

Chapter 2

What Are the Literacy Demands of Experts in the Disciplines?

Talking with Scientists, Historians, Mathematicians, Authors of Fiction, Musicians, Artists, Athletes, and Technical Experts

What exactly are the literacy demands of scientists, sociologists, chefs, and every other person who heads out for the workplace each morning? The answer to this question is one that educators must consider when planning instruction for their students. Are we preparing students to have the literacy skills they will need to function in the workplace? We have had many opportunities to collaborate with others throughout our careers, but one of the most intriguing collaborations occurred recently as we've listened to how literacy professionals, professors, practitioners, and teachers come together to inform each other and us about the role language plays in their discipline and subsequently in the future careers of their students. Their conversations highlighted how those who work in each of the disciplines use language, how teachers in content areas and in literacy education might collaborate to design instruction to ensure that their students are prepared for the workplace, and what that means for students (Draper, Broomhead, Jensen, & Siebert, 2010).

These collaborations were compiled as narratives or transcripts of each conversation between a practicing expert or professional in the discipline and a professor of literacy. Teachers then responded to the conversation describing how they prepared students in each discipline to use language in the ways described by the practicing experts.

You may be tempted to turn to the section of this chapter that addresses just your discipline, and we hope you do, at first. However, there is much to be learned by comparison with the other disciplines. Read them all to get a firm grasp on just

where your discipline is among the others. Of course, this is only a representative sample because there are many disciplines and specialties within disciplines that we might address. This is a good place to get started. Have fun!

MATHEMATICS

Dana L. Grisham Interviews W. David Scales¹

W. David Scales is a colleague and fellow researcher in the Teacher Education Research Study Group, or TERSG, a special-interest group of the Literacy Research Association. David's expertise has been invaluable to our group as we conducted longitudinal mixed-methods research. Although I am a Californian and David is located on the East Coast, he generously made time to talk to me via Skype with video enabled. We talked for the best part of an hour as I interviewed him and I learned a great deal about how he views literacy, mathematics, and psychology.

David doesn't regard himself as a mathematician, although mathematics is a large component of what he does, or as he termed it, "a means to an end" or a very necessary and "cool" tool. Instead, a psychometrician is a measurement "expert." David regards his job as matching or adapting research questions to the best research methodology and design to gain the maximum knowledge from the collection and analysis of mostly quantitative data. He works to understand "constructs" and then to measure them effectively, always asking himself these questions: How do I do it? What are the mechanics?

When asked about how he reads various texts, David talked about reading an article from a scholarly journal in his field, stating that there were at least two types of articles (practical and theoretical) and that he read them differently. He laughed as he noted that there might be more formulae than words in some of the texts, but for both, he skims the abstract to find out where the article is heading because that makes even the "heavily technical" parts more understandable. Unless the theoretical topic is truly essential for him to know, he prefers to read articles for a "practicing psychometrician." He lives in both worlds, of course, but he talked about the courses he teaches and that the articles he prefers to read are practical, much like the way he teaches his courses—to practitioners, not to "hardcore math stat geeks." As a teacher, David states, "I'm trying to explain to students that it's actually a language that is to be read and they don't see it." And so when he reads these articles, he skims through the abstract first to ask himself basic questions: "Do I already have a good working knowledge of where I'm going? Do I understand all the moving pieces before I get into it, or do I need to go hit that great big collection

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$$\sqrt{\frac{\sum (X - \bar{X})^2}{N - 1}}$$

FIGURE 2.1. Example of mathematics as a collection of symbols.

of references that I have sitting right there, up and down, and go look stuff up? Because if I see something that is mind-bogglingly complex, I'm going to have to go dig in my books and find out what it is."

For David, learning in psychology is almost purely Skinnerian behaviorism. He tells me he is not a behaviorist of any kind but feels that Skinner was "dead on with shaping." Mathematics and statistics, in particular, are a collection of symbols, and the student must learn what each piece does and how they may be combined (put together or chunked) to see how the whole thing works. He provided the example in Figure 2.1, which shows the formula for the standard deviation.

David stated he sees this formula as a single communication, but that the uninitiated will instead observe that X has eight moving parts. The formula makes use of PEMDAS, the order of operations. PEMDAS is parentheses, exponents, multiplication, division, addition, and subtraction. And so we can read this, which is a score, minus the mean to get the difference. So literacy is indeed involved in math. Students may disagree at first, but my insistence is that it absolutely is—because it's shorthand, the same now as "LOL" or "LMAO" when texting: "It's a way of getting from point A to point B without having to write out the entire thing."

As far as learning to communicate mathematically, David argues that one must first acquire it using "short-term memory," in that a formula is like a telephone number that must be memorized and eventually becomes automatic. He stated, "And so it comes from having to work on these rooting pieces to begin with to understanding that single thing. This is now not a collection of moving pieces, it's a 'known' phenomenon that makes sense because, in my experience, having looked at this formula 28 billion times in my life, I know how it works. I see the bigger picture."

When talking about writing, he notes that the *Publication Manual of the American Psychological Association* (APA, 2009) is a "formula" for how to write, although you must consider the audience and the message as well—the purpose is communication, or, as David notes, "Absolutely, because what we do is no secret. People think that much of what I do involves witchcraft. But the magic, such as it is, occurs in being able to explain to somebody what I do because if you understand this after you and I have talked, I have done my job correctly. If you don't, I have not." In fact, he keeps the equivalent of a psychometrician's "bible" on his desk, *The Visual Display of Quantitative Information*, by Tufte. From the APA "formula" to the formula for standard deviation (above), is a stretch, but the comparison is strangely apt when the sole purpose is communication between individuals and groups. David

switches from Skinner to Vygotsky—using it as a verb, noting, “Let’s Vygotsky this bad boy out!” In other words, step back, think again, and try again to communicate.

When asked specifically what teachers need to know to communicate the language demands of a psychometrician’s work, he stated that flexibility is the key in communications. Flexibility is necessary for anyone who wants to communicate his or her expertise to another because individuals come with strengths and needs, as well as (in mathematics, surely) fear of failure. This heterogeneity means that some learners will have “aced” calculus, while others “freak out” when they must add a string of numbers together: “Flexibility is absolutely mandatory, and people can often be afraid of the subject matter or the tools that in my trade are necessary to convey that information and these tools because . . . we’re not just talking about oral communication and written communication, we’re talking about manipulation of software as a form of communication.”

In running a statistical program such as SPSS, the results are provided in tables and graphs, which are another means of communication. The psychometrician must find multiple ways to convey meaning to his or her audience. Developing the expertise to communicate a message (information) accessibly to a variety of learners must be developed over time and becomes part of a professional expertise, which the psychometrician may call upon. A qualification essential to David is open mindedness: “There is more than one way to get to an answer. Rigidity is a fear of mine in thinking.” Another element that is important in communication is that there are no absolutes in research. He talks about the fact that there is only one rule: “You’re gonna die.” That’s why researchers and psychometricians don’t talk about rules and laws. They talk about probabilities, likelihoods, and tendencies. They characterize using the terms *most*, *some*, and *few*. But they never talk about *all* or *none*.

The learner in working with mathematics, statistics, and computer programs must first put the pieces together in a hierarchical manner. David talks about putting the smaller pieces together and that there must be patience in the explanations because you have to break things down. Losing one’s place along the way can be dangerous because it is difficult to learn the new without the necessary background knowledge. Thus David provides a routine for the learner: “A structure. We talk about it. I show you how to do it by hand. I show you how to do it in Excel. I show you how to do it in SPSS [a statistical analysis program]. I do Excel and SPSS because I need [students] to understand how to do it in more than one program or format. Excel is universal, SPSS costs.”

David is funny and thoughtful as he describes what a psychometrician does and how a person who uses mathematics as a tool (or language) for communication accomplishes it. As I look back over the interview, it seems to me that mathematics is a semiotic system of communication, akin and related to what human beings do: use language to express and exchange ideas. The idea of social semiotics seems very important here—each of us belongs to groups that have specialized language

for communicating the knowledge base of our specialty . . . and mathematics is one more “system” for communicating knowledge.

