CHAPTER THREE

Integrating Comprehension, Thinking, and Knowledge Building

GUIDING QUESTIONS

- What function does knowledge play in comprehension?
- What are the unique attributes of each discipline and their relationship to reading comprehension?
- What are the perspectives on the integration of disciplinary knowledge building and reading comprehension instruction?
- What does the research say about specific protocols and programs that integrate reading comprehension instruction with disciplinary knowledge building in the intermediate grades?
- What are research-based principles to consider when transitioning to an integration of literacy and disciplinary knowledge building in the intermediate grades?
- What considerations are needed for emergent bilingual students when integrating comprehension, thinking, and knowledge building?

SETTING THE STAGE

While waiting to begin their grade-level team meeting, two fourth-grade teachers at Mercury Elementary School discuss their recent instructional experiences with the shared reading text, *Number the Stars* (Lowry, 1989). Ms. King reports, "It is a short book, but it has been slow going for my students. I have to stop frequently to explain the historical context that is both unfamiliar and incomprehensible to my students."

Mr. Beckum says, "We are having the same challenges. The book is beautifully written and has important themes. However, I wonder how much of this classic book's message is getting through to my kids when I have to spend time switching back and forth to a map of Europe and essential historical

information. Probably 80% of my students have never left their neighborhood except for our school field trips or to visit relatives in another borough."

"I am torn because the message in this book is valuable, and it is a Newbery Award winner. The characters are the same age as our students. Nevertheless, as 9-year-olds, my kids don't have the prior knowledge or life experiences to make the most of this book. If anything, my ongoing explanations of the historical background make the reading experience tedious for all of us. I feel like I am ruining the book and any chance for my students to ever appreciate it due to the current mismatch," complains Ms. King.

THE CONTRIBUTION OF KNOWLEDGE TO COMPREHENSION

The Mercury Elementary School teachers' experience is shared by many teachers working with a district-mandated English language arts (ELA) curriculum or in settings that rely on teacher favorites as their canon. Teachers use the texts as vehicles to support their students' acquisition of particular ELA standards. In order for readers to understand any text, they need to bring relevant prior knowledge to the reading experience (Kintsch, 1988). Prior knowledge is as essential for reading informational texts as it is as for reading narrative texts such as *Number the Stars* (Lowry, 1989). In most ELA classrooms, we see teachers supporting children in their efforts to activate the prior knowledge required to understand the shared text. However, children come to classrooms with wide variations in both range and depth of experiences and information. At Mercury Elementary, as in many schools in the United States, students are expected to read and understand texts that are disconnected from their preexisting knowledge or any knowledge that is systematically built into their classroom curriculum. This disconnection puts the burden on teachers to add this content to their curriculum haphazardly, if at all. This demand adds weight to a literacy block that is already stretched thin. As stated by Ms. King, this weight tends to extend the length of lessons and units to the point of student disengagement, thus ruining the book and losing the learning focus.

The Function of Knowledge in Reading Comprehension

Over the years, researchers consistently demonstrated the vital role that knowledge contributes to comprehension (Kintsch, 1988; Recht & Leslie, 1988; S. A. Stahl & Jacobson, 1986; S. A. Stahl et al., 1989; Cervetti et al., 2016). A simple overview of Kintsch's (1988) construction–integration (CI) theory suggests that readers integrate text-based information with existing knowledge, prune unimportant or inaccurate information, fill in coherence gaps, and make inferences to arrive at what he calls a *situation model.* The ability to decode the text is necessary but insufficient to arrive at even a *surface* (verbatim) understanding of an academic text (Kintsch,

1998). A *basic* comprehension level requires that the reader apply individual word meanings, analyze complex sentences, and automatically retrieve relevant prior knowledge to arrive at a new mental representation or situation model.

Knowledge as a Comprehension Pressure Point

Kintsch's (1988) CI process also aligns with Perfetti and Adlof's (2012) concept of pressure points discussed in Chapter 1. Fundamental among these pressure points is the reader's prior knowledge. Baseball expertise has been used in many studies to investigate the influence of content knowledge on comprehension. Recht and Leslie (1988) had middle school students read a passage about baseball. Students with high baseball knowledge performed better on several different comprehension tasks than did students with low prior knowledge. Surprisingly, there was no benefit for high reading ability over high knowledge! Miller and Keenan (2009) also demonstrated that when poor readers possessed relevant prior knowledge, they recalled more information than peers who were more proficient readers. This finding has important implications for text selections for students. Students who perform poorly on benchmark text assessments may be disadvantaged by being restricted to low-level materials. When readers have some prior knowledge of a topic, they can read and understand at higher levels than indicated by a benchmark test.

Knowledge's Influence on Strategic Processes

Knowledge also influences a reader's ability to utilize cognitive strategies. Another baseball study demonstrated that poor readers familiar with baseball could better utilize the question-generating strategy with baseball texts than with nonbaseball texts (Gaultney, 1995).

The IES RfU studies indicated that students' ability to generate inferences and conduct self-monitoring made the most substantive contributions to their comprehension (Pearson et al., 2020). The above strategies rely heavily on the knowledge that the reader brings to the comprehension process (Kintsch, 1998). Readers with more background knowledge are more likely to connect sections of text to make text-based inferences and create cohesiveness within the text, particularly for texts that lack explicit cohesive connections. Additionally, knowledgeable readers can fill gaps in texts to make more distant or global inferences. Readers with knowledge about a topic are more likely to self-monitor their comprehension process than those without such knowledge.

