generalizing it. Students often do not recognize that what they learn in one lesson or subject area often can be applied in other scenarios. Our consistent use of the CERC model for writing allowed students to see how writing is connected across the content areas. Although there are slight differences for each content area, this model can be applied to all writing, even in mathematics. No longer do students write “just because” or “I don’t know.” Those students who once struggled with writing feel successful, no longer staring at a blank page with frustration in their eyes. The standardized-test anxiety has also disappeared. We still have work to do, but our interdisciplinary coherence around writing has certainly resulted in remarkable student achievement.

References

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