A Teacher Reflects: Faith Bass-Sargent, Middle School Mathematics Teacher²

The changes in the new California Common Core Standards (CCSS) and other standards have sparked a conversation in the math community regarding the role of language in the development of conceptual understanding in math. In addition to concepts to be taught by grade level, the CCSS articulates a set of Standards for Mathematical Practice (NGA & CCSSO, 2010), the first of which is a student’s ability to “make sense of problems and persevere in solving them.” The sense-making portion of the Standards is what drives the conversation about language and how math teachers can use it as a feasible tool to create honest understanding of the math they are practicing. In the traditional view of math education, there was emphasis on “answer getting.” For example, all that is asked of the student is to show the proper steps while solving a problem.

However, with the Standards, the mood in math has shifted to understanding and critical evaluation of the work product. For example, a teacher may ask students how they know their answer is correct and whether they can predict a rule that would work in similar situations. As educators have moved away from traditional numerical answer getting, students are struggling with how to articulate themselves inside the classroom. Under the Standards, teachers impress upon students the need to use precise vocabulary to describe and defend their work. This question arises: When do teachers begin implementing necessary vocabulary, start treating the numerical values as a bridge to a greater discussion on what principles are at work, and what conjectures can you make? As middle school teachers, we have found that strong, consistent vocabulary development and a focus on common language throughout sixth, seventh, and eighth grades has vastly improved student learning. In addition, as we work closely as a team, we prepare lessons that specifically refer back to concepts taught in earlier grades that have different applications.

For example, prime factorization is taught in sixth grade. When a teacher asks a student to factor, the student may take the number and create a factor tree that breaks it down to the number’s prime factorization. In one case, the teacher may assign additional practice in “prime factorization.” Prime factorization lays the groundwork for the Algebra 1 concept of polynomial factorization. In order to have an effective and descriptive conversation about the new concept of polynomial factorization, we have carefully scaffolded our lessons specifically to refer to the earlier lessons on prime factorization. For students to make sense of the problem, they

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need to be engaged in the full story of what is happening in the math. Much like a story or movie, the pieces of math interconnect at multiple grade levels in a variety of ways. The student should be able to get a sense of the “big picture” and be able to carefully articulate its story from the beginning. The consequence of students focusing on communication and dialogue versus answer getting has led to the realization that students who traditionally have been successful in concept development are making greater strides in their classes.

We have seen the benefit of focusing on creating a clear vertical articulation of language. As such, part of the vertical articulation process is to collectively start creating meaning regarding what a vocabulary word represents. As educators, we discuss the progression of a specific concept and how it represents itself at each grade level. We diligently discuss what the word means and collectively commit to encouraging the students to use that word with precision. When we find a student using a word incorrectly, we should use it as an opportunity to fill out the meaning of the word completely. For example, when a student says he or she is going to factor, the teacher should ask clarifying questions, such as, “Are you factoring to find prime numbers, or are you factoring to find the binomials?”

In addition, when a student encounters a cognate (in this context, a polysemous term that is used in different ways depending on the disciplinary context) that has a different meaning in another field of study, it is important to address its similarities and draw connections. For example, the words *difference* and *share* have multiple meanings. Asking a student what the difference between two numbers is can be a daunting task if you do not establish clear parameters to the question. It seems simple—if you are looking through the lens of a math teacher, then the teacher assumes the student knows he or she is being asked to subtract. However, if the student has just come from language arts class and been asked to discuss the difference between the roles of adults and children in the novel *The Giver*, he or she has now been asked to use the same word in two very different applications. The teacher can use these situations to carefully articulate that, in math, an entire concept can be attached to a single word. Without knowing the students’ experience with the vocabulary, a single word could be misleading or confusing. These misunderstandings can be the difference between having only procedural understanding of the steps versus making sense of the concept.

With the CCSS, math teachers have had to thoughtfully reevaluate their role in language development. For a student to receive full and well-defined mathematics stories, the conversations held in classrooms throughout a student’s career must be clearly connected. This connection can be achieved, in part, through the vertical articulation process that starts in kindergarten and ends with calculus. If they can craft a way to establish what each concept looks like in fruition, and create a common language, the students will be able to cross the crevasse from procedural understanding to being able to talk about math in a way that communicates deeper thinking and understanding.

ATHLETES AND OUTDOOR EDUCATION

Steve Mogge Writes about Adventure Sports, Outdoor Physical Education, and Literacy³

Research has examined the literacy practices of professionals and academics in order to understand successful participation in different disciplines (Moje, 2008; Shanahan & Shanahan, 2008; Shanahan, Shanahan, & Misischia, 2011). T. Shanahan (2012) explains that experts' use of literacies in unique ways stems from appreciation of different research traditions and ways of knowing, an effort to ensure expert participation, and as a means to protect power and authority in the discipline. The CCSS being implemented across the United States identify literacy practices in social studies/history and science and technical content areas (NGA & CCSSO, 2010) that are informed by disciplinary research. Teachers in these content areas are called on to build bridges between students' out-of-school discourses, general academic discourses, and the disciplinary discourses.

Of course, there are other disciplines and subject areas to consider. Adventure sports are part of the outdoor recreation industry, which has enjoyed increasing popularity in recent years. The "No Child Left Inside" (Louv, 2008; Orion, 2013) and environmental advocacy movements have led many states and schools to expand outdoor experiences through outdoor and physical education. Some states have adopted standards that include exposure to outdoor natural environments (Lieberman, 2013). School leaders and teachers may look to outdoor education and physical education as subject areas worth comprehensive, integrated curricular attention. This chapter focuses on one sector of the outdoor industry—whitewater adventure sports—in an effort to learn about the unique literacy practices so that these can be considered for K–12 education.

Research Methods and Interview Participants

The research that informs this chapter involved participant observation in a community college whitewater adventure program as well as interviews with six leading professionals in the whitewater adventure sports industry. As Table 2.1 illustrates, the six interview participants are highly accomplished, representing world-class competitors, international explorers, and industry-leading businesspeople. Their experiences and insights can be taken seriously by anyone aspiring to succeed in those fields and by K–12 educators who want to expose youth to outdoor experiences.

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TABLE 2.1. Careers, Backgrounds, and Accomplishments of Whitewater Industry Interviewees

Current whitewater profession	Professional background and accomplishments
Executive director, whitewater park	<ul style="list-style-type: none"> • U.S. national kayaking team • Four-time national C2 champion • Two-time Olympic competitor
Co-owner, high-end whitewater garment manufacturer	<ul style="list-style-type: none"> • Kayaking instructor • U.S. national kayaking team • Three-time national K-1 champion
Co-owner, high-end whitewater garment manufacturer	<ul style="list-style-type: none"> • Kayaking instructor • International “alpine kayaking” explorer • First whitewater/river explorations of Baffin Island and Borneo
Owner, whitewater rafting and adventure company	<ul style="list-style-type: none"> • First and largest whitewater adventure outfitter in the northeastern United States • Interpretive history scholar and leader • Industry leader and education advocate
River safety expert, author, and river products representative	<ul style="list-style-type: none"> • Early Appalachian river explorer • River safety teacher and author • Guidebook author • Member of the Whitewater Hall of Fame
Rodeo competitor and multisport expeditionary summit-to-sea adventurer	<ul style="list-style-type: none"> • Professional rodeo kayaker • Teacher at a world-class kayak academy • Adventure sports marketing manager • Summit-to-sea adventures: Mt. Denali to the ocean

Findings and Implications for K–12 Schooling

Below are key findings from interviews with the adventure sports professionals along with suggestions for K–12 curricula. While “physical literacy” (Whitehead, 2001)—learning to read natural or man-made environments and move with purpose, efficiency, and success to meet the challenges encountered in the environment—may be a valuable construct for adventure sports and outdoor education (and will be pursued in other writing), the focus here is on the role of more traditional (print and digital information) literacies. As will be shown, traditional reading and writing can complement an outdoor and physical education curriculum, although it certainly should not replace time and experience in the outdoors and in physical education activities. In schools where these are valued, cross-curricular collaborations with language arts, social studies, and science teachers will likely be more successful.