Knowledge and Inhibitory Control

To comprehend speech or text, children need to inhibit knowledge that is not relevant to the oral or printed content. At a granular level, this would include irrelevant

definitions of homophones in speech (*break/brake*), homographs in a text (*wind/wind*) or polysemous words (*run*). However, listeners and readers must also inhibit information that is not directly related to the content and that may distract from the central message or distort it. Listeners or readers with a richer vocabulary and more topical knowledge are more likely to inhibit incorrect information. For example, one of us (Kay) was listening to a child read a story about boys who ran a race around a track. However, when answering questions about the story, it became apparent to Kay that the child had applied the definition of *track* related to an *animal's footprint remaining in dirt,* not the definition for an athletic pathway.

Many children with limited prior knowledge will bring irrelevant information to the reading task, leading to confusion and misunderstanding. Children who are new to English may not have the English language skills to match the text with their bank of experiences. Additionally, children with attention difficulties may find retrieving and specifying the relevant prior knowledge to the passage they are reading challenging. Reading programs such as Guided Reading (Fountas & Pinnell, 2016) and Teachers College Units of Study (Calkins, 2015, 2017) limit children to reading texts at a particular level, and books vary by topic daily. As a result, these programs result in a disadvantage for many children because they do not build their knowledge and vocabulary within the proximal curriculum.

DISCIPLINARY KNOWLEDGE AND COMPREHENSION

The term *disciplinary literacy* has become more prevalent than *content literacy* in the last 15 years because our understanding of the differences in what counts as knowledge within literacy, science, social studies, and math has expanded. When we use the term *disciplinary literacy,* we recognize that each discipline has its own "*core constructs:* (a) epistemology (i.e., beliefs about how knowledge is built and communicated); (b) inquiry practices; (c) overarching concepts, themes, and framework; (d) forms of informational representation/types of texts; and (e) discourse and language structures" (Goldman, Britt, et al., 2016, p. 220). This ideology is very different from content literacy that focuses on teaching a set of facts and concepts. Disciplinary literacy encompasses each field's *epistemology,* or beliefs about how knowledge is built and communicated. These beliefs permeate the texts that learners read, write, and use to build their cognitive networks of knowledge.

Literary Knowledge

Literary texts teach us about humanity and the sociocultural influences of the world in which we live. Lived experience and linguistic craftsmanship intertwine to create the most powerful literary texts. Literary texts invite us to dialogue with others because multiple viewpoints will expand our comprehension of the themes,

characters, and worldviews. Literary criticism evaluates how authors handle content, text structure, and linguistic craftsmanship to convey their message (see Table 3.1).

Delia Owens describes *Beloved* as the last great book that she read by saying that it "reached so deep that it tore my heart open with the roaming loneliness of Beloved" (Tamki, 2019). As readers, we often judge the quality of literature by the author's ability to help us understand others while opening the deepest part of our souls to remind us that we are not alone. As teachers of students in the intermediate grades, we want to convey these unique epistemological characteristics through questioning, discussion, and explicit examples during both the reading and writing processes.

Historical Knowledge

Historians try to understand historical events through the study of multiple primary and secondary documents. Historical and news sources are open to interpretation. However, unlike literary texts, historical documents often contain indisputable facts such as dates and major events for readers to consider. Both historians and readers of historical texts need to consider the source (author and media), context (time, place written), and level of corroboration for the information in the text (Wineburg, 1991). One example of how disciplinary literacy differs from content literacy is the shift from a focus on memorizing historical facts to becoming a participant in ongoing argumentation that contributes to the provisional interpretation of the past (Goldman, Britt, et al., 2016; Herrenkohl & Cornelius, 2013.) As teachers, we often ask our students to provide textual evidence for their responses to a question. What happens when they do not read multiple sources or critique the source, context, and corroboration for the evidence that they select? In that case, we violate the principles of historical knowledge building and [illegible]ices that lead to uninformed, flawed, and possibly dangerous conclusions.

TABLE 3.1. Disciplinary Criteria for Text Evidence

Literary (Rosenblatt, 1978)	Social studies (Wineberg, 1991)	Science (Duschl & Osborne, 2002; Herrenkohl & Cornelius, 2013)	Web resources (Beck, 1997; Coiro, 2003)
• Story grammar elements • Theme • Author point of view • Author craft • Universal human experience	• Context (time, place written) • Source (author and media) • Corroboration of information by other sources	• Precise language • Quality of data • Corroboration of information by other studies • Comprehensiveness of experimental sample • Visual evidence (tables, charts, diagrams, models)	• Accuracy • Author background • Objectivity • Recency • Comprehensive coverage of topic

Note. From Stahl (2014). Copyright © the International Literacy Association. Reprinted by permission.

The practice of asking students to identify evidence from a single piece of text contributes to some of the challenges associated with the saturation of information in the digital age. Today's iGens, those born between 1995 and 2012, are more likely to obtain information from short Internet blasts, memes, and tweets instead of primary sources or more comprehensive peer-reviewed sources (Twenge et al., 2019). Additionally, they tend to "pluck" the information they need to accomplish an isolated task rather than utilize their resources to contribute to an evolving network of knowledge (Alexander, 2018). During the 2020 election, US Americans across the political spectrum demonstrated a need for more education in critical reading skills concerning government and civic responsibility. As teachers, it is our responsibility to teach these essential disciplinary literacy skills.

