CHAPTER 6

Literacy Learning Clubs in Science

The recent release of the The Next Generation Science Standards (NGSS; NGSS Lead States, 2013), a national effort facilitated by individual state representation calls for science education to focus on the deep understanding and application of content in ways that are transferable to what the educational community commonly refers to as college and career readiness but perhaps is best understood as life. The focus of these standards is on learning how to access, comprehend, and construct scientific content. This is a shift from paradigms that focus exclusively on discrete knowledge. In the executive summary, the authors note:

Every NGSS standard has three dimensions: disciplinary core ideas (content), scientific and engineering practices, and cross-cutting concepts. The integration of rigorous content and application reflects how science and engineering is practiced in the real world.

This view of three-dimensional learning is a call for educators to see science instruction and learning as a balance of building content knowledge by developing cognitive paradigms in students that allow them to access the content (NGSS Lead States, 2013; see Figure 6.1):

The Standards offer this overview for educators:

The National Research Council’s (NRC) Framework describes a vision of what it means to be proficient in science; it rests on a view of science as both a body

FIGURE 6.1. Three-dimensional learning experiences need of how students learn in pedagogy as well as an represent scientific inform...
of knowledge and an evidence-based, model and theory building enterprise that continually extends, refines, and revises knowledge.

Learning science should be about accessing content by developing a framework for thinking like a scientist. Educators positioned to facilitate these scientific learning experiences need to blend content expertise with a strong understanding of how students learn in the discipline. This requires expertise in the content and pedagogy as well as an awareness of the literacy demands needed to access and represent scientific information.

These standards, like many others we have seen and will investigate throughout this text, privilege developing cognitive frameworks for accessing content in the absence of a classroom over discrete knowledge. This shift does not reflect our typical disciplinary boundaries found in classrooms. We do not, for example, generally study themes that invite us to pull in multiple disciplines. Imagine a school day when students' scheduled areas of study are organized by themes to investigate rather than by disciplines. Literacy learning clubs may be a bridge that allows for the development of these deeper cognitive frameworks while working within the disciplinary boundaries that currently exist in schools.

In this chapter, I step inside literacy learning clubs as a tool for learning in a science classroom that embodies this philosophy of providing tools to access the content of the discipline, while also developing a cognitive framework for understanding the discipline outside of traditional concepts of classroom instruction. The NRC (2012) offers this paradigm for the revision of science education in the NGSS:
Science, engineering, and the technologies they influence permeate every aspect of modern life. Indeed, some knowledge of science and engineering is required to engage with the major public policy issues of today as well as to make informed everyday decisions, such as selecting among alternative medical treatments or determining how to invest public funds for water supply options. (p. 8)

This is at the heart of the call for authentic science instruction and learning that asks students of science to both understand the content of the discipline and develop the skills needed to independently navigate the discipline as part of their daily lives.

Science education, according to this perspective, is a much deeper and more complex endeavor than memorizing discrete facts and principles. It, much like social studies education, is an opportunity to engage in transformative ways of thinking and learning that allows participants in science education to effectively learn the discipline by adopting the natural habits of scientists (NGSS Lead States, 2013). The NRC (2012) goes on to offer this call to action to K–12 science educators:

The framework is designed to help realize a vision for education in the sciences and engineering in which students, over multiple years of school, actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields. The learning experiences provided for students should engage them with fundamental questions about the world and with how scientists have investigated and found answers to those questions. Throughout grades K–12, students should have the opportunity to carry out scientific investigations and engineering design projects related to the disciplinary core ideas. (pp. 8–9)

This call for more engaged learning that connects to real-world applications prompts an opportunity to discover how the disciplines that often exist as discrete blocks of time during the school day naturally spill into each other when authentic investigations occur. As adults, we do not live our lives engaged in the world with barriers between the disciplines of literacy, social studies, science, math, and the like, but we instead draw naturally from those areas in order to engage with the activity at hand both professionally and personally. Scientists draw from math and history in their effort to make sense of the natural world around them and to create alternatives in medicine and the ecology, among others. As we turn our lenses to the other academic disciplines found in school, we find that the same is true.