Formative Experiences in the Outdoors: Outdoor Awareness, Confidence, and Competence

In childhood, three of the interviewees attended after-school and summer camps where exploration, adventure, and outdoor play were important additions to their September–June school-focused lives. They lived in urban or suburban settings, but each summer left their families for weeks-long immersion in wilderness camps where whitewater river paddling captured their attention. The other three participants grew up in the whitewater country of north central Appalachia, where this research study is focused. They came of age in an environment where whitewater play was regular part of after-school and weekend life as well as summer adventures. Immersion and interaction in wilderness environments were a foundation for their future adventures and professional pursuits.

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As Louv (2008) and others point out, a fully formed, healthy childhood requires not only that children be active in physical education courses but that they also have the opportunity to explore wilderness, become comfortable in natural environments, and engage the outdoors in physically and emotionally challenging ways. The excitement and interest launched through outdoor experiences can be foundational to many social, cultural, historical, geologic, geographic, ecological, and biological inquiries conducted in classrooms, libraries, and online. Collaborating with school colleagues, outdoor and physical education teachers can provide the field experiences that catalyze further disciplinary inquiry in social studies, science, and literacy classrooms.

Formative Experiences and Adventure Literature

Five of the six interviewees claimed to be avid readers throughout childhood. Two genres that captured the participants' attention were adventure literature and world history and cultures. Stories of Ernest Shackleton's expedition to Antarctica and Joe Kane's book *Running the Amazon* were frequently mentioned, as were *National Geographic* magazine and, more generally, fiction reading. Through escapist literature they were able to transport themselves to distant lands for exploration and excitement. These types of reading experiences aligned with their outdoor adventure interests and helped them to establish their identities and ambitions for the future. The Executive Director of the Whitewater Park explained: "You can't expect everybody to go on these amazing adventures, so both literature and art are kind of our bridge to real-life experiences." The alpine expeditionary explorer added, "The idea of using kayaking as a tool for exploration, that's what I love doing. And that whole self-image was completely formed by these explorers [I was reading about]. . . . I

have this culture in my mind of what exploration means, and I want to be part of that.”

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Again, it is not suggested here that schools replace guided outdoor experiential or physical education time with reading literature. Rather, adventure literature can complement outdoor experiences and expand on the excitement derived from time in the outdoors through stories of those who push adventure boundaries. Schools that adopt outdoor and physical education as a priority should integrate adventure literature in the language arts curriculum, thereby promoting students’ interest and engagement with literature, reading achievement, and physical development.

Adventure Guides, Exploration, and Trip Reports

The interview participants confirm that guidebook and, more recently, Web-based information from sources such as American Whitewater (see www.americanwhitewater.org) is essential to outdoor adventure planning. Before contemporary paddlers put out on a whitewater river, they consult these guides to learn about transportation shuttle requirements and access, river levels, topographic gradients, the difficulty of rapids (based on an international rating scale), significant hazards, and navigation time. The international expeditionary explorers claim to having spent months and even years studying the history, culture, politics, geography, geology, and watershed environments of the regions they explore. They take copious notes and make detailed written plans—most of which are left behind once the formal adventure is underway. These professional explorers often document their adventures in magazine articles and videography. Even recreational paddlers frequently write up “trip reports” to share with fellow paddlers in club newsletters and online forums.

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While direct experience and activity are the foundations upon which many outdoor experiential and physical education curricula are built, information is still critical to successful and safe outdoor experiences. Students should be exposed to information sources and read about the outdoor environments they visit. Small groups can take part in drafting trip plans, anticipating the physical environment, flora and fauna, and important safety precautions. Reflective journaling has long been recognized as an important learning tool for helping outdoor learners contemplate the physical, emotional, and psychological challenges they experience (Bennion & Olsen, 2002; Rappaport, 2011). More conventional narratives of personal adventure can support sustained interest and fascination with outdoor experiences and encourage creative storytelling among some reluctant writers. K–12 language arts curricula can expand

on students' initial excitement with outdoor activities through nonfiction and fiction accounts. Combining student trip reporting and adventure literature with outdoor experiences can foster successful collaborative themed units and guided creative outdoor explorations.

Writing

When asked specifically about the role of literacy in K–12 schooling, the interviewees were unanimous in declaring that success in the profession requires good writing abilities. The market for guidebooks and adventure stories in a relatively small niche arena is highly competitive. High-quality adventure writing, most of them claimed, is rare but essential in the field. On the business—retail garment, equipment, and outfitter—side, marketing is everything. One of the garment manufacturers asserted that millions of dollars in business transactions depend on successful communication with suppliers and customers, most of it via email. “Strunk & White, Strunk & White,” he repeated over and over. The outfitter explained that his river guides need to be able to write up trip reports and accident reports that can withstand critique in the event of a lawsuit. The Summit to Sea adventurer explained that in the competitive sponsorship world, the adventurer who has a strong social media presence and can capture the experience through engaging adventure stories wins the grants.

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As discussed earlier, outdoor and physical education teachers can incorporate reflective and adventure writing on their own but also collaborate with language arts colleagues to help students move from direct field experiences to reflection and writing. Outdoor experiences can spawn creative writing and, as shown above, involve business and technical writing. Students should be informed that, “even in the world of adventure sports,” observation, creativity, and concision in writing are highly valued.

Experiential-Literacy-Learning Guides/Guidance

Because adventure sports and outdoor experience programs privilege direct field experiences as the foundation upon which other learning occurs, various texts (simulation, drama, audiovisual media, pictures and audio, traditional print) play a supplemental but essential role in curriculum design. The community college adventure sports program, in which participant observation was carried out for this research, sequences the curriculum first to prioritize immersion in outdoor field experiences; then promote reflection through discussion, simulation, and video; and finally, introduce text for more formal learning of concepts and professional preparation.

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Rous (2000) offers examples of literature and writing integration with environmental and adventure activities. These can be presented through traditional before, during, and after strategic frameworks that prioritize students' outdoor engagement throughout the learning experience and then incorporate reading and writing. Teachers can construct learning guides that sequence outdoor experiential observations; data collection; audiovisual documentation; reflective, analytical, and exploratory writing; as well as adventure, science and social studies readings to expand on field observations and incorporate advanced disciplinary understanding across curriculum areas.

Conclusion

The CCSS (NGA & CCSSO, 2010) initiatives may well guide youth toward college and career readiness, but they still focus only on traditional school disciplines and content areas. This limited emphasis leaves many stones unturned, many forests, mountains, and rivers unexplored and underappreciated, and many children staring out of classroom windows longing to be in the outdoors as explorers and adventurers. Collaborations across the school curriculum that link literacy with outdoor and physical education may lead these students to embrace academic achievement as a means for participation in the great outdoors.

**A Teacher Reflects: Kathy Blakemore,
Physical and Outdoor Education Teacher⁴**

My most gratifying teaching experiences have come not from covering the standards in my classroom or in the gym, but from getting my students outside the classroom to directly interact with nature. It's always surprising to me that so many of my students have never ventured beyond our little town, have never seen the ocean, or hiked in the local mountains. While it can be a frustrating and time-consuming task making these excursions happen for our students, the seemingly insurmountable challenges surrounding the planning and approval process melt away once we see our students' smiling faces as they experience nature and return to our classrooms with a wealth of new experiences to draw from.

As a life science and physical education teacher, I have had the pleasure of taking my students to the Catalina Island Marine Institute (CIMI) for more than a quarter century. My students have the opportunity to experience firsthand what we have been learning about in our seventh-grade classroom. Imagine my joy as I'm mobbed by my students excitedly telling me about the bioluminescence they

⁴Kathy Blakemore is an outdoor education enthusiast who also teaches science and physical education at Elsinore Middle School in Lake Elsinore, California.

observed on their nighttime snorkel adventure. Their use of the academic language of science and outdoor education was proof of their enthusiasm: “We waved our hands around and kicked our fins and the plankton lit up beautiful blue! Seeing bioluminescence was one of my bucket list experiences, Mrs. B.”