Scientific Knowledge

The COVID-19 pandemic revealed the general public's lack of understanding regarding the scientific process. Many citizens lost confidence in federal health experts due to their frequently changing health advice rather than seeing the evolving protocol recommendations as part of a scientific process. As educators, we are responsible for teaching this process to our students as part of elementary science instructional routines (Next Generation Science Standards Lead States, 2013).

Science knowledge consists of learning about the physical world, life, Earth, space, and engineering. "Science inquiry builds scientific knowledge from developing coherent, logical explanations, models or arguments from evidence" (Goldman, Britt, et al., 2016, p. 232). Scientists develop theories or tentative explanations about their observations or the evidence collected. Scientists evaluate empirical data based on whether they meet the criteria for reliability (consistency of outcomes) and validity (tests measure what they intend to measure). As they learn more, they revise their theories.

Students need to become familiar with how scientists communicate the scientific process and outcomes. However, science discourse is quite different from most of the texts that we read daily. Grammatical structures, such as the use of a passive, objective voice; precise language; and dense, complex, and unfamiliar content make scientific texts among the most difficult to comprehend and compose.

In the elementary grades, administrators need to allocate resources and classroom time for the hands-on, concrete activities that demonstrate scientific concepts. In today's classrooms, videos also are a useful tool to support the development of students' scientific knowledge. Additionally, teachers need to invest the time needed to guide students' reading and writing of science-related texts. See Chapter 6 on how to use the gradual release of responsibility (Pearson & Gallagher, 1983) to guide students' comprehension of texts in science and Chapter 8 on how to write texts in science.

Epistemological Implications for the Intermediate Grades

As teachers, we should not expect students to automatically develop disciplinary literacy skills. During reading activities, we recommend that teachers point out the epistemological characteristics of texts. When students are writing scientific reports, teachers should model the appropriate text structure, the use of headings, precise language, and graphics before holding students accountable for writing a report independently. One of Kay's graduate students, Ms. Camellia, noticed that her fifth graders were describing every piece of data in separate sentences within the results section of their scientific experiment reports. Therefore, after their next experiment, Ms. Camellia provided a lesson on writing the results section of the report. She used her smartboard to model how to use precise language to describe the findings in a short summary statement and then displayed the facts and data in a table. She also made a class chart highlighting tips for writing each section of a research report. On this chart, she included specific words to exclude from the results section such as *suggests* or *because*. These features are unique to scientific writing. We need to call attention to them when we are reading scientific reports and model them before assigning students to write a scientific report.

In the intermediate grades, students begin to read a high volume of informational texts that include new, complex concepts. As we introduce these units to our students, we want to habituate the literacy behaviors that will serve them for a lifetime of learning. We all know that it is more difficult to break bad habits than to learn to do something the correct way from the start. Let's establish some early, basic disciplinary literacy skills before students leave elementary school to attend middle school.

INTEGRATING LITERACY AND DISCIPLINARY INSTRUCTION

In the past, curricula separated the instruction of literacy and content areas as distinctly unique sets of content items that students needed to learn. However, as our understanding of disciplinary literacy has increased, the boundaries have become less distinct. We know that readers need to meet a threshold of word recognition to achieve a basic level of comprehension (O'Connor et al., 2002; Wang et al., 2019). We also know that good readers use a common set of general cognitive strategies that supports reading comprehension in all disciplinary areas (Shanahan & Shanahan, 2008). These cognitive strategies include activating prior knowledge, making purposeful predictions, visualizing, summarizing, questioning, identifying and applying text structure, identifying the levels of importance, generating inferences, and monitoring comprehension (see Chapter 6). However, since the introduction of the CCSS, the NGSS (Next Generation Science Standards Lead States, 2013), and the C3SSS (NCSS, 2013), it has become increasingly important to teach elementary students how to read, write, and build knowledge in ways that reflect the practices

of each discipline. In the last section, we addressed what it means to teach literary, social studies, and science standards in today's classrooms. However, if reading and communicating historical or scientific knowledge calls for understanding that community's procedural and Discourse nuances, how do we find time in the day to do it all?

Traditionally, each discipline wanted schools to preserve time to teach their discipline separately. Literacy experts and teachers were afraid that they would need to give up the essential time needed to teach basic skills or favorite literature if they integrated science or social studies into the too-short literacy block. Science and social studies experts often observed science and historical content becoming diluted and trivialized when taught in tandem with literacy. However, in most schools, reading is the "curriculum bully," crowding out science and social studies (Cervetti et al., 2006). Many elementary schools allocate 30–45 minutes in the afternoon to a rotating schedule of social studies or science. When schools have early closures, assemblies, or other disruptions, science and social studies are always the first to go. Many of Kay's university elementary education students report never seeing science or social studies being taught in their student teaching field placements. When they are taught, teachers often do not use the current standards for their grade level. Instead, they teach Native Americans in November and Black history in February. Other popular units include the solar system, plants, or biomes. Some grade levels spend a half year researching the city or the ocean. These half-year projects often involve decorating the room to look like a particular environment and creating engaging parent performances or displays. Expansive units like these crowd out the engineering or physical science units that often hold less appeal for elementary school teachers.