If students are going to develop this conceptual framework, alternate pathways into the content must be considered. Literacy learning clubs offer a structure for engaging learners in scientific core content in ways that support the natural development of the

In this chapter, I look at the examination of scientific text. This is what we are designed to support subjects as well as of science through

Disciplina

Research on the literate scientific text, their Shanahan et al., 2011, "weeding out the close attention to the often necessary before close analysis of the (2011) cite the follow

Martin (1993), Vi science to include procedural recur (c) science report steps, or by listing why phenomena o

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Analyzing text str vocabulary specific to as mentor texts for wr differences in discourse ematics. This further
Development of the literacy habits necessary for this deep engagement in science. In this chapter, I look specifically at how literacy learning clubs allow this deep examination of science content while constructing paradigms for accessing content. This is what I term “knowing-and-ways-of-knowing.” The examples offered are designed to support elementary school teachers who are responsible for multiple subjects as well as those who are content specialists and teach multiple periods of science throughout the day.

**Disciplinary Literacy: The Literacy Lenses of Scientists**

Research on the literacy habits of scientists suggests that when these experts read scientific text, their intent is to learn specific information (Fisher & Frey, 2015; Shanahan et al., 2011). When reading and writing in the sciences, there is a perpetual “weeding out” of what is new and what is known, allowing for careful, close attention to the new information. For this reason, rereading is common and often necessary before comprehension can occur. These scientists engage in similar close analysis of text when they are writing as well. Shanahan and colleagues (2011) cite the following as hallmarks of the discipline:

- Martin (1993), Veel (1997), and Wignell (1994) classified common genres of science to include (a) procedure (to provide instruction for experiments), (b) procedural recount (to record what has already been done in an experiment), (c) science report (to organize information by setting up taxonomies, parts, or steps, or by listing properties), and (d) science explanation (describing how and why phenomena occur). (p. 398)

Using academic vocabulary, the semi-technical and technical terms specific to the discipline, is an essential literacy skill for scientists, and they assume an objective stance when they are working with scientific texts (Fisher & Frey, 2015). This is in direct contrast to writers of social studies texts, which are often driven by human intention with rich narrative instead of experimental findings or reports (Draper, 2010; Fisher & Frey, 2015; Shanahan et al., 2011; Shanahan, 2015). There is also a shift in writing demands as writing in science tends to adopt the passive voice, whereas the social sciences prefer the active voice.

Analyzing text structure along with a close look at the type of academic vocabulary specific to the discipline of science provides anchors for reading as well as mentor texts for writing within the discipline. This work describes the distinct differences in discourse patterns when comparing science, social studies, and mathematics. This further debunks the notion that there can be a “one discipline fits
all" set of literacy skills and strategies (Draper, 2010; Fisher & Frey, 2015; Shanahan et al., 2011; Shanahan, 2015). Just as in Chapter 5 where we looked at what it means to read and write like a social scientist when working within the discipline of science, we need to teach the student to read and write like a scientist when working within the sciences.

**Literacy Learning Clubs in Science Classrooms**

**Literacy Learning Clubs in Elementary Science Classrooms**

Science instruction, like social studies instruction, is often marginalized in the elementary grades due to the increase in high-stakes assessment in language arts and math. A longitudinal study of instructional time in classrooms in grades 1–4 shows a marked increase in time devoted to math and language arts and a gradual decrease in science and social studies instruction. While the National Center for Education Statistics (NCES) has not yet repeated this study, based on current trends it is likely that this decrease is continuing (see Table 6.1).

In addition, elementary educators often do not have academic experience in the discipline during their preservice years; few students pursuing certification in elementary education major in one of the sciences, and even if they do, much as is the case for social studies, the sciences cover a wide range of subdisciplines (chemistry, biology, physics, etc.). This consideration, coupled with the lack of methods preparation found at many institutions, creates an environment in which science is easily forgotten and at best marginalized when not dictated during a testing year.