My students also noticed distinct differences between the aquatic environments of Long Beach Harbor and the coves at CIMI and were able to describe their observations. “If everyone could see how beautiful and clear the water was at Catalina, they would take better care of the ocean,” Marlee said.

My favorite camp experiences with students include our full-day kayaking adventure and our snorkeling trips. Sahar shared that not only had she never kayaked before, but also she had never swum in the ocean before: “Now I want to go ziplining and skydiving! It’s fun to be active.”

Even my wheelchair-bound students were able to experience camp this past year. Working with our chaperones and aides to get these kids suited up in wetsuits and out in the ocean to snorkel was a worthwhile endeavor. Janelle smiled as she proudly announced that she “got to snorkel for the first time, something I never dreamed I would be able to do.” As I stood on the pier at camp overlooking Janelle and Gabby snorkeling with their classmates, tears came to my eyes, and I still get misty thinking about making this experience happen for them.

Even students who did not have the opportunity to attend camp were able to learn about the experience through the eyes of their classmates. My language arts colleague has the CIMI students write about a day at camp from the perspective of a moray eel. As the students share their stories in class, the kids who did not have the opportunity to attend camp get to live vicariously through their peers’ written observations.

As teachers, we have a tremendous responsibility, as we power our students’ connection to the world. Although my students remember, first and foremost, how much fun their visit to the Catalina Island Marine Institute was, I know how these firsthand experiences act as a bridge to scientific literacy. I truly believe that sharing our love for the great outdoors might be the most important lesson of all.

HISTORY AND THE SOCIAL SCIENCES

Donna Ogle Interviews Susan J. Pearson⁵

I met Susan on a blustery November afternoon as she dismounted from her bike, took off her helmet, and locked it to her front wheel. She was just finishing a day working at the university and had made time to talk with me. As we settled into a

⁵Dr. Donna Ogle is Professor Emeritus of Literacy Education at National Louis University in Chicago, Illinois. Dr. Susan J. Pearson is Associate Professor of History at Northwestern University in Evanston, Illinois.

cozy corner restaurant table I turned on my tape recorder and asked her to describe her work as an academic historian. Susan explained that she combines her own research and writing with her responsibilities developing and teaching courses in American history.

Her training is as a United States cultural historian with a focus on the 18th to 19th centuries. In graduate school she researched issues of animal protection from 1865 to 1920, and through her research identified a connection between the development of societies designed to protect animals and those advocating for children's rights. She pursued this connection in her doctoral dissertation research and was the first scholar to establish the relationships between the animal and child rights movements. This research is also the topic of her recently published and award-winning book, *The Rights of the Defenseless: Protecting Animals and Children in Gilded Age America* (Pearson, 2011).

Currently, Susan is researching the history of mandatory birth record-keeping in the United States, a practice that didn't begin until the beginning of the 20th century. Her research involves identifying and searching government archives, periodicals and contemporary press, and personal papers. Many of the resources she needs are in the National Archives in Washington, DC, and the Library of Congress. She also uses other libraries and searches for notes from historical writings that provide leads for additional sources. In addition, she sometimes uses the Central Archival Catalog, which is now available online.

Susan explained that her approach as a researcher involves finding and reading sources pertinent to the problem she is investigating and always asking two questions: What point of view is represented in the text, and what is its context? After identifying the perspective of a text she checks to see whether the view is reliable and can help her more deeply understand the problem she wants to study. She explained that all source texts do reflect the author's perspectives, and we need to understand them to make credible interpretations.

It is also important to Susan to contextualize each source; she asks herself what the source is and how it fits within its own time, who the intended audience was, and what the text can or cannot reveal. It isn't enough to read a text from a 21st-century point of view because that can really distort an author's point. Historians need to have a clear understanding of the issues and contexts within which the texts they use were written. Only then can they begin to make reasoned interpretations and build strong arguments.

In order to contextualize sources, Susan explained that it is important to know the basic debates in the field at any particular time—what questions were being grappled with during the time a text was written, and how the sources she studies reflect these debates. "In fact," according to Susan, "75% of graduate school is learning the debates in the field." For her, "the fun part is that people disagree, and I like to find the different perspectives." By understanding the factors that influenced the

debates and putting the different source documents in context, “you find the contribution you can make” by more deeply understanding and interpreting the issues.

When asked about her own reading, Susan responded that she reads in various ways. In looking for details while researching a topic, she may use the index first and then locate specific information. At other times, she reads with the intent of both identifying and understanding the argument and content of the piece and then contextualizes it: “Interpretation—that’s what we do.”

Susan explained that, for historians, a key to historical reading is understanding arguments; in fact, that is a focus of her work with graduate students. She explained that, generally, undergraduates come in with little experience or understanding of how to identify arguments and evidence provided by authors. She wants them to become familiar with both primary and secondary sources and use both types of texts because her goals for their reading include both developing a deeper understanding of the content and the details surrounding an issue and also looking for arguments. She thinks it is important that undergraduate students read to build a good foundation in knowing the content and contexts in which historical issues can be addressed.

Susan shared how she helps build this orientation with freshmen and sophomores who are in her course “United States Women’s History to 1865.” Each week, she addresses a particular topic and has assigned readings that include both primary and secondary sources. The secondary source generally provides a historical context for the topic, and the primary sources bring in voices with particular points of view. For example, the week that the class explores “Women’s Work and Industrialization,” the readings include a chapter from the book *The Bonds of Womanhood* (Cott, 1997) and two primary-source documents: *Rules of the Mill, Lowell and Lancaster, 1820–1840* (Woloch, 2014) and Harriet Farley’s “A Letter from Lowell” (1844).

When she assigns primary and secondary sources, Susan expects students to know that each text has an argument or point that is supported with information. She also expects them to find the relationships between the primary and secondary sources; sometimes these are complementary and at other times different. She explained, “That’s what historians do; we compare our evidence with other people’s findings.” A tension for undergraduates is that they are often overwhelmed with the amount of information presented; however, by junior or senior year they are better able to look for arguments in the texts they read.

Developing her students’ writing skills is very important, so each week Susan has them write an argumentative essay based on the readings. She poses a question and they draw on the sources they have read to construct their arguments. For example, when reading four chapters from *The Bonds of Womanhood* students were asked to respond:

“The author argues that domesticity is both a constraint and empowers women. How is it so? Explain in 500 words or less.”

In writing these essays students must focus on both the relevant content (identifying issues and details from the text) and do the thinking to formulate their own argument and use relevant evidence in response to the author’s statement.

Susan explained that she actually thinks more actively about students’ writing than their reading. Her course syllabus also reflects her expectation that students write each week and also compose a final memoir paper. Her directions read:

“For this paper, you will read the memoir of an American woman and make an argument about how she exemplifies, defies, or otherwise relates to the historical context in which she lives. You will choose your memoir during the first week of class. For each memoir, I will hold a writing workshop during a regularly scheduled class meeting. Memoir papers are due on the last day of class. Choose one of the following selections: Mary Jemison, Abigail Bailey, or Elizabeth Keckley.”

Conclusion

Susan Pearson is a historian active in her own scholarship as well as fully involved with teaching history to university students. During the interview she explained in some depth the types of reading and writing she expects of herself and her students. For those teachers who read this from the frame of the CCSS there are clearly some important issues to consider:

1. A historian doesn’t read a text without first determining the authorship, context, and the larger setting from which it emerged. The terms—author’s perspective or point of view and contextualizing a text—are central to her ways of thinking about texts she reads.
2. Interpretation means understanding the perspective of the author in relation to how it fits with its own times.
3. Developing enough knowledge of the context from which sources emerge is important in understanding them.
4. Identifying and evaluating the evidence provided by authors is central to historical thinking.
5. Writing argumentative texts using accurate historical data is at the heart of historical work.

A Teacher Reflects: Javier Vaca, 11th-Grade Social Studies Teacher⁶

In her interview, Susan J. Pearson talks about the importance of contextualization when studying any issue or document. The idea of identifying the context is one that I emphasize in my 11th-grade United States history class.

I teach my students that when preparing to read historical documents, it is important to familiarize oneself with the societal, political, and financial issues of the time. With these contextual parameters they are better able to evaluate the document. As we study a topic I often model through thinking aloud how I contextualize or consider what was happening in America when a document we are studying was created, and how that context affects my interpretation of the document.

For example, when we study early American history, my students read about and discuss the effects of the Great Awakening, a sweeping religious movement. My purpose is for them to understand how this movement spread and influenced society during the 18th century. We often view photos of this period. While doing so I might think aloud and wonder about all of the folks gathered around George Whitefield as he preached. I might share that I had read that he had such a power of persuasion that even Benjamin Franklin, who is often described as a scientific skeptic, emptied his change purse into the collection basket after hearing the preaching of Whitefield, a British minister who toured the colonies to enlighten folks about religion.

Once students understand the importance of contextualizing all types of documents, they are better able to consider the possibility of persuasion as a factor that could fuel a 21st-century religious movement. They understand the Enlightenment period in the timeline of American history and contrast it with current religious persecution and newly developing ministries. My students recognize there was no social media in the 18th century and the spread of information and ideas today is completely different because one can daily hear a contrastive perspective. Understanding contextualization allows my students to more effectively evaluate the information.

The other portion of Dr. Pearson's interview that relates to my teaching and my students is the idea of prompting students to write as historians. It is important for my students to synthesize their ideas and thoughts through writing. After studying a particular time period through reading primary sources, my students need to show their understanding and learn from their writing. They are able to make better connections to the historical time periods we are studying when they are prompted to look for evidence from primary and secondary sources to support their claims in writing. Like Dr. Pearson's students, my 11th graders are taught how to identify as well as write convincing arguments.

⁶Javier Vaca is a teacher of social studies at Health Sciences High and Middle College in San Diego, California.

After reading this interview I realized the power a teacher has to prepare students for real-life participation and the positions they must take in society. By teaching students in high school these principles, they might be better prepared to learn in university settings that demand even more from them. They are on their way knowing how to contextually study an issue from many perspectives, share a well-documented interpretation, and identify new areas for investigation. I hope I am preparing my students so they will want to continue deepening their historical thinking under the guidance of university professors like Dr. Pearson.

LITERATURE AND THE ENGLISH LANGUAGE ARTS

Denise Johnson Interviews Steve Sheinkin⁷

Steve, what is involved in your daily work? In what way do words matter in your job?

The funny thing about doing this work, even though it's called being a writer, is that most days aren't writing days. Most days are research or organizing and outlining days. I find that's what takes the most time and actually that's probably what I enjoy the most. The actual writing process is hard. I find it hard to get started. It's easier to do the research and then say, maybe I'll just do one more outline or maybe I'll just read one more book. I really have to force myself to sit down and write. That first draft is by far the hardest part, and that is about words. I already know at that point exactly what the story should be, but now I have to translate it from my head to this two-dimensional piece of paper and somehow keep it as exciting as I think it should be. That's by far the hardest part. But in terms of words, it's just a matter of seeing it and then writing it and describing it as simply and as clearly as I can.

How do you read texts in your discipline? What processes do you use?

A big part of my job is reading and taking notes. So when I'm reading, I'm always writing at the same time. I'll read with my notebook or usually a computer open and have the book open and take notes because I know that is all the raw material that I might use. I will take hundreds of notes and most of it or some of it won't make it in, but I feel like I need to have a record of where I got everything. That file gets very big and unwieldy by the end of the project. I think of it as a series of steps in solving

⁷Dr. Denise Johnson is Professor and Director of the Literacy Leadership Program and Department Chair of Curriculum and Instruction at the College of William & Mary in Williamsburg, Virginia. Steve Sheinkin is the author of several award-winning nonfiction books for young adults: *The Notorious Benedict Arnold: A True Story of Adventure, Heroism & Treachery*; *Bomb: The Race to Build—and Steal—the World's Most Dangerous Weapon*; and *The Port Chicago 50: Disaster, Mutiny, and the Fight for Civil Rights*.

a mystery. Each book is almost like a witness to me—they present ideas almost like an interview—through the quotes within the book or source notes at the back. That’s a big part of the reading for me—letting one source lead to the next, and to the next, and to the next, and sometimes to surprising sources.

If you were to interview a candidate for a job, what demands for reading and writing (and perhaps discussion or speaking/listening) would you expect people to know that are specific to your type of work?

To me, the ability to write clearly and concisely, that’s where I don’t regret my whole textbook life. [Steve wrote material for history textbooks before becoming a full-time author.] You know that piece of wisdom that says you need to work at something for 10,000 hours to get good at it? That was my 10,000 hours. I want somebody who has put in a lot of time. People do ask me how they can become a writer, and really, the only thing you can do is just put in that time. Nobody can really help you that much until you’ve really put in that time, which some people don’t want to hear. Writing doesn’t come easily for most people, at least not to me.

What cognitive tasks are involved, such as synthesis? What are the demands of reading and writing for you in your job?

The thing I love doing most of all is taking massive amounts of information and then thinking of it as a puzzle or parts of a movie and trying to figure out how to fit it together. That’s where index cards come in, because I think that really helps—to have something in your hands to move around just like the pieces of a puzzle. There’s a scene or a piece of information I have—maybe 50 things—and just moving them around where they go because I think the biggest challenge with writing nonfiction for this age is that you can’t assume they already know about anything. So the *Port Chicago* book starts at Pearl Harbor, and if I say that to an older person, they have a million associations, but a kid—you never know—maybe they do and maybe they don’t. So how do you work in the basics of what was going on in December 1941 and what the Japanese were doing and what we were doing? I have to include enough background information so that it makes sense in context while still keeping the story. That, to me, is the biggest challenge—figuring out how to synthesize the stuff you need to know and the stuff that’s going to make it fun to know.

What would you say to teachers about the language demands (reading, writing, discussion, etc.) of your particular discipline or job?

The number one thing teachers ask me to talk about is the editing process and the fact that just because you hand a paper in doesn’t mean you’re done. That’s true

of the best writing you can think of, just like it's true for your seventh-grade paper. When I hand something in, I get it back full of comments. One of them is: This isn't working. That's a big, big part of the process. You must be open to revision. By all means, get it down. That's the hardest part. But once you do that, show it to people and don't get defensive if they point out things that don't work or aren't clear. I'm just so glad nobody ever sees first drafts that I write except my editors. Published work is so good because so much revision has been done. It's that back-and-forth with my editor where she'll say, "If you really feel strongly about this piece, tell me what you think," and we'll go back and forth. It's important to be able to express what the book is really about, and if that's what it's really about, how does this part fit into the core story and how does it advance that story? That's what good editors will do—they say that's a great scene but it doesn't advance the story.

A Teacher Reflects: Stacy Miller, High School Teacher⁸

I love that Steve Sheinkin refers to the 10,000 hours to be successful. I first read about this theory in Malcolm Gladwell's *Outliers: Stories of Success* (2008). I like to read about people applying it to their own lives, to include reading and writing. Often we see the successful result of something—even an essay or an op-ed piece—without seeing the 10,000 hours behind it. It's like that cliché movie storytelling technique where shortly before we see a character achieving success we see a montage of "this is the character working hard" scenes that comprise, maybe, 30 seconds of screen time. Of course, the soundtrack swell helps as well. I have to remind students that 30 seconds of screen time is not the same as 10,000 hours or practice and real work.

The index card thing. I get that. As a tactile, visual learner who likes to see things, to manipulate them, index cards are a great tool. It is literally hands-on. It's important not to overlook the myriad ways to learn something or process information, and I like that Steve Sheinkin mentions the cards and puzzle pieces.

Steve Sheinkin makes some great statements about the editing process. I agree that we need to teach students more about that and to appreciate good editing—and editors—for what they do. It's the difference between writing something to turn in for credit and writing something to really express yourself. As a full-time educator, I wish I had more time for the revision process with my students. I wish we had more time for drafts and revisions. The funny thing about teaching honors and advanced courses is that you are preparing students to write an exam answer (I'm referring to the College Board and the AP Exams) that cannot be edited or revised. Students get one shot to express their thoughts intelligently and cogently. There are no drafts.

⁸Stacey Miller teaches at Stuttgart High School (U.S. Department of Defense Education Activity [DoDEA]) in Germany.

SCIENCES

Maria Grant Interviews Devin Burr⁹

I interviewed Devin Burr, a medical student, on a gray May day from my home in San Diego. Devin and I talked by phone. He was residing in Oregon at the time of our conversation, poised to graduate from Western University of Health Sciences in June, and ready to move to Jefferson City, Missouri, where he would begin an intern year followed by either a dermatology or emergency medicine residency. Grateful that a busy medical student would make time for a lengthy conversation about “literacy in his life,” I proceeded to barrage him with the queries on my mind. His responses were not only insightful, but they were also thought provoking, so much so that I was compelled to make significant connections to my own area of passion—instructional practices in the discipline of science teaching.

A Day in the Life of a Physician

Devin began by clarifying his educational background to date. As mentioned, he’s a medical student, currently focused on disease processes and how the human body reacts. The first 2 years of his course of study were spent in the class—brick-and-mortar studies to build background knowledge and expertise. The next 2 years were spent in the field, engaged in “rotations” as a way to encounter all areas of medicine. Through this experience, Devin was able to visit with patients under the guidance of physicians, report findings back to physicians, and practice making diagnoses under the guidance of mentors. As a future intern, he will be tasked with more responsibilities that might include ordering labs and giving medications. He’ll be on duty for longer periods of time and will stay with a particular rotation for at least a month. As he continues to progress, he’ll conduct exams and will recommend treatments.

In my own attempt to better understand the role reading, writing, and academic language might play in the life of a medical student, I questioned Devin about his daily routine. He let me know that the morning hours spent in the hospital consisted of visits to patients, consultations with night nurses, and writing notes that would later be presented to a resident or attending physician. By afternoon he might be working in the emergency room to help with examinations. His time in the hospital was variable—sometimes he’d be at the clinic from 8:00 A.M. until 5:00 P.M., other times he’d be at the hospital until 10:00 P.M. After each rotation, Devin was required to complete an assessment (a test) with content based on his experience. The test was designed to assess his acquired skills proficiency and

⁹**Dr. Maria Grant** is Professor of Education at California State University, Fullerton, and a physics teacher at Health Science High and Middle College in San Diego, California. **Dr. Devin Burr** is a resident physician at Aspen Dermatology in Spanish Fork, Utah.

content knowledge. An exam might cover the treatment of appendicitis or surgery for a gall bladder issue. Devin would read up on the area of focus to become expert in whatever discrete area of study he was tackling for the rotation.

Literacy Practices in a Doctor's Day

As soon as Devin mentioned books and reading, I knew it was my cue to delve deeper with my interrogation: “How do you read texts in your discipline? What processes do you use?” In response, Devin clarified that when he reads a text he often follows his self-developed protocol. He provided me with an example, stating, “I might have to read a book with pages and pages about a topic or a disease—heart attacks, for instance.” Devin clearly outlined his protocol for me, adding that it’s really effective for him. Here’s how it works:

1. The first read is a general read. Devin reads the text like a storybook. There’s no highlighting, and it’s done only one time during the first day of study.
2. The next day, he rereads, this time looking for findings, labs for a disease, medications, and so on. He highlights these for future reference.
3. Devin says he begins to focus his reading, from big ideas to smaller details. He calls this “reading like a funnel.” He was definitely engaged in close reading.
4. Next, he studies the highlights for the exam.
5. For any subsequent readings, Devin clarifies that he often will take notes. He adds that the note-taking helps him to focus and then he has the notes for future study, as a tool. That reminded me of the need for K–12 classroom science teachers to think of note-taking as both beneficial in terms of the process and the product. Students learn when they take the notes and they have a product—the notes—that they can use to study for a test, write a paper, or develop a podcast or poster.

Noticing that Devin emphasized how essential it was for him to do a general read followed by a series of detailed, focused readings, I felt compelled to ask him about the complexities of the texts he studies: “Do you encounter diagrams or charts? How do you deal with these and with other difficult areas of text?” Once again, Devin’s response offered insights into this issue of science literacy.

Devin often comes upon tough areas in his readings—technical terminology, academic styles of writing, and content that requires strategies in order to negotiate meaning. To wade through this high water of struggle, Devin often turns to podcasts about particular medical topics. In this way, he augments his reading with audio content that is clarified by an expert in the field. Devin enthusiastically tells me that he “likes diagrams,” adding that they break up the text and provide alternative ways to understand the content. In other words, diagrams help Devin

to augment his learning. He even admitted that sometimes he uses them to bypass the complex, tedious text that accompanies a diagram. He has copious amounts of reading, and a diagram can provide a shortcut to understanding—one that Devin enjoys taking if it leads to learning in a more abbreviated manner. Since Devin does place such importance on his reading of diagrams and since they are numerous in medical books, he added that he finds meaning in the details: the captions, the labels, the arrows, and so on. He truly *reads* a diagram just like he might a paragraph or a page, first paying attention to the generalities, then homing in on details. He added that his math background is helpful when reviewing graphs and charts.

Impressed with Devin's ability to articulate his reading strategies in such a metacognitive manner, I asked him to share his thoughts on the literacy expectations in his field of study: "What demands for reading, writing, and speaking-listening are there in the medical profession and within the studies that lead up to a career in this field?" Devin had clear thoughts on this topic of discussion, replying, "For medical school and to be an intern you need to know how to read technical texts." He added, "When it comes to writing, there is much more involved than I ever thought." Dwelling a bit on the topic of writing, Devin reflected, "What a medical professional writes on a patient's chart is the path that will be followed for treatment. It needs to be clear and coherent. Medications need to be clearly described and this all needs to be interpretable." Devin closed his thought, noting with a serious tone, "You're dealing with people's lives." It became clear to me that the topic of *writing in the medical* profession was one that Devin had given considerable thought to, realizing that the degree of clarity and precision could mean life or death for some patients. In a cursory manner, I had always thought of medical writing in terms of my own personal experiences as a patient—scribbled code on a slip of paper called a prescription.

Devin made clear that complex descriptions that paint a picture of a patient's history and current status need to be composed with detail in a coherent, understandable way. As Devin underscored, many people, including doctors, nurses, pharmacists, surgeons, and others, might need to review a patient's profile. Unclear writing puts a patient at risk. Devin added that sometimes bullet point notes are acceptable, especially when it comes to listing treatments. In addition, it is essential that a doctor justify requests in his/her writing. If a doctor wants to order an expensive test or treatment, the request should be made using detailed, precise language. For instance, a request that states "Patient has a dark mole, with an irregular border that has increased in size. It requires an incision," is more compelling and clearer than a request that notes "Patient has a brown mole, needs incision." Writing for the profession is often an expectation and/or interest of medical students and doctors. Devin has publications in professional journals, in print and in the works, one article on the topic of treatments for feet of diabetics and another on the topic of minimal-incision extraction for large lipomas.

As our conversation proceeded, Devin made sure I also knew that strong oral communication skills—listening and speaking—are critical to the medical profession. He clarified this by describing the importance of probing questions, especially when it comes to a patient's illness and treatment: "As medical students and interns, we must listen carefully to get a picture of the patient. Then we must be able to verbally convey the information to doctors." He also commented that sometimes patients don't reveal enough and doctors need to rethink their questions. Often they have to reframe the question in a way that delves deeper. Sometimes a doctor may even need to contact others who can contribute more to the understanding of a patient's condition and needs. This might include family members or even nursing facility personnel. Conversations with different people require different registers. For example, when discussing issues with other medical experts, a doctor can speak in more academic, topical terms; however, when speaking with family members, the dialogue may need to be tempered by compassion and understandable layperson's terms.

Medical students are constantly engaging in high-level cognitive tasks, including analysis, synthesis, and evaluation. Devin provided an example of this by describing how doctors conduct physical exams when they are trying to diagnose a person's condition. He explained that doctors often use data from a physical exam, along with labs, to determine a disease or patient issue. They analyze the data and evaluate the condition of the patient; then they can outline next steps for treatment. These thinking skills are intimately integrated with the literacy demands of the profession.

Devin provided me with valuable insights into the requirements for reading, writing, and oral communication. Consequently, I thought it greatly appropriate that I ask him to provide future medical students with advice, so I asked, "How could young people considering a career similar to yours best prepare for future study and career demands?" Without hesitation, Devin emphatically advised, "Develop a love of learning early on. Doctors who have had decades in the profession are still reading, still learning. There's always something new to learn." Devin didn't mince words with this advice. He emphasized that learning takes place in the class at the start and has to be a part of any doctor's personal goals throughout his or her career. Devin left me with a final thought, "Becoming a doctor requires more than just retaining information. You must apply your knowledge every day and your knowledge must continually grow."

Literacy to a Physician Is a Life-or-Death Matter

As I hung up the phone, reflecting on the conversation, I realized that expertise in all aspects of literacy is at the core of a doctor's daily life. It's the lifeblood of the profession. Being a highly literate expert in the medical field—one who reads,

writes, and engages in professional, academic conversations—is the only way that a medical student and a doctor can flourish to offer patients high-quality medical care to treat illness and preserve health. I left more compelled than ever to promote the integration of discipline-specific literacy learning—*science literacy learning*—as means for our society’s young people to become career and college ready for studies in science and related fields and to become informed global citizens who can have a voice in science issues that affect our planet. As Devin noted, the difference between life and death for patients rests on the literacy skills of their physicians.

A Teacher Reflects: Angela Hackman, High School Science Teacher¹⁰

As I read Devin’s interview I was excited, as a science educator, to see how clearly he valued literacy in science as a medical student. I identified connections not only between the skills used by Devin and the activities in my classroom, but also with the need to continue sharing with my students the importance of literacy practices in the real world. My students gain so much by practicing literacy skills in class, but I believe they underestimate how valuable these skills will be to their future success.

In describing his reading of texts, Devin outlined a five-step procedure that allowed him to fully gain understanding for his daily activities and assessments. The steps he described are very similar to the process my students undergo when completing close reading in my classroom. The students begin by reading the text for general meaning and then begin to focus on details for a clearer understanding of the text. The students are also making notes, highlighting, and annotating the text while reading to ensure they know what to reference for future competencies in the class. Devin also mentioned how important diagrams can be to support the text. In class, we do close readings of diagrams, graphs, and tables. The students are able to process the text in a new way while learning the skills to analyze visuals so that in the future they can better understand information they read in college or their personal lives. We begin by generally looking over the visual, and then we begin to focus on details such as the title of the visual, the units on the axes, the labels, and any descriptions provided in the text. The students are able to recognize that a visual that initially seemed overwhelming can become understandable by breaking it down into smaller segments. The techniques my students learn, like Devin’s practices, provide a foundation needed to process and use scientific information in their future workplaces, college, or when voting on a scientific ballot issue. I passionately believe in helping my students process scientific information with the intent of ensuring they will have the skills needed to become participating citizens involved in their community.

¹⁰Angela Hackman is a teacher at Health Sciences High and Middle College in San Diego, California.

In the interview, Devin also describes the importance of written and oral communication in addition to reading skills. The variety of literacy practices he uses is similar to the structure in my classroom. The students are required to read, write, and speak about science every day. To complete these practices, I must provide the structure to ensure they are using academic language as well as evidence to support their thinking. I expose my students to good and bad science so they can decipher what makes a good argument. My students are given sentence frames to help communicate their ideas. The vocabulary important for the topic is posted as a word wall in my classroom as a reminder of what scientific language should be used. I want them to see, learn, and use scientific language, so I must be sure they have a positive exposure to doing so.

Devin also stressed the need for clarity and detail in communication, which made me think of the students writing lab reports. When describing how to complete lab reports, I remind the students that detail is necessary because scientists must use their lab reports as evidence for studies in medicine and that the procedures must be replicable step by step. With patients' charts, Devin provides another example of the real-world necessity for explicit explanations that the students could relate to when completing in-class writing. In explanations, evidence and justification are necessary throughout the science world, which I stress in my classroom through using the Next Generation Science Standards (NGSS) and Engineering Practices. The students are required to use texts or labs as evidence when explaining their thoughts both in written and oral forms. For example, the students wrote argumentative letters to President Obama regarding solutions to global climate change. They described the problem by citing evidence from a speech by President Obama, an article from *Scientific American*, and labs completed in class about ocean acidification. The students continued the letter by providing a solution to carbon pollution using texts and online sources. They were able to see that, in order to make a valid claim, they needed to use detail and evidence just as Devin must use to ensure the patient gets the best care.

Ultimately the demands on a person to use science requires the ability to understand and express scientific thoughts through reading, writing, and verbal communication. Devin stressed a variety of ways science literacy affects his education and his future career. My students are practicing science literacy in the classroom. I believe my role as a teacher is to push my students to understand science through different types of communication while helping them see that by being able to truly understand and communicate science they can achieve more success in college classes and careers as well as better understand how the world around them works. My students are going to leave high school and become voters, leaders, and productive citizens, and I want them to be able to process difficult information to use as evidence to support their thoughts and actions.

MUSIC

Linda Lungren Interviews Tim Peterson¹¹

Tim received his degree in visual arts (illustration, visual artist and storyboard artist) in 1998. He has worked on several projects and productions and television series and continues to do freelance arts projects in this area.

He has a passion for music and is part of a band formed in 2008 called Evertheory in Los Angeles, a semiprofessional band “hoping to make it big one day.” His primary occupation is as a retailer at the Guitar Center, where he is surrounded by music and musicians.

As a retailer in the music store he uses language constantly. His knowledge of art and music is translated into sales on the floor. Words are absolutely important, as he has to be extremely clear and articulate with the customers. He feels 80% of his time with customers is spent listening, assimilating their thoughts, and interpreting their needs and directing them to find the best product for their needs.

His job in the Guitar Center involves a lot of reading. He has full certification in all areas of the store, which he achieved through demonstrating skills learned in required training modules, viewing training videos, listening to everything presented in the store, reading manuals and PDFs online, technical specifications of electronics, and so on.

As a member of a band, he is very involved with words and language. He must be an active listener of the world and translate that meaning into his lyrics and music.

Interviewing for members of a band is something that he does often, as members of the band come and go and must be replaced. He and his band partner have it down to a “science” with a list of questions distilled from things they have found to be important to the group. (e.g., expectations of rehearsal time; commitment to being available for rehearsals and performances; commitment to solo practicing outside of group rehearsal; willingness to collaborate). Reading music is a “plus,” but not necessary in this type of band—much of today’s rock band rehearsal is through listening, attaching chords, experiencing the music rather than note reading.

The actual work at the Guitar Center does not have to involve reading. However, to be skillful, an employee must be ready to meet, greet, listen, find the solution, and close the deal. To be knowledgeable, he must be able to read the specifications from manuals for the various instruments in the store (especially the electronic ones), finding the right equipment that works together through comparing specifications. These resources can also include websites, Google searches, and databases on the computer. Reading is one thing, but there is a need to interpret the words

¹¹Dr. Linda Lungren is a music teacher for San Diego City Schools and a pianist, composer, and choral director. Tim Peterson is a bass guitar specialist in the Los Angeles area and a member of the popular band Evertheory.

for the customer. Experience is important, but being able to research the resources is also important. The customer is making an investment and wants to make the right choice based on information backed by literature, other people's experiences, and salesperson knowledge.

In the band, literacy is important in a variety of ways. Members must be able to read contracts and make sure the language is working to the band's advantage. They must be able to break down each part of the contract point by point so they can accept some and reject others.

In addition, social media plays a huge role in today's world. You must get your information "out there" and sound reasonably intelligent so you are giving your best impression and convincing people to listen to your quality of music. Social media is now "the press." In the past, publishers always had an editor to organize, check grammar, format, and conform to industry standards. There has been a deterioration of that model lately as the artist has become the social media creator, organizer, editor, formatter, and proofreader, so there is a far greater risk for error. It probably has to do with a change in the economy—doing away with jobs; doing more with less; using skeleton crews for jobs that are still big. Tim's graphic arts background has helped him in much of his social media design.

Writing has become interesting for the band artist. Sometimes you are asked to "post" something immediately on social media, and you have to make sure you are not misrepresenting something through hurried posts. You press "send" and it is gone. Tim's band has done several interviews where the interviewer typed out the questions to send to the band. The band typically divides it up and each member takes a few of the questions. They had an experience where the interviewer merely inserted his questions and their answers (typed as they had submitted) without really looking through and perhaps changing some of the grammar and spelling—not a good experience. A lot of interviewing is now done through written correspondence as opposed to face-to-face talking.

Tim is very involved in literacy and music and making commentary through his lyrics. He decides what kind of message he is trying to convey. It has to be concise, and he really has to condense and be frugal with his words like a poet. Songs are not like chapters or books—they need to be to the point. They have to distill their thoughts down to a song verse, simplify, find the exact words or phrases. Lyrics and songs are like sketches—the "underdrawing" of a sketch, expressing a lyrical idea, pulling out the purest form of language, refine, refine, refine, refine and layer, layer, layer, and revisit your original thoughts.

His band, Evertheory, is based on the Theory of Everything, and they love to investigate science within musical sounds, expressions, and words. They play with concepts and imagery of planets and the galaxy, the bell curve of knowledge, geometric shapes, and radiation belts. A listener must be willing to explore language with Evertheory's music, which can be quite complex and abstract; a superficial listener might just not "get it." The band has made a conscious effort to exclude swear

words from their lyrics; even though swear words can be expressive, there often are other words that better express what they want to say.

A Teacher Reflects: Cameron Brown, Middle School Director of Instrumental Music¹²

Reading and interpreting music in the realm of instrumental music education comes about, in my opinion, similarly to the way the English language is taught to American schoolchildren. The first things that are mastered are the technical aspects of reading and writing, and how to do each of these correctly and effectively. Later, children are taught that reading and writing can also be artistic in the form of poems, lyrics, plays, and more. I would say that reading music and performing it on an instrument is taught in the same order, but the arrival at the performance of artistic elements, as well as evaluating of these elements, comes much sooner in music than it does for the English language.

Musical Language That Is Taught to Students

In the first year or two, music students are taught to read the two most basic aspects of music: pitch and rhythm. Pitch is the particular sound that is to be played on the instrument (A, B, C, D, E, F, or G, sometimes with a modifier such as flat, sharp, or natural). Rhythms are the symbols that tell the musician how long the note should be played in the number of beats it should receive. The basics are whole note (four beats), half note (two beats), and quarter note (one beat). It gets more complicated with both pitch and rhythm as students get older, continually progress, and advance their skill set to be able to encounter more difficult pitches and rhythmic patterns on their instruments.

In the first 2 years of music education, students also learn foundational artistic elements to performing as they continue to learn and grow with the basic pitches and rhythms on their instrument. The main artistic concepts taught in these early stages are the basics of dynamics (different levels of volume) and articulations (in band music) or stylistic bowings (in orchestral music), which are different ways to attack notes to achieve different effects.

As students progress into advanced middle school and high school music ensembles, and they learn many other stylistic markings that increase artistry and add emotional context. Examples of stylistic markings include the following: *appassionato* (impassioned), *cantabile* (play in a style as if the instrument were singing), *con fuoco* (with fire), *maestoso* (majestically), *marziale* (march-like), *scherzando* (playfully), and *tranquillo* (tranquil).

¹²Cameron Brown is Director of Instrumental Music at Thurgood Marshall Middle School in San Diego, California.

Language Used by Music Teachers and Conductors in Classrooms and Rehearsals

In addition to knowing the extensive lists of dynamics, articulations/bowings, tempo markings, and stylistic markings, teachers and conductors (who are the same person in a school music context) must convey artistic messages using spoken words to their students and/or ensembles (again, one in the same in a school setting). First, all of these artistic concepts must be taught effectively by the conductor/teacher. Once students master these concepts, teachers and conductors must utilize the terms in order for their students/musicians to perform these aspects of each piece of music accurately, as written by the composer and/or arranger, throughout the rehearsal process.

The descriptive, artistic language used by educators and/or conductors must effectively teach the concepts of the creative aspects of music. Once their students understand, educators/conductors must use the common language of the ensemble to convey their interpretation of the composer's and/or arranger's artistic vision for the music. I often find myself using metaphors and analogies to help communicate my interpretations of music to my students. In the past, I have said things like "This passage must be performed as if we're trying to put a baby to sleep," "We are sending soldiers off to war!", or "In this piece, we are attempting to recreate the beauty of a sunrise through sound." Other descriptive things I can recall saying to students would include "punchy" (to further emphasize some staccato markings), "lush" and "warm and cozy" (to describe a particular ballad), "soul lifting" (to describe an apex in an emotional), "vengeful" (to describe a particularly intense passage), and "snob-bishly" (which is probably not a real word, but I used it to describe a march that was written for a royal family). Using these descriptors, and holding my students/musicians accountable for performing these artistic concepts as effectively as they can, is how I develop great musicianship in my students.

The Importance of Language in Music Education

The importance of both the common language spoken/written by students, as well as the multiple languages utilized in music (pitch, rhythm, and all artistic performance concepts), are imperative in both the learning, as well as performance, of music. There are so many dimensions in which language is used in music education that, without it, great music would be, in my opinion, impossible to make. Legendary conductor and composer Leonard Bernstein once said, "Music can name the unnameable and communicate the unknowable." Without the written and spoken language between musicians, I do not believe music of the caliber we know and enjoy in today's world could've been produced to such depths. I'm sure that, if language had never been developed, music would still happen in some way, shape, or form. I just cannot imagine it being performed to the levels that Mr. Bernstein described in his quote. Language and music are inseparable. Both allow humans to connect with one another. Without one or both of them, our lives would be empty and without much meaning.

LEARN MORE



Go to <https://goo.gl/ttzQeg> on YouTube or literacybeat.com/literacy-in-the-disciplines to watch interview videos at our Disciplinary Literacy channel, including the following:

The Visual Arts

Interviewee: Liz Jardine, an artist in San Diego, California.

Interviewer: Dr. Barbara Moss, San Diego State University.

Teacher: Tim Benson, teacher and president of the San Diego Education Association.

Technology

Interviewee: Paul Hill, Film Editor.

Interviewer: Alex Gonzalez: Director of Technology, Health Sciences High and Middle College, San Diego, California.

Teacher: Annaleah Enriquez, Health Teacher, Health Sciences High and Middle College, San Diego, California.

Be sure to listen to the podcasts as well.

Literacy Meets Music

Teacher and musician Linda Lungren interviews musician Tim Peterson. Podcast.

A disciplinary approach to reading sheet music.

Video resource from AdLit.



Evertheory

Engineering Education, Design, STEM, Mechanical Engineering, and Literacy

Cynthia Brock, Cal Anderson, and Joe Assof discuss intersections of engineering, mathematics, and literacy. Part I video.

Cynthia Brock, Cal Anderson, and Joe Assof discuss teaching implications from Part I regarding engineering, mathematics, and literacy. Part II video.

Ian O'Byrne and Kurt Becker discuss engineering education, design, STEM, and literacy. Video.

Classroom examples: Joe Assof uses close reading to understand word problems. Middle school example video. High school example video.



Joe Assof uses close reading in a high school math class.

Students Use the Language of Science

High-school student-created video: Cyberbridge

Reading a graph like a scientist. Video contributed by Josh Lawrence at the University of California, Irvine and AdLit.

Be sure to listen to the podcasts as well.

CHAPTER 2 ACTIVITY

Read at least two of the interviews and teacher reflections in the chapter and create a graphic organizer that compares and contrasts the two disciplines. Use Figure 1.3 (pp. 13–15) for guidance about what to look for as you read. Possible columns include Discipline #1 Features, Discipline #2 Features, Similarities, and Differences. Focus especially on the unique features of each discipline that are not found in the comparison discipline.

Identify the literacy demands in your discipline and then write a concise paragraph that describes how you might apply the disciplinary features of learning content and language at your grade level and within your discipline. What would help you to demonstrate clearly for your students what makes your discipline unique?