There is now strong evidence that when intentionally planned, the integration of science or social studies with literacy can yield positive results in each discipline, without compromising either field, and may increase learning more than when taught in isolation (Cervetti et al., 2012; Connor et al., 2017; Guthrie et al., 2004; Romance & Vitale, 1992). Romance and Vitale's (2017) longitudinal study of the Science IDEAS program, which integrated literacy and science, yielded statistically significant direct-achievement effects in grades 3–5 and transfer effects in grades 6–7 on standardized science and reading comprehension tests. In another experimental study that compared an integrated literacy and science approach with a business-as-usual control group in fourth grade, Cervetti and her colleagues reported that the integrated instructional group learned significantly more science concepts and more science vocabulary than the control group (Cervetti et al., 2012).

Connor et al. (2017) conducted a yearlong study of students' performance in the Content Area Literacy Instruction (CALI) program, which integrated social studies or science units with literacy for students in kindergarten through grade 4. CALI students performed better on standardized and researcher-constructed reading comprehension measures than a control group did, especially in grades 3 and 4. The students in CALI also increased their disciplinary content knowledge compared

to the control group. Further, students' increased performance in science or social studies appeared to boost their performance in literacy, and vice versa, in a reciprocal manner. The CALI study provided *strong evidence* that instruction in science and social studies can be integrated with literacy instruction in elementary school without negatively impacting students' reading gains. In fact, there is growing evidence that integrating literacy instruction with disciplinary knowledge accelerates achievement in both, rather than compromising student achievement in either!

PROGRAMS THAT INTEGRATE LITERACY AND KNOWLEDGE BUILDING

Over time, several programs achieved success in integrating literacy, science, and/or social studies. Teachers often participated in these programs to help match the national, state, or district content standards with the proposed curriculum. Teacher involvement also ensured that the programs were managed within classroom constraints. As you review the programs below, we suggest that you read to extract the programs' common elements and how the planning teams manipulated the program features to accommodate the unique needs of each school. It is unlikely that you and your grade-level team will be able to adapt one of these programs, as is, for your setting. Most schools with whom we worked gradually transitioned to the model they selected, adding or revising a few units of study each year as they worked toward a master plan.

Science IDEAS

Science IDEAS (Romance & Vitale, 1992, 2017) initially was implemented in fourth-grade classrooms. Over the last 25 years, IDEAS has expanded to include all elementary grades. The model has remained relatively consistent in protocol and student outcomes over time. IDEAS classrooms combine their daily 90-minute literacy block and 30-minute science block to form an expanded 2-hour integrated instructional block. The knowledge-driven curriculum has been based on the district's science and literacy standards. In the original study (Romance & Vitale, 1992), teachers ensured a balance between the new science content and literacy objectives. Today's units are consistent with the NGSS (Next Generation Science Standards Lead States, 2013). The learning routine typically includes science concept introduction through hands-on activities and discussion; the reading of multiple sources that address processes and concepts; discussions in various configurations led by teachers and students; student writing in response to the activities and reading; and embedded assessments (see Table 3.2).

Results indicated that students in the Science IDEAS treatment made significantly greater reading comprehension and science achievement gains than did a business-as-usual group, who participated in traditional literacy and science

TABLE 3.2. Science IDEAS Model of Instruction

Element	Activities
Inquiry/scientific investigation	Hands-on activities, guided open-ended inquiry and discussions, concept verification, scientific proofs and practices
Reading comprehension/ strategy instruction	Explicit, general comprehension strategy instruction; reading multiple text sources; comprehension strategies specific to science
Propositional concept mapping	Unique and important facet of IDEAS; strategy for ongoing visual organization of science concepts and concept relationships
Journaling/writing	Use of gradual release of responsibility to teach students to record their thinking, understanding, and questions as a basis for developing and communicating scientific knowledge
Application activities/ projects	Research and a wide variety of activities in which students apply what they have learned
Prior knowledge/ cumulative review	Strategy development of prior knowledge retrieval and synthesis of knowledge development
Embedded assessments	Formative assessments are embedded within each unit of study

instructional blocks (Romance & Vitale, 1992, 2017). The students who participated in the IDEAS program also displayed a more positive attitude toward science and reading and greater self-confidence in science (Romance & Vitale, 1992). Despite early teacher reservations, teachers in the IDEAS program quickly overcame their misgivings as they saw the enthusiasm of their students and parents.

Concept-Oriented Reading Instruction

Concept-oriented reading instruction (CORI) has been implemented across the elementary and middle school grades with both science and social studies. Guthrie and his team designed CORI to determine how combining motivational techniques with cognitive strategy instruction would impact students' reading comprehension. Guthrie and Humenick (2004) found that utilizing rich content instruction fostered intrinsic motivation in students. *Intrinsic motivation* is the drive or a sense of purpose within the individual rather than originating from an external reward such as a prize. Prominent content goals seemed to contribute to students' close reading to obtain meaning, build knowledge, and understand deeply rather than merely acquiring superficial skills. Guthrie and Humenick also reported that using interesting texts, hands-on activities, collaborative work, and providing students with choices contributed to intrinsic student motivation.

Guthrie et al. (2004) tested CORI with third graders during two 6-week science units. Teachers conducted CORI during daily 90-minute periods. The integrated units employed disciplinary inquiry that featured hands-on activities;

various genres, formats, and levels of texts; student agency regarding reading material, inquiry topics within the unit topic, and work partners; and various opportunities for peer collaboration. Teachers provided explicit strategy instruction to support students' activation of prior knowledge, search for information, questioning, summarization, and use of text structures and organizational information.