**TABLE 6.1.** Average Number of Hours of the Student School Week That Public School Teachers of Grades 1–4 Self-Contained Classrooms Spent on Each of Four Subjects: Selected Years 1987–1988 through 2007–2008

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<tr>
<td>English</td>
<td>11.0</td>
<td>10.5</td>
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<td>Mathematics</td>
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<tr>
<td>Social studies</td>
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<td>3.0</td>
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<tr>
<td>Science</td>
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**Literacy Learning Science Class**

It is no surprise, t dents enter middle daily with an instr content. It is a lar arguably an even l without the habits like for the subject the elementary gra are confident in th of the discipline. I science teachers tr of the appropriate In the elementary needed.

In addition, th understanding of st navigate the
When the CCSS in ELA called for more attention to nonfiction texts, the integration solution of simply inserting science texts as a piece of literacy instruction seemed an easy answer to fulfilling the requirements of attending to more nonfiction in ELA while bringing in more science content. I argue, however, that this is a solution in appearance only. The research on disciplinary literacy acknowledges that there is not one single tool kit for reading and writing that maps easily onto all disciplines (Draper, 2010; Fisher & Frey, 2015; Shanahan, 2015). Simply using science texts in the language arts block does not engage students in the deep investigation of the discipline called for by the NGSS, nor does it offer students the opportunity to develop the scientific literacy habits necessary to successfully navigate the discipline.

Many national organizations have issued a call to focus on STEM or STEAM education in the early grades to create a population of students who are engaged in the sciences and related fields and continue on to pursue careers in these areas. If we are going to cultivate this embrace of the sciences in our youngest students, we also need to invest in the educators who will be facilitating interest in these areas. While many local programs provide opportunities for this engagement, the national reform effort that is needed has yet to occur. And so the disparity continues.

**Literacy Learning Clubs in Middle School Science Classrooms**

It is no surprise, then, that struggle and disengagement are the result when students enter middle school where they are typically engaged in science instruction daily with an instructor who has a core academic major or concentration in the content. It is a large leap for those beginning a focused study of social studies and arguably an even larger leap for many in the sciences who come to middle school without the habits of mind necessary to navigate the discipline. For many, a dislike for the subject occurs because their positive experiences have been limited. In the elementary grades, many children find themselves working with teachers who are confident in their capacity to create structures for learning but lack knowledge of the discipline. In middle school, the reverse is often true. Many middle school science teachers may have strong content knowledge but limited understanding of the appropriate literacy instruction for supporting students in the discipline. In the elementary and middle school classroom, a deep understanding of both is needed.

In addition, the research suggests that it is critical that all educators have an understanding of the discipline-specific literacy habits necessary to help these students navigate the course content. The recent integration of the CCSS for literacy

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<th>Week That Public Schools Spent on Each Subject</th>
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*Notes: SASS, "Public Teacher Data 2008; Public School Data 2008; Charter Teacher Data 2008"
INSIDE THE DISCIPLINES

in science offers a pathway for considering the literacy habits necessary for success in this discipline. These standards name the following literacy skills needed in science and the technical subjects in the middle grades. In order to cultivate this discipline-specific literacy lens, however, we need to consider integration in the elementary grades as well.

Key Ideas and Details

CCSS.ELA-LITERACY.RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts.

CCSS.ELA-LITERACY.RST.6-8.2: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

CCSS.ELA-LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Craft and Structure

CCSS.ELA-LITERACY.RST.6-8.4: Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

CCSS.ELA-LITERACY.RST.6-8.5: Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.

CCSS.ELA-LITERACY.RST.6-8.6: Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

Integration of Knowledge and Ideas

CCSS.ELA-LITERACY.RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS.ELA-LITERACY.RST.6-8.8: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

CCSS.ELA-LITERACY.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Range of Reading and Level of Text Complexity

CCSS.ELA-LITERACY.RST.6-8.10: By the end of grade 8, read and comprehend science/technical texts in the grades 6–8 text-complexity band independently and proficiently. (NGA & CCSSO, 2010)

The Standards outline curricula to support students' academic vocabulary in the call to position statement of a cognitive framework to create opportunities simultaneously becoming information.

Naming the standards be connected to create a new discipline. This is an area for sharing the book paradigm to see the literacy habits need access to the inquiry-based literacy learning community, collaborating with opportunity for professionals.

In the next section, sixth-grade classroom as instruction. As we do so, pedagogy in a way that is

Literature

Mr. S's Fourth-Grade

Mr. S has been teaching for growing in science, but the curriculum consisted of science that were meant to motivate and many of his colleagues rushed implementation, as the activity, he recognized study itself.

Mr. S is not considering how to investigate a day ahead of the students.
The Standards outline the types of literacy experiences Shanahan and colleagues (2011) describe in their work with scientists. These standards ask educators to support students' awareness both of content and of the text structures and academic vocabulary necessary to get at that content. This connects well with the call to position students to balance acquisition of content with the development of a cognitive framework to navigate the discipline. This calls for educators to create opportunities for students to begin to develop content knowledge while simultaneously becoming aware of the cognitive frameworks needed to learn new information.

Naming the standards, however, is not enough. A number of pieces need to be connected to create a pathway for student success beginning in the elementary grades. This is an area for professional development as we consider the many gaps in science education that interfere with student success. Use of the literacy learning club paradigm to support both teachers' and students' explicit awareness of the literacy habits necessary for success in the content is one avenue for offering access to the inquiry-based model of learning that the NGSS supports and the literacy learning club paradigm offers. For educators first embarking on this journey, collaborating with colleagues while implementing this paradigm becomes an opportunity for professional learning and understanding.

In the next section, we step inside Mr. S's fourth-grade classroom and Ms. B's sixth-grade classroom as they integrate literacy learning clubs into their science instruction. As we do so, I invite you to reflect on their efforts to link content with pedagogy in a way that is transformative for the students.

**Literacy Learning Clubs in Practice: Voices from the Classroom**

**Mr. S's Fourth-Grade Classroom**

Mr. S has been teaching fourth grade for 4 years and does not have a broad background in science, but he is eager to learn. Previous to this year, the science curriculum consisted of science kits (building electrical circuits, growing plants, etc.) that were meant to motivate inquiry-based learning. In practice, however, Mr. S and many of his colleagues found that they offered a scripted curriculum with rushed implementation, so while the students certainly were engaged and enjoyed the activity, he recognizes that learning was limited beyond the specific unit of study itself.

Mr. S is not confident that the students left the class with an understanding of how to investigate phenomena as scientists. In fact, since he only kept one day ahead of the students with the content, he is not certain that he has a firm
understanding of these phenomena either. Science in his classroom has become a series of activities to check off a list. Mr. S realizes that in order to allow students to learn, more time and understanding need to be invested and students’ natural questions about the world around them have to be considered.

This is easier said than done, however. Mr. S is feeling a tremendous amount of pressure to get his students ready for the state assessment in math and literacy and is torn about how to handle the call for a “deeper dive” into the discipline of science, particularly since he himself is not confident in the discipline. Mr. S was asked, however, to participate as the grade-level representative in a committee looking to integrate the NGSS into the curriculum. He was inspired by his reading of the document, and while he has questions about the implementation, scripted rubrics and the like, he is ready to try and balance the knowing with ways of knowing. In addition, the CCSS for ELA place a greater focus on discipline-specific texts, so he feels it is now necessary and appropriate to incorporate the discipline into language arts.

Literacy learning clubs are a pathway for that “deep dive” into the content while allowing students to build their own cognitive framework for accessing content. The curriculum in fourth grade calls for a study of plants, which Mr. S, an avid gardener, had felt he had done a reasonably good job of in the past. Students grew a plant from a seed, documented growth with an observation journal, and researched how plants grow. They celebrated their work with a “plant show” for parents, complete with a written expository essay about the process. Mr. S is eager to try this new framework with an area of the science curriculum he feels comfortable with, so he gets ready in early March to launch the students into an investigation using the literacy learning clubs paradigm. In looking at this activity through the lens of what he is beginning to understand is meant by science education, he realizes that students were not deeply engaged with scientific content or processes but instead used this study as a vehicle to develop expository writing skills.

This time, instead of starting with the answer, that plants will grow and they will document the process, he is asking students to start with a question—what is the process through which growth happens? Mr. S then organizes the students into learning teams, or clubs, based on the area that they are most interested in studying. This time, however, instead of growing a seed in a Dixie cup, his students are partnering with a local farmer (a relative of one of the students in the class) to plot out a garden. “There’s a lot more than science happening here,” Mr. S thinks to himself. “But that’s the whole point.” To begin the project, the local farmer skypes with them from her farm, taking them on the tour of the land available and the dimensions. The class will periodically skype with the farmer throughout the project, as well as visit for the initial planting.

The class of 201 students is to identify possible, time, climate, and In preparation for the academic vocabulary reading/viewing need to then engage in this set of articles, videos, and their report. Prior to study in science and their findings and reports that in science, they need the list. The planned activities include:

- Potatoes
- Strawberries
- Tomatoes
- Lettuce
- Peas

New groups are then formed to create initial groups submit their ideas. The groups are given teams have 1 week to prepare a modal presentation for the group meeting of a learning club framework.

Each session begins with a session where the students read multiple websites, Mr. S balances reading and the think-aloud and presents the necessary reading and...
The class of 20 is organized into five groups of four. The initial task of each group is to identify potential crops that can be planted given the dimensions available, time, climate, and goal of potentially donating whatever crops are harvested. In preparation for this part of the study, Mr. S does a mini-lesson on some of the academic vocabulary used when reading about planting and models the type of reading/viewing necessary for looking for key facts within scientific texts. Students then engage in this study for two 40-minute periods using a series of bookmarked articles, videos, and their textbook. On the third day, they spend time developing their report. Prior to this development, Mr. S does a mini-lesson on creating a case study in science and demonstrates that when sharing their ideas they must include their findings and recommendations, along with their sources. Mr. S reminds the students that in science they must be able to offer evidence for their ideas as well as their findings. They submit their recommendations to the farmer, and he finalizes the list. The planned crops include:

- Potatoes
- Strawberries
- Tomatoes
- Lettuce
- Peas

New groups are then formed based on interest. Each group begins by learning more about their chosen food. The class has a good organizing start because each initial group submitted a framework that was compiled and shared via Google Docs. The groups are tasked with providing the dimensions needed for planting, the plan for growth, challenges to be aware of, and methods for harvesting. Each team has 1 week to develop this plan, which they will put together in a multimodal presentation following the models of scientific reports they are reading. The group meets for five sessions of 40 minutes each, and Mr. S uses the literacy learning club framework to guide these meetings.

Each session begins with Mr. S providing the necessary content about the science behind plant growth as well as the strategies successful botanists adopt when working with plants. In addition, since this method of study requires that the students read multiple types of printed reports, view video clips, and navigate websites, Mr. S balances this presentation of content with study both during the focusing session and at the concluding think-aloud. During the focusing session and the think-aloud Mr. S models what he does as a reader and writer to gather and present the necessary information across these different text types. The students are reading and writing content as well as exploring methods for reading and
writing in the content, which provides the opportunity to build knowledge as well as create the mental habit needed to come to that knowledge.

The team submits its recommendations to the farming staff at the local farm and then visits to launch the work with periodic site visits over the 6-week growth period, during which the team has the opportunity to observe and chart growth. Technology allows them to "visit" more frequently than the two scheduled on-site trips. At the conclusion of the project, each team writes a final report that includes recommendations for future planting based on what they learned through this initial work. The final reports are inclusive of the academic vocabulary that they have been introduced to and come to understand throughout the process. Mr. S is confident that the students have deepened their scientific knowledge of botany and have begun to develop a framework for engaging with scientific content both as readers and writers in ways that allow them to see the relevance of that knowledge to the world around them. He believes they are beginning to understand what it means to read and write like a scientist in ways that will support their learning inside the classroom and outside, too, when the heavy scaffolding he has provided throughout is not available.

The literacy learning club framework allows the learning to be designed in a way that positions the success of collaborative learning with individual accountability. Mr. S establishes the expectations and parameters of the content and context of learning, but the ability to dive deeply into the learning itself, in ways that relate beyond typical classroom exercises, creates an opportunity for the very type of scientific learning called for by the NGSS.

**Ms. B's Sixth-Grade Classroom**

Ms. B has a background in chemistry and secondary education. She began her career teaching high school chemistry but has enjoyed her work in the middle school. She is passionate about her content and concerned about the apathy she sees toward science when she first meets her students in September. Ms. B has always believed in an inquiry approach to science, so she generally engages students with the curriculum through questioning, engaging in experiments, and showing examples of the content studied in the world around them. Ms. B views the text as a supplement and believes that actually engaging with science through hands-on experiences is how students learn. The challenge is and always has been resources and time.

Ms. B's students often feel frustrated by the complexity of the textbook and have a difficult time writing up their scientific work. Ms. B believes firmly that she is a science teacher and not a language arts teacher, so has generally complained about this piece of to improve, believe

The expectations the NGSS require help students become a more scientific literacy in collaborative learning. The new piece of and facilitated conversations necessary to science literacy habits as a disciplinary practice requires like a science sixth-grade curriculum is weather and erosion unit of study.

Typically, Ms. students memorize ments and analysis ering and erosion. She the next unit with the activities. When asked if she improves science content working in small groups acquisition of content, if they could replicate scripted steps she provides development staff decides it may be w dence when accessing.

This time, instead Ms. B begins by studying the impact on beaches asks the students to know. Ms. B then provides a roadmap to the ones presented, demen she reads again and
The expectations of the CCSS for science and technical subjects and the alignment with the local farm plan, as well as the role of the CCSS in supporting the content, help the NCCS to integrate literacy in ways that support the curriculum and help students become independent learners. The new piece of the puzzle for Ms. B is being explicit through the_units_of_study.

Typically, Ms. B has begun with a traditional introduction where the students might the key terms of the unit and then engage in several experiments. She frequently uses photographs to understand the different principles of weathering and erosion. She concludes the unit of study with a final test before moving on to the next unit. Ms. B's students like her class because they enjoy engaging in collaborative learning, and she sees that piece as the core of the approach. The learning goals for Ms. B's units are always clearly defined, blending science content with the activities. Ms. B is enthusiastic about the students' progress and how they are building a framework for understanding when and how the activities relate to the content. She has never really thought about how the students read and write like scientists as a disciplinary expert. Ms. B decides to pilot this implementation with the unit of study on weather and erosion. This science content is centered on physical science. One of the units of the study is weather and erosion, and Ms. B decides to pilot this implementation with the unit of study.

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erosion together. In doing so, terms specific to the discipline come up that she teaches and she also shows resources where they can be found or understood when the context in which they are found are examined. In doing so, Ms. B is modeling "knowing and ways of knowing." It is necessary to have someone with Ms. B's disciplinary expertise model the knowledge, but it is also essential that she is explicit about the strategies she is using to access that knowledge. Central to the literacy learning model and to what is called for in the NGSS and related documents cited earlier is this capacity for students to build both.

Ms. B then breaks down the subtopics of the unit, which include:

- Mechanical weathering
- Chemical weather
- Wind erosion
- Glacial erosion

Ms. B does a quick topic talk on each, and then groups are formed based on area of interest. Ms. B has allotted one week of study during her 40-minute class. For the first 3 days, students will develop expertise in their area using the hands-on activities that she previously had done with all students and the related text and digital resources. On the fourth day, the students are expected to put together a digital poster that demonstrates their findings using the scientific language and reporting that they are reading throughout. On the fifth day, students will engage in a gallery walk to gather data and information on the other areas. At the start of each session Ms. B offers a 10-minute lesson on the core content of erosion as well as the strategies scientists use when reading and writing reports and conducting field experiments. Throughout, while the groups meet, Ms. B is facilitating, guiding, and at times pulling together small groups of students to reteach concepts that seem to be challenging.

Ms. B follows the framework outlined in Chapter 3 very carefully and finds that in accessing and developing materials for the think-aloud portion, she is becoming much more aware of the specific literacy habits she engages in as a scientist that she had previously taken for granted because it is so woven into her way of reading and writing and her view of the world. In doing so, she finds she is much better at articulating what students need to do to navigate the discipline—what she had previously referred to as “not my job” in ways that are of tremendous support to her students.

Instead of the typical multiple-choice test Ms. B usually gives at the end of a unit of study, the students will write an individual report titled "What Is Weathering and Erosion?" They are given specific criteria about academic vocabulary, use of scientific report, both their own invent.

Ms. B has always thought that report growth. She re-discipline has afford sometimes challenging.

Current trends in a framework for achieving the science that focus on specific literacy habits rate disciplinary literacy importance of helping students scientific information knowing. As education pedagogical skills.

Literacy learning for achieving the continuing that learning is mediated by focus as well. The literacy: students can "try on" the support of peer opportunity to learn in composing, consensus types and discourse students develop a cog outside of the medi
of scientific-reporting language, and careful and clear citation of evidence from both their own investigation and from their colleagues.

Ms. B has always prided herself on creating an engaging classroom environment and believes this has allowed her to work with students individually to support growth. She recognizes, however, that the addition of the literacy lens to the discipline has afforded her the opportunity to better understand why students are sometimes challenged as well as to see students deepening their understanding of content. Now she is better able to offer a pathway into the content.

Summary

Current trends in science education call for a study of content by developing a framework for accessing the content. This is a departure from traditional paradigms that focus on content knowledge, with little attention to the discipline-specific literacy habits needed to access the content. The recent call to incorporate disciplinary literacy into content areas along with the NGSS highlights the importance of helping K-12 students develop a cognitive framework for accessing scientific information. This is a shift from knowing and instead focuses on ways of knowing. As educators, this requires that we are expert both in the content and in the pedagogical structures and literacy habits needed to access the content.

Literacy learning clubs are presented in this chapter as one possible pathway for achieving the goal of content learning as well as creating schema for continuing that learning independent of the classroom. The collaborative structure mediated by focused direct instruction where needed in the content of study, as well as the literacy strategies used to access the content, provides a context where students can “try on” new knowledge and ways of getting to that knowledge with the support of peers and the expert in the classroom. In doing so, they have the opportunity to learn core scientific content while also becoming more proficient in composing, constructing, and engaging in the multiple print and nonprint text types and discourse patterns of the discipline. This second piece is what helps students develop a cognitive framework that can be used when engaging with science outside of the mediated classroom environment.
QUESTIONS FOR REFLECTION

- When you examine your curriculum and program of study, what role do you see for literacy learning clubs?
- What place does science education have in your work, program, day?
- What opportunities and challenges do you foresee when integrating this approach in your science program?
- The NGSS have the potential to shift traditional formats for science instruction. What might be some ways we can organize the discipline of science to reflect these revised goals?

ACTIVITIES TO CONSIDER

Work to develop one or more units of study in science using the literacy learning club paradigm. The detailed outline offered in Chapter 3 as well as the multiple resources available in the Appendix offer a roadmap for planning. It is ideal if you can plan this unit with a colleague. After you have implemented the literacy learning club in the scientific unit, reflect on the following:

- How did this paradigm support learning in this science unit?
- How did you assess student learning?
- What cognitive paradigms did you begin to see develop in your students?
- What are your thoughts about the future use of literacy learning clubs in science?

The National Core Curriculum for students in understanding of facts, procedures, and why operations (mathematics education) suggests an activity that can transfer their understanding to new processes. It's called procedural fluency, which is the ability to fluently perform familiar procedures. Students are taught through distributed practice what is appropriate.