CORI students outperformed strategy-only students and traditional-reading-instruction students in reading achievement, motivation, and strategy application on multiple measures, including researcher-designed and standardized assessments. However, the researchers did not conduct any measures of science achievement (Guthrie et al., 2004). Like Science IDEAS, there has been ongoing research on the effectiveness of CORI in other grade levels and with specific student populations. See more information, recent research, and examples of CORI units of study at *www.cori.umd.edu*.

Seeds of Science/Roots of Reading

Seeds of Science/Roots of Reading (SSRR) is an integrated literacy-science curriculum for grades 2–5. It is based on the theory that the development of knowledge and literacy are synergistic (Cervetti et al., 2006, 2007, 2012). The program focuses on in-depth scientific knowledge, academic vocabulary, and essential skills and strategies in literacy and science. A fundamental idea is that literacy instruction is most effective when contextualized within purposeful learning, not as an end to itself. SSRR assumes that knowledge and comprehension are reciprocal, vocabulary is conceptual, texts (read and written) play a dynamic role in the learning cycle, and literacy and science share a common set of cognitive strategies (Cervetti et al., 2006).

Fourth- and fifth-grade SSRR content units consist of four subunits (10 lessons each) to be taught during 45- to 60-minute daily sessions. SSRR utilizes a Do-it, Talk-it, Read-it, Write-it approach. Teachers explicitly teach students to build new knowledge, read, write, and discuss as scientists do. For example, explicit instruction, modeling, and guided practice in writing summaries and scientific explanations are included in the curriculum. Additionally, during Discourse Circles, students work collaboratively in small groups to analyze a claim or statement, collect evidence that supports and refutes the claim, and engage in a discussion to determine acceptance or rejection of the claim.

Research studies demonstrated that SSRR more effectively promoted science content knowledge, reading comprehension, academic vocabulary growth, and writing development than nonintegrated instruction in grades 2–5 (Cervetti et al., 2007, 2012). For example, Cervetti et al. (2007) found that second and third graders in SSRR performed better than students in business-as-usual literacy-only and science-only instruction. The same was true for fourth and fifth graders in SSRR compared to fourth and fifth graders who received instruction based on

state-provided curriculum materials for the same content unit, time, and duration (Cervetti et al., 2012). Researchers also demonstrated that SSRR was effective with emergent bilingual students (Wang & Herman, 2006). For more information, see *https://seedsofsciencerootsofreading.wordpress.com*

Content-Area Literacy Instruction

We focused on the CALI program's design and positive research outcomes earlier in the chapter (Connor et al., 2017). This section will share the instructional elements of the CALI program in grades 2–5. The program integrated literacy and science units and literacy and social studies units at each grade level based on the Florida state standards. The researchers determined that 2–3 weeks was the ideal length of time for each unit of study. Unlike the other programs that we described, research team members, not classroom teachers, taught the lessons during the study. Instructors conducted the lessons four times a week, and taught each introductory *Connect* lesson during a 30-minute, whole-group session. Children worked in small homogeneous groups of five students or less during the *Clarify, Research,* and *Apply* components of the unit. These groupings were based on reading comprehension pretest scores. Instructors led each 15- to 20-minute, small-group session. Compared to the other programs, this program was more instructor-driven with less student agency regarding inquiry, text selection, or peer collaboration. See Table 3.3 for the details of each component in the instructional routine.

The researchers used qualitative and quantitative data from the preliminary design study plus teacher input to refine the CALI program so that it would be less difficult for classroom teachers to replicate. For example, they rewrote trade books to ensure that texts at different reading levels contained the same content

TABLE 3.3. CALI Routines

Process		Activities
Connect	Day 1; whole class	Students will connect the key unit concepts with local, personal life experiences to build enthusiasm, motivation, and interest.
Clarify	Next 3–4 contiguous days; small group	Teacher-supported reading of secondary sources about the topic; instruction on strategic reading and how to navigate the disciplinary demands; support Day 1 connections to build motivation
Research	Next 3–4 contiguous days; small group	Teach students how to read and use primary sources, including disciplinary evidence criteria Science: Conduct experiments/hands-on activities
Apply	Next 3–4 contiguous days; small group	Make connections, draw conclus[illegible]ommunicate findings through writing, talking, media; [illegible]t on findings

and conceptual vocabulary. They also recommended that teachers use comprehension pretest scores to group students in the homogeneous groups. Despite the above changes, the CALI lesson components are consistent with the processes and activities in the other integrated programs.

CONSIDERATIONS IN DEVELOPING AN INTEGRATED PROGRAM

In this section, we discuss how schools might approach either the purchase or development of an integrated program in grades 3–6. ELA standards address both literacy skills and literary content. There are several shared components among the programs that we reviewed (e.g., explicit comprehension strategy instruction, writing instruction). However, each study also had a few unique characteristics (e.g., attention to student agency, homogeneous grouping). Table 3.4 lists and describes the elements that a district or school should consider when creating or purchasing an integrated program. Although it is not possible for every unit to devote multiple lessons to each of these goals at every grade level, grade-level teams should move toward these goals over time. Incorporating these components into the program increases the likelihood of the cognitive reciprocity and efficiency that characterize the integration of science and/or social studies instruction with literacy instruction.

TABLE 3.4. Components of an Integrated Program

Component	Elements
Inquiry	Hands-on experiences or experiments, research
Content development	Experiences, reading, writing, and talking lead to the development of connected conceptual networks of knowledge shared by the classroom community
Vocabulary	Selection of 10–25 target conceptual and academic vocabulary words that are used multiple times throughout the unit
Reading	Multiples sources of information, primary and secondary sources, explicit cognitive strategy instruction using the GRR, attending to unique disciplinary reading demands such as visuals, tables, diagrams
Writing	Writing for multiple purposes related to the unit; explicit instruction using GRR of both general and disciplinary writing that is related to the unit
Epistemological awareness	Fostering practices of evidence gathering, evidence critique, writing and discussion practices that are unique to the discipline (e.g., participating in the unit like a historian or scientist)
Collaborative	Opportunities for students to work together to solve problems, discuss texts, create projects, and build knowledge
Agency	Some opportunities for students to choose texts, partnerships, and projects that serve the community knowledge-building mission related to the unit

Into Action

To our knowledge, there currently are not any commercial integrated programs that include literary, science, *and* social studies units. Each school that Kay worked with developed their own curriculum. Some schools purchased commercially produced units that included lesson plans and materials that publishers aligned with the NGSS (e.g., Rourke Educational Materials; *www.deltaeducation.com/foss/next-generation*) or materials that were produced to meet the goals of the NGSS (e.g., *https://communitywaters.org*). We recommend that you approach this work patiently with a long-term plan. Most schools that Kay worked with made the transition over a 2- to 3-year period.

Scheduling Integrated Instruction

Schools need to decide on an integrated model option. Some schools prefer to commit to full integration (e.g., Science IDEAS, CORI, SSRR) that combines the literacy block and allocated science/social studies time to create a single extended 90- to 120-minute integrated time block.

The second option maintains separate existing time frames but plans for content unit consistency across the two time blocks. In the second option, schools use the traditional literacy block to do the reading and writing associated with the unit and a separate content-area time block to do the hands-on activities. Two schools that Kay worked with selected a teacher identified as the "content specialist" to teach the content block. The content specialist did all the hands-on activities, experiments, fieldwork, and some science units that did not fit into an integrated approach.

Kay taught in a school that used a parallel block scheduling model as a means of integrating literacy and content in grades 2–5  school faculty decided to increase the classroom size from 20 to 25 students i er to utilize one member of each grade-level team as a content lab teacher and math interventionist (during the math period). Each grade-level team used this model to incorporate daily heterogeneous whole-class shared reading/writing, small-group homogeneous reading/writing, and in-depth content work centered on a single unit of disciplinary study. The classroom teacher provided all the reading and writing instruction related to the disciplinary unit. The content lab teacher conducted most of the hands-on activities and provided the experiences that took advantage of limited, expensive materials, including kits or technology. During literary-focused units, the content lab teacher either took the lead on unit-related research projects or taught science units that were difficult to integrate. Projects and presentations might be done in either setting or collaboratively. Although in this case, the content lab teacher did not have an advanced degree in any disciplinary content area, she quickly became a specialist in the grade-level content units and related resources. After the first year, her expertise and familiarity with available materials for each unit influenced

the classroom reading, writing, and projects. As years went by, the curriculum and learning periods become more homogenized (see Figure 3

The school ecology and resources will often dictate the scheduling decisions. However, it is likely that most schools will want to create a curriculum calendar that spends approximately 12 weeks each teaching literary, science, and social studies integrated units distributed across a 36-week academic year.

Building Integrated Units

The first step is to plan a calendar that incorporates the essential units dictated by the CCSS ELA standards, NGSS, and C3SSS, or the respective state standards. In our experience, grade-level planning teams at the school or district level do this work. Typically, teachers who previously taught related content in separate units, begin by combining literary and content-area units that fit together organically.

In a few schools where Kay worked as a consultant, grade-level teams began by creating a large calendar chart on butcher paper to display their current ELA and science/social studies units (see Figure 3.2). Another way to do it is on a shared Google document. However, the teachers with whom Kay worked were not fans of reading shared documents online to get the "big picture." After each grade level completed a chart, all charts were displayed in a meeting room and shared at vertical grade-level meetings. This landscape view of all the charts made it very easy to see connections and disconnections across grade levels. The teachers discovered that some content units, such as "plants," were being taught the same way in multiple grade levels.

At Lake View School (pseudonym), this process was undertaken shortly after the introduction of NGSS and C3SSS. Therefore, the aim was to use the new standards to create integrated units that met all the criteria for social studies, science, and literacy standards logically so that content was neither duplicated nor left out in a vertical curriculum. After comparing current units to units required by the new standards, the teachers created a new integrated unit calendar. They had to abandon some former literacy units. However, the richest literary content became part of a comprehensive literary unit with more cohesion and depth than their original units. They moved other isolated reading material within the appropriate science or social studies units.

Once the calendar was in place, the teachers planned the big ideas and objectives for each unit (see Form 3.1 at the end of the chapter). At this stage of the process, the teams began sharing their ongoing work on Google docs or another school sharing platform. Kay supported one school that began building its units during the spring and summer of 2017. During the 2017–2018 academic year, they taught units that they had developed. Many of these units were revisions and updates of units previously used in either ELA or science/social studies. The revisions were integrated and taught to achieve the new complexity of the C3SSS and NGSS. By

	Class 1	Class 2	Class 3	Class 4
7:50–8:00	Opening	Opening	Opening	Opening
8:00–8:45	Whole-Class Word Study	*8 Below-Level Students	*17 On-Level/ Above-Level Students	Whole-Class Shared Reading/ Writing
		17 On-Level/ Above-Level Students to Content Lab	8 Below-Level Students to Content Lab	
8:45–9:30	Whole-Class Shared Reading/ Writing	Whole-Class Word Study	*8 Below-Level Students	*17 On-Level/ Above-Level Students
			17 On-Level/ Above-Level Students to Content Lab	8 Below-Level Students to Content Lab
9:30–10:15	*17 On-Level/ Above-Level Students	Whole-Class Shared Reading/ Writing	Whole-Class Word Study	*8 Below-Level Students
	8 Below-Level Students to Content Lab			17 On-Level/ Above-Level Students to Content Lab
10:15–11:00	*8 Below-Level Students	*17 On-Level/ Above-Level Students	Whole-Class Shared Reading/ Writing	Whole-Class Word Study
	17 On-Level/ Above-Level Students to Content Lab	8 Below-Level Students to Content Lab		
11:00–11:45	Lunch (30 min.) Recess (30 min.) Class Miscellaneous (30 min.)	Lunch (30 min.) Recess (30 min.) Class Miscellaneous (30 min.)	Lunch (30 min.) Recess (30 min.) Class Miscellaneous (30 min.)	Lunch (30 min.) Recess (30 min.) Class Miscellaneous (30 min.)
11:45–12:30				
12:30–1:15	Math	Math	Math	Math
1:15–2:00	Specials	Specials	Specials	Specials
2:00–2:20	Closure	Closure	Closure	Closure

FIGURE 3.1. Example of an integrated instruction schedule. Shading indicates heterogeneous- content class. *Small-group-differentiated integrated instruction with the homeroom teacher.

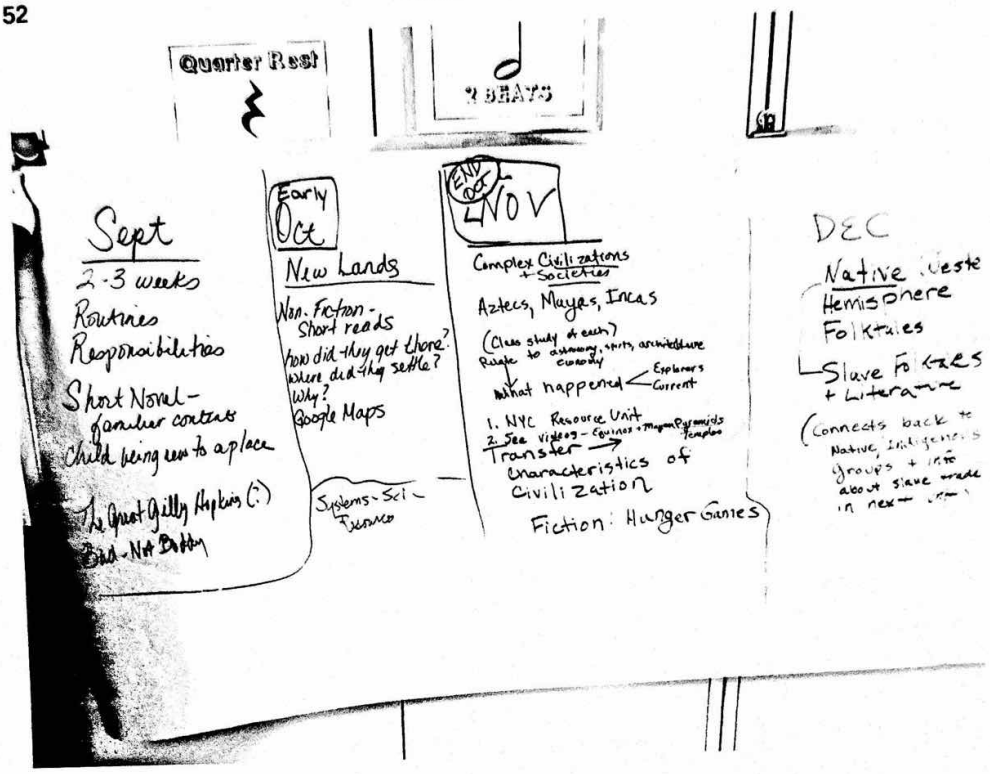

FIGURE 3.2. Example of a calendar chart for ELA and science/social studies units.

the 2018–2019 academic year, they had added newly required units and tweaked the 2017–2018 units based on observations and experiences they acquired while instructing their students. This time frame and process was somewhat similar across multiple schools that Kay supported.

CONSIDERATIONS FOR BILINGUAL STUDENTS

Providing themed instruction on the same topic across two fields (e.g., literacy and science or literacy and social studies) usually is helpful for current emergent bilingual students (those receiving bilingual or ESL instruction) and former emergent bilingual students (those exited from such instruction and now in the all-English classroom) because the increased amount of instructional time and the different contexts in which students are exposed to the same topic deepen all students' background knowledge. Also, integrated instruction often means that bilingual students are exposed to multiple uses of the same vocabulary, and provided with increased opportunities to hear, see, read, and write the same vocabulary, two characteristics of high-quality vocabulary instruction. However, bilingual students only accrue

these benefits if they comprehend their teachers' English instruction. Therefore, if you are involved in integrated instruction that includes emergent bilingual students, please be sure to employ the bilingual and ESL instructional techniques described in Chapter 2.

An additional ESL technique that you can employ to make your integrated instruction comprehensible to bilingual students is from the SIOP (Echevarría et al., 2012, 2016). When fields like ELA and science or social studies are integrated, bilingual students often find it difficult to identify what they are supposed to learn, making it hard for them to focus their attention and monitor their learning. You can help offset these problems when you post in writing, orally read, and frequently review the specific learning objectives for each of the integrated fields by specifying the content to be learned, tasks to accomplish, and how students are to accomplish the tasks. For example, if you are integrating your study of science fiction in English language arts by reading a story about life in space and your study of the universe in science, you could post the following objectives:

English Language Arts
1. Decide on the parts of the story that are fiction (not true).
2. Write your answer in your response log.

Science
1. Complete the graphic organizer on how Venus and Earth are different.
2. Discuss with your partner why humans cannot breathe on Venus.

For information on how to write objectives for your integrated instruction, we refer you to the Center for Applied Linguistics websites (*https://cal.org/siop/about*; *www.tesoltrainers.com/siop-lesson-preparation.html*) or to one of the SIOP books (Echevarría et al., 2012, 2106). Classroom teachers who posted, stated, and reviewed lesson objectives for their classroom instruction, reported to Georgia that all their students benefited, not just their emergent bilingual students.

We also encourage you to provide bilingual education teachers, the school librarian, and ESL teachers who work with your emergent bilingual students with a list of the topics (in the summer or as early in the school year as possible) that you and your colleagues plan to cover during the school year. Because it is easier for emergent bilingual students to learn new information in the language they know best, it is helpful when you collaborate with the bilingual education teachers so that they present new conceptual information in students' L1 before the students encounter it in their integrated instruction. In addition, you can ask the school librarian to provide your bilingual students with L1 texts, abridged English texts, or easy texts in English that they can read independently on the topics that you cover in your integrated instruction. Lastly, we encourage you to ask the teachers

in charge of ESL instruction (this could be the bilingual education teacher or ESL teacher) to present your emergent bilingual students with instruction on new English vocabulary items and syntactic/rhetorical structures for the topics that you plan to cover later in the school year. Although some bilingual education and ESL teachers may have set curricula that they have to cover, many of them will be interested in collaborating with you, especially if you give them advanced notice.

CONCLUSION

Knowledge plays a critical role in reading comprehension. Readers need to activate relevant prior knowledge before and during the reading process. During reading, readers need to prune irrelevant or inaccurate prior knowledge as they integrate what they know with the information in the text to arrive at a situation model or expanded networks of knowledge. Readers rely on prior knowledge to make within-text and more global inferences. Of key importance, knowledge contributes to a reader's ability to self-monitor and repair a meaning-making hurdle.

Students in the intermediate grades increasingly read more texts to learn new information. Each discipline has unique core constructs that define how knowledge is built and communicated (epistemology). These constructs are infused into the texts that learners read, write, and use to build the knowledge of that disciplinary content. Although there are several general reading and writing strategies that cross disciplinary boundaries (e.g., asking questions, summarizing), there are unique nuances within each discipline that need to be addressed as one engages in the practices of that discipline.

Although historically, advocates of each discipline have expressed concern that integrating science and social studies instruction with literacy would compromise the learning of each, a body of work over the last 30 years has demonstrated that integration can enhance both literacy learning and content learning in a discipline for all students, including emergent bilingual students. Rather than compromising student achievement, research indicates that integration can accelerate synergistic growth in reading comprehension, academic vocabulary, disciplinary writing, and knowledge building when compared to isolated instruction.

Whether teachers are building their own integrated units or using commercially produced programs, there are common components of effective integrated programs. Effective programs include hands-on experiences and content instruction, opportunities for wide reading, writing for authentic purposes, and repeated opportunities to use target vocabulary. Instruction develops epistemological awareness that engages students in knowledge building consistent with experts in the field of study. Finally, learning is engaging, collaborative, and allows for student agency.

FORM 3.1

Unit Introduction Template

Month	Topic	Content Discipline	Texts	Writing Focus

Big Ideas—Connective tissue or conceptual Velcro. Big ideas transfer to other contexts and manifest themselves in various ways within disciplines. Examples of transferable big ideas are change, exploration, freedom, power, justice, and so forth.

Essential Questions—Essential questions are open-ended. They "hook" the students into wanting to learn more about the topic. Every lesson within a unit should be exploring one of the essential questions cited for the unit. When writing essential questions, teachers should ask themselves, "What should my students remember and be able to do, or reflect on, a year from now?"

Essential Vocabulary (15–25)—Taught, tested throughout and at conclusion of unit

(continued)

Unit Introduction Template *(page 2 of 3)*

Comprehension Strategy Focus—*What comprehension strategies will help students overcome the meaning-making hurdles of the texts encountered in the unit? (Pick 2/3 to teach directly and explicitly: activation and appropriate use of prior knowledge; purposeful predictions; visualization; text structure-narrative, expository-descriptive, compare-contrast, sequential, problem-solution; cause-effect; inference generation; ideational prominence; summarizing; questioning; monitoring; evaluation-critique)*

Skills—Knowledge that students need to arrive at big ideas, answer essential questions; facts, details, procedural processes

STANDARDS: Large-grain learning outcomes

Content Standards:

Reading Standards:

Writing Standards:

Speaking/Listening Standards:

(continued)

Unit Introduction Template *(page 3 of 3)*

OBJECTIVES: What are the observable, measurable learning outcomes of the unit?

ASSESSMENTS:

PROJECTS:

FIELD TRIPS: