In this chapter, we describe how preschool through first grade (PK–1) teachers scaffold young children’s disciplinary writing in environmental science. The ideas we provide are informed by research, learning theories, and our work as teachers of young multilingual and multidialectal children and as teacher educators in culturally and linguistically diverse schools. First, we discuss the potential of integrating science with language and literacy learning and the importance of linguistic pedagogical knowledge. We then explain how teachers can weave into their existing practice the teaching and learning
cycle (TLC), a supportive framework for scaffolding multilingual children’s academic writing. Applied to science, the TLC provides abundant opportunities for children to think, talk, and write about science phenomena and to develop awareness of how the language of science works so that they are well prepared to communicate effectively through disciplinary writing.

Throughout the chapter, we offer illustrative examples of how the TLC looks in bilingual classrooms and in classrooms where English is the primary language of instruction. At the end of the chapter, we provide inquiry questions and action research suggestions so that teachers, teacher educators, and researchers can explore the full potential of the TLC so that all children have an equitable opportunity to learn and thrive in science.

INTEGRATING SCIENCE WITH LANGUAGE AND LITERACY LEARNING

The Next Generation Science Standards (NGSS Lead States, 2013) sets high expectations for all children’s science learning, and the Framework for K–12 Science Education (National Research Council, 2012) guides teachers to engage all children in quality science learning. This new era of standards-based science education calls for dynamic and engaging science education, beginning in the earliest years of schooling, that is:

• **Inquiry focused:** Children pursue scientific questions they are curious about, engage in scientific inquiry, and come to their own understandings about science phenomena.

• **Collaborative:** Children interact in a learning community, explore their questions and reasoning with one another, and negotiate new meanings together.

• **Dialogic:** Children ask questions, explore phenomenon, explain their thinking, and offer their own interpretations in extended discussions with peers and teachers.

• **Inclusive:** Teachers—and children themselves—believe that all children are able to fully participate in science and have cultural and linguistic assets from their homes and communities that are valuable for classroom science learning; teachers promote children’s use of their full linguistic repertoires, including multiple languages and dialects.

The National Research Council (2012) contrasts this new era of science education with more traditional approaches that overemphasize a focus on discrete facts and “breadth over depth,” while de-emphasizing opportunities for students to engage in the real practices of science. In the Council’s
extensive framework to guide science education moving forward, they recommend three interrelated dimensions for science education: (a) scientific and engineering practices (Figure 6.1); (b) crosscutting concepts that unify the study of science and engineering through their common application across fields; and (c) core ideas in four disciplinary areas—physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science.

As illustrated in the scientific and engineering practices listed in Figure 6.1, science is a language-intensive discipline and a rich venue for science disciplinary language development. This dual challenge and opportunity requires teachers to develop new linguistic pedagogical knowledge, in other words, knowledge of how language works in the discipline and the relevant pedagogical practices to scaffold student learning and development of such language. Science disciplinary language refers to the specialized and often technical, grammatically dense language used in science that facilitates scientific thinking and communication. It differs from “everyday” language at the word, phrase, clause, sentence, and whole-text levels in terms of extent of precision, formality, and abstraction (Christie, 2012; Derewianka & Jones, 2016; Schleppegrell, 2004). It is characterized by sophisticated vocabulary, complex syntax and grammar, and highly structured and cohesive whole texts (e.g., an argument).

Beyond these generalities, each written genre in science (e.g., science information report, science explanation, science argument), uses language in different ways. The concept of genre that we use is from systemic functional linguistics, a theory of language first developed by Michael Halliday (1925–2018) and developed over the years by scholars and teachers around the world. The theory has been helpful to demystify language for students and support them to talk about how language works in the academic texts they read and write in school, thereby increasing educational equity. According to systemic functional linguistics, genres are goal-oriented and staged social processes (Rose, 2010). Goal-oriented means that there is always a social

**Figure 6.1** Eight essential science and engineering practices (from National Research Council, 2012).
purpose for texts (e.g., to entertain, to persuade, to inform). Staged means that in the text, there are multiple “stages” toward achieving the goal. These stages are meaningful sections within the text that are recognizable because of where the stages are placed in the text (e.g., the “orientation” stage in a story that introduces the characters and setting) and the language resources used (e.g., the use of the word “suddenly” to indicate a shift in a story’s plot). Teachers understand intuitively that genres have these meaningful stages, but they don’t always discuss stages in texts with students. Teachers also recognize that genres within and between disciplines “feel” different (e.g., stories versus science information reports versus science arguments), but they don’t always know why. When teachers develop their knowledge of how genres work and the linguistic pedagogical knowledge to support students’ understanding of how genres work, this helps both teachers and students demystify the “why.”

In order to teach students how the language of science works, teachers need to strengthen their own linguistic muscles by exploring the nuances of the various written genres of science. One example of how a science genre works is the case of an information report (e.g., “All About Honeybees”), the social purpose of which is to inform readers about a topic, or a class of things (e.g., honeybees). At the whole-text level, science information reports are organized logically, by category, because grouping important information about a topic is more readily understandable than a chaotic list of facts. The two main stages of science information reports are (a) general information about the topic (e.g., honeybees) to introduce it, and (b) coherent sets of key attributes about the topic to provide more detail. Within each stage, information is grouped together even further (e.g., characteristics and appearance, activities, and behavior) so the text “hangs together” cohesively, which makes it easier for readers to understand it. Specific language resources help with this cohesion. For example, text connectives (e.g., in addition, however, finally) connect large chunks of information across and within paragraphs and keep the information flowing (rather than just listing facts). At the sentence level, complex sentences often convey specialized science concepts, such as relationships between ideas (e.g., Bees are very important insects to humans because they pollinate plants). Complex grammar also provides a way to add more detail about an idea, for example by expanding a noun group with clause embedding (e.g., Bees pollinate plants that people need to survive). At the word level, domain-specific vocabulary (e.g., pollinate, thorax, membrane) and general academic vocabulary (e.g., endangered, protect, contaminated) are used to communicate specialized and technical information with precision and clarity.

Here, we are presenting information about complex science texts that teachers need to understand in order to support children’s disciplinary language development. These understandings about how science language works
may seem too advanced for young children. But young children are much more capable of understanding how complex texts work than we often give them credit for. They already hear this complex language through their interactions with complex science texts during teacher read alouds and through science inquiry activities. Children also are frequently asked to use language to “ask questions and define problems,” “obtain, evaluate, and communicate information,” or engage in other science practices (National Research Council, 2012). When children learn to notice disciplinary language, discuss it with their peers and teachers, and try it out themselves, they stretch from what they can already say (e.g., “Bees are important”) to a slightly higher level (e.g., “Bees are important because they pollinate plants”). With appropriate and strategic scaffolding, many children can stretch even higher (e.g., “Bees are critical to ecosystems because they pollinate plants that animals need to survive”). Beyond the sentence and vocabulary levels, instead of writing a set of disconnected facts, children can learn to organize their ideas cohesively and craft science informational reports, explanations, and arguments. This is not just aspirational. With scaffolding, daily exposure to science disciplinary language in complex texts, plentiful discussion about how texts work, and ample opportunities to write authentically, we’ve seen 5-year olds produce this type of language. Teachers can learn how to support their young multilingual students to meet these types of high science disciplinary writing expectations through the TLC, which we discuss in the next section.

THE TEACHING AND LEARNING CYCLE

We have found that many PK–1 teachers are quite skilled at providing content-rich activities for children, such as facilitating science inquiry tasks and experiments, using digital resources or photos to reinforce concepts, reading aloud science informational texts with children, or going outside the classroom to explore the natural world. Most teachers tell us that they are eager to support their students to develop as writers, as well, but they don’t always know where to start or how to go beyond sentence frames and vocabulary. The TLC is an effective framework for scaffolding science learning, science disciplinary writing, and genre awareness, particularly for culturally and linguistically diverse students (Derewianka & Jones, 2016; Gibbons, 2015; Rothery & Stenglin, 1995; Spycher, 2017; Spycher, Austin, & Fabian, 2018; Spycher & Linn-Nieves, 2014).

Using the TLC to plan instruction (Figure 6.2), teachers guide their students through five stages of learning toward learning goals and a culminating writing task, such as a description of a local freshwater ecosystem or an explanation about why honeybees are a “keystone species.” These five stages are: (a) building the field, (b) exploring the language of text types,
In this section, we share suggestions for effective planning for a science TLC, including choosing worthy texts for teacher read alouds, establishing routines, crafting robust questions, and anticipating the language students will need to develop for a culminating writing task.

The Importance of Planning

Investing time in planning for strategic scaffolding and for a supportive classroom community are critical to a successful TLC science unit. The TLC is designed to support students to engage in science practices and meet the genre expectations for a culminating writing task. Therefore, one of the most important questions teachers ask themselves in the planning process is, “What will my students write about?” This decision is framed by
the science learning goals for the unit and the unit’s big ideas and inquiry questions, and is guided by standards for science, English language arts, and English language development. The complex texts teachers select also help to answer this question. Students can learn to emulate the complex science informational texts their teachers read to them and analyze with them, such as topic-based explanations (e.g., “How Honeybees Pollinate Plants”), as well as different types of arguments, including calls to action (e.g., “Save the Bees!”). Helping students write calls to action has the added benefit of promoting a sense of empowerment by instilling within young children the idea that their voices matter and they can make a positive difference in the world.

Being very clear early in the planning process about what students will write at the end of the unit and being familiar with the purpose, organizational structure, and language features of the culminating writing task help teachers to identify what content and language to focus on in each stage of the TLC. In our TLC planning process, we outline our big ideas, inquiry questions, and culminating tasks before beginning a unit, but as the unit progresses, students’ questions and interests often shift or add to the focus.

Choosing Worthy Texts and Crafting Robust Questions

Text selection is key to creating rich science and disciplinary language learning opportunities using the TLC approach. Because higher order science concepts are communicated through rich and complex language, careful selection of complex science informational texts is critical. These are texts that are typically several grade levels above what most children in grades PK–1 are able to decode independently and that afford multiple peer-to-peer and children-with-teacher discussions about complex ideas. The texts need to be robust enough to pique students’ curiosity about science knowledge and science language. Engaging with such texts interactively creates a special space for students to explore ideas through extended discussions. Texts also need to be relevant to students. For example, addressing topics related to environmental justice issues affecting students’ communities, such as the prevalence of contaminated water in lower income neighborhoods, and affording them an opportunity to explore and communicate possible solutions (e.g., how communities can advocate for clean drinking water, ways of getting clean water) gives students a voice in something that is personally meaningful to them and a vision for the future.

Determining what young learners will talk about as they explore these texts is guided by science standards and learning goals, along with listening to what children themselves are interested in learning about. To support quality peer-to-peer interactions around texts, we carefully read the texts
we will use, analyze them for what they afford in terms of science learning and language development, and collaboratively plan worthy questions that will promote a lot of thinking and talking among students, keeping our eye on the inquiry questions, big ideas, and culminating writing task(s) we’ve established for the unit of study. Since we read the same texts with students over multiple days, we plan increasingly complex questions for students to ponder and discuss in peer-to-peer, multi-exchange interactions. We like to use sticky notes to write the questions we will ask students and place them directly in the book, since referring to a lesson plan and holding a book during a read aloud can be awkward. We also use sticky notes to help us remember any vocabulary terms we want to pause to explain or illustrations we want to highlight to support students’ conceptual understanding. Young children are eager to discuss the big science ideas in complex science informational texts. They readily take up the complex disciplinary language they encounter when it is called to their attention and explained and when they have an opportunity to use it meaningfully in extended discussions with open-ended questions.

Expecting all students to engage with rich science texts through interactive reading and scaffolded peer-to-peer interaction demonstrates a strong respect for all children’s intelligence and their capacity to grapple with complex ideas through equally complex language. Teachers may feel concern that students are not understanding every word of the text that is read interactively. However, both the linguistic and conceptual knowledge development that students engage in is planned, yet unfolds in an organic and multi-faceted (and sometimes unpredictable) way. Through repeated interactions with rich science texts, along with scaffolding for using disciplinary language purposefully and in a socially and emotionally supportive environment, children weave together the concepts and language needed to interpret and communicate their ideas. When teachers employ quality texts and quality questions that are worthy of children’s attention, there is a lot for students to be curious about, talk about, and discover.

Using Routines for Equitable and Quality Interactions

The science disciplinary language development that is possible through the use of rich science texts and concepts in the early years assumes interactive and dialogic approaches to learning. With young children, teachers often guide conversations around central texts through interactive reading. They set students up for success by facilitating their ability to discuss their ideas with their peers in extended, multi-exchange interactions. The learning and practice students do around collegial discussions is the co-requisite work that goes hand-in-hand with learning the language and content. Most
children love to talk, but talk is not always equitable. Equitable talk requires that students have clear procedures for conversing with multiple partners; that they know how to take turns, track their discussion partner(s), and focus on active listening; and that they have learned to engage physically during paired conversations. Physical engagement includes showing their discussion partner that they are listening attentively by making eye contact, leaning in, nodding, or using other gestures that are socially recognized in U.S. classrooms. We recognize that not all cultures share these norms for behavior, which means that patience is needed while some students learn to add these new ways of interacting to their repertoires. Teachers also need to consider how they can modify their thinking and behaviors to better include students with unfamiliar communication styles or cultural backgrounds.

To help students acquire discussion skills, early-years teachers can explicitly teach discussion moves, such as prompting students to “hold our thoughts” (sometimes accompanied by a “thinking pose”) so that everyone has enough think time before sharing ideas; providing sentence frames to support effective expression; and inviting students to rehearse statements or questions (sometimes by whispering responses into an imaginary microphone) as a way to prepare before they talk with a partner. Learning to take turns and listen while others talk, express one’s own understandings and ideas, and ask questions to extend discussions supports students’ social-emotional, academic, and linguistic development.

Exploring practical and culturally responsive routines for each classroom community offers an opportunity for teachers to honor the assets young learners bring with them to school. We have witnessed students in grades PK–1, full of joy for learning, who insist on standing in front of their classmates to teach alongside the teacher. We have also witnessed students engaging readily and joyfully with a call-and-response approach and asking for more of this approach because it reflects a communication style some students bring from their home communities. Teachers, being the great innovators that they are, can take students’ ways of interacting and combine them with other important structures they’ve put into place to create a successful space for interactive learning.

**OVERVIEW OF THE TLC STAGES**

The stages of the TLC (Figure 6.2) are presented as steps toward standards-based learning goals around big science ideas, culminating in a writing task that helps students progress in their science disciplinary thinking and writing. However, in reality, the stages do not occur in a lockstep fashion. Typically, there is a lot of back and forth from one stage to another, and stage
Stage One: Building the field

The first stage of the TLC focuses on meaning making, or “building the field” of knowledge about a science topic, accomplished through language-rich experiences. We like to start a TLC science unit by inviting children to share what they already know about the topic from their home and previous school experiences, and what they are curious about. All ideas are entertained, and, as is the case throughout the unit, we encourage the children to express themselves using their home languages or dialects of English, as they choose. We use a “K-C-L chart” (what we know, what we are curious about, what we learned) to record ideas and keep it posted in the classroom so that children can add their questions and learnings as the unit progresses. We do a lot of charting throughout the TLC unit in order to create a text-rich environment and provide language and ideas that children can use in their own writing.

To support children’s curiosity and invite their inquiry into a science topic, we use hands-on activities in which they can freely explore and discuss their thinking with peers. For example, for our honeybees TLC unit, we provide photographs of bees engaging in various behaviors, such as sucking nectar from flowers, gathering pollen on their bodies, and protecting the hive. We also provide models (plastic replicas) of different types of honeybees (e.g., queen, drone, worker) and stages of the life cycle (e.g., egg, larva, pupa, adult). We invite the children to discuss what they observe in small groups and to generate questions they want to explore in the unit. The children record these ideas in their science logs and share them with the whole group so that they can be added to the K-C-L chart. We also have an ongoing science independent learning station where the children can observe photographs, models, or tangible examples of science phenomena (e.g., a classroom butterfly garden, plants growing in different conditions) and record their observations in their science logs.

Creativity in the early learning classroom, including dramatic play, visual arts, or music, can support language development, as children are eager to talk about the concepts they are imagining or creating using newly acquired terms. For example, for the concept of pollination, we have children pretend they are bees flying from flower to flower (replicas we make out of tissue paper) to sip nectar and gather pollen on their “pollen baskets.” We put an edible powder, such as powdered sugar, in the center of each flower...
to replicate the pollen, which sticks to the children’s fingers. While the children are dramatizing the pollination process, we encourage them to verbalize what they are doing using new science terms (e.g., proboscis, pollen baskets), as well as general academic vocabulary (e.g., gather, collect), and we then invite them to orally recount the experience in small groups before writing and drawing about it. Singing is another especially joyful activity that young children readily engage in. One technique we like to use is to take a familiar tune and create new lyrics, ideally with the children, to reinforce the new science concepts and language (see an example in Figure 6.3).

Quality interactions with complex science informational texts are integral to science learning in the early childhood classroom. Interactive teacher read alouds using worthy complex texts should be joyful experiences in which children talk abundantly with their peers to expand their science thinking and develop disciplinary language. We use a multi-day read-aloud routine where we read the text (or key sections of the text) with the children several times over the course of a week, stopping to invite them to discuss with a partner increasingly complex and carefully crafted questions. We use dialogic techniques to support children’s cumulative learning, including the following:

- **Ask open-ended questions** so children can engage in extended, multi-exchange peer-to-peer discussions (e.g., “Why do you think the bees are gathering all of this pollen on their bodies?”).
- **Ask known-response questions** that they can all respond to chorally to reinforce concepts and language (e.g., “What do we call this body part?”).
- **Respond to children’s responses** to stretch their thinking and language: Affirm their responses, prompt them to elaborate on their responses, recast their ideas to model the appropriate use of new language, and repeat responses so all children can hear.

**Figure 6.3** Singing in science.

---

**Do You Like To Buzz?**

(to the tune of “Do Your Ears Hang Low?”)

Do you like to buzz?
Are you covered all in fuzz?
Do you call a hive a home?
In the garden do you roam?
Do you gather pollen when it’s sunny?
Is your proboscis a little funny?
Do you like to buzz?

---

Do You Like To Buzz?

(to the tune of “Do Your Ears Hang Low?”)

Do you like to buzz?
Are you covered all in fuzz?
Do you call a hive a home?
In the garden do you roam?
Do you gather pollen when it’s sunny?
Is your proboscis a little funny?
Do you like to buzz?
In addition, because there is a lot of technical language as we read aloud these complex texts, we explain new technical science vocabulary (e.g., pollen), act it out with the children, or point to illustrations that match the new terms while we are reading, and we have the children say the words with us so they become familiar with the terms. Since children need to build up a repertoire of sophisticated general academic terms (e.g., survive), after first explaining some of these words while reading, we also explicitly teach a select set of general academic vocabulary words using a predictable routine (Figure 6.4), which helps the children use the words in their speaking and writing (see Spycher, 2009 for additional information on this approach).

These are just some of the ideas we incorporate as we plan a TLC science unit, and the activities we select vary by science topic. Many of the activities we suggest are likely to be familiar to early childhood teachers, although all of us could spend a lifetime refining and enhancing our methods.

---

**General Academic Vocabulary Instruction Planning Template**

**Timing:** about 8 min.

**Word:** Select a general academic vocabulary word from the complex text with which the children have already engaged at least once. The word should be useful to them for better understanding the text and topic and for effectively communicating about this and other texts and topics.

**Teaching Routine:**

**I. Introduce the Word:** (2 min.)
- Say the word, invite the children to say it with you, and briefly remind them where they first heard it in the text. Write the word and highlight the first letter. Point out any cognates. (e.g., *investigate* in English is *investigar* in Spanish).
- Explain what the word means in child-friendly terms (1–2 sentences). Use the word in a complete sentence so you don’t sound like a dictionary.
- Provide a few examples of how the word can be used in other contexts. Show pictures and use gestures to support comprehension.

**II. Children Use the Word Meaningfully:** (5 min.)
- Guide students to use the word meaningfully in one or two think–pair–shares (three, if needed), with open-sentence frames that are appropriately grammatically complex (e.g., I want to *investigate* __________________ because __________________.).
- Use pictures as prompts where useful. (For example, for *investigate*, show a picture of a meadow and ask students what they might investigate there.)

**III. Check and Develop Word Knowledge:** (1 min. plus repeatedly over time)
- Ask short-answer questions to check for understanding. (Is this something you’d investigate? If yes, say “*investigate.*” If no, say “wouldn’t *investigate.*”)
- Invite the children to teach the word to someone when they get home, and encourage them to use the word as much as they can in speaking and writing.
- Post the word, and model using it over time as appropriate.

---

**Figure 6.4** General academic vocabulary instruction routine.
Stages Two and Three: Exploring Language and Jointly Constructing Texts

What often happens is that teachers spend a lot of time on building content knowledge and then ask children to write independently, with varying results. By adding some activities where the language of the genre is talked about explicitly and where children can co-construct the genre writing with skillful teacher guidance, more students will be able to successfully engage in the culminating writing task and meet genre expectations. We explain stages two and three together because language that is deconstructed in stage two is often reconstructed in stage three. We outline some of the activities we use below.

Stage Two

In this stage, the focus is on helping children to explore the language of the genre, or text type. Here, we help children to notice the language at different levels and talk about it meaningfully. Teachers might analyze a short passage of the text with children by writing it on a large piece of chart paper so all students can see it and then drawing their attention to how all of the information in the passage is about the same category (e.g., describing honeybees’ bodies) and how the sentences are organized. The class might “unpack” a complex sentence by identifying some of the “linguistic boundaries” (e.g., prepositional phrases, noun groups), which form “chunks” of meaning. We use metalanguage, or language for talking about language, in these discussions. One meaningful chunk we like to help young children notice is the “that chunk,” a type of embedded clause, which, when tucked into a noun group (e.g., long proboscises) expands and enriches its meaning by providing important detail. We talk with children about how the sentence “Bees have long proboscises that they use for sucking and tasting nectar” has a “that chunk” that gives readers more information about the noun group (long proboscises). Using such metalanguage (language to talk about language) supports discussions about genres. Children readily take up child-friendly terms (e.g., “that chunks,” “noun groups”) and may even make up their own metalanguage.

Stage Three

Here, the teacher serves as a “facilitative scribe” to jointly construct a well-crafted text with children, scaffolding the use of language they explored in stage two and have been using throughout the unit. The class, or small group, could craft complex sentences, tight paragraphs, and even longer passages. The teacher’s job is to listen closely to what students say and scaffold their use of language appropriate for the genre, always attending to accurate science meaning. This helps the children “rehearse” for independent writing of the genre. For example, we might start off inviting ideas about what to write (e.g., “How should we start our description of
bees?”) and negotiate with the children about which language to use. As we craft the text with the children, we ask probing questions to encourage precision (e.g., “Is there another more scientific word we could use for bees’ tongues?”) and expansion (e.g., “Can you say more about what worker bees do? Is there a ‘that chunk’ we could use?”). We affirm what students say and sometimes recast it to model disciplinary language (e.g., “Yes, they do get pollen on their legs, or on their pollen baskets!”). We also ask students to make revisions as we go (e.g., “What do you think about adding a connector here so that these ideas are linked?”).

**Stages Four and Five: Independently Constructing Texts and Reflecting on Own Texts**

Stages four and five are an opportunity for children to spread their wings with independent science disciplinary writing, support their peers as they write, and reflect on what they learned and wrote.

**Stage Four**

By this time in the TLC, the children have been writing daily and are now well-prepared to independently write texts that meet the expectations of the genre. By “independently write,” we don’t mean that children are completely on their own. Young children still need supports, such as graphic organizers to categorize information, charts around the room with exemplary texts, science terms posted on charts or on a science word wall, and consultations with peers and teachers. In stage four, we always post and discuss with children the “success criteria” for the writing task (e.g., “My ideas are clear to me”; “I describe what bees are, have, and do”; “I use precise words”). The children also like to add their own success criteria, based on the learning they’ve engaged in throughout the unit (e.g., “I use ‘that chunks’ to add detail”).

**Stage Five**

This final stage is an opportunity for children to reflect on their own writing and what they have learned, which sets them up for success in the next TLC. For example, teachers might ask students to analyze their own science information reports, using the same success criteria they used to write it, and identify strengths and areas for improvement. They might structure peer feedback sessions where the children analyze one another’s texts, using norms (e.g., “Listen carefully when others talk”) and protocols (e.g., “Use the success criteria when you give feedback to your friend”) to help children become peer mentors and cultivate a learning community. Importantly, teachers also provide an opportunity for children to reflect on and share about what they learned during the unit, which helps them to become mindful of their own learning processes.
CLASSROOM EXAMPLE: HUMAN IMPACT ON EARTH SYSTEMS

The following classroom example highlights how one teacher, Ms. Flores (a pseudonym), used the TLC to guide her kindergarten class through an environmental science unit on human impact on earth systems, specifically focusing on how the choices that humans make impact other living things. The culminating task for this unit was for students to write an argument persuading people to take care of our water systems. The children’s arguments were realized through collaborative advocacy posters in which they described what fish need, explained the plight of fish due to water pollution, and argued for steps we should all take to create clean water in a call to action. Through this example, we hope to illustrate the potential of the TLC in multilingual and multidialectal early childhood settings. While the example provided is from a bilingual classroom, the ideas and activities can be easily adapted for other contexts.

During the course of the unit, students engaged in scientific inquiry tasks, including observing fish and recording their observations and labeled drawings in a science journal. They read and discussed (through interactive teacher read alouds) how fishes’ different body parts help them survive and what additional things fish need to survive. These discussions and learning tasks segued into a focus on the importance of clean water and the impact humans have on water systems.

Stage 1: Building the Field

In this part of the TLC, students learned about fish, their characteristics, and their survival needs. Pedagogical practices and classroom tasks in Stage 1 focused on building content knowledge about the topic of fish. To begin the unit, students were invited to share their background knowledge about fish and generate initial questions about them. They engaged in multiple interactive read alouds with science informational texts and viewed and discussed short science videos to build content knowledge. The classroom had fish tanks with small goldfish and guppies so that students could observe the fish daily and take notes in their science journal, which they used in discussions with their science team (small groups of students). Students then engaged in collaborative group work, where they discussed observations about fish using different images; engaged in extended, scaffolded conversations as a class about their observations; and then collaboratively created a visual representation to explain what fish need to survive and to record questions they had. Each group then presented their posters to the class, after which Ms. Flores helped the class create a list of observations and questions (Figure 6.5).
To build students’ understanding of human impact on water systems, students engaged in a hands-on inquiry task, where they learned about water pollution by adding waste to clean water and then trying out different ways to clean it. Working in science teams, students followed the protocol for the inquiry task (Figure 6.6): they observed, took notes, discussed their observations, and came to conclusions about the difficulty in cleaning polluted water.

After the inquiry task, the class engaged in a debrief discussion about their new insights about water pollution and began to discuss the implications for
fish and people. Students shared their ideas about why clean water is important and what people should do to maintain clean water. This discussion fostered students’ use of the language of causal explanation, which was later revisited in Stage 2 of the TLC and used in writing in Stages 3 and 4. For example, within student discussions, students expressed statements such as, “Cuando la gente tira basura al agua, se contamina, y se enferman los peces” [“When people throw trash into the water, it gets contaminated, and the fish get sick”] and “Los peces se mueren porque el agua está sucio por la gente que tira basura al agua” [“Fish die because the water is dirty from people throwing trash into the water”]. Through these discussions, students were able to articulate the relationship between human actions and their effects on fish and their habitat (Figure 6.7).

Stage 2: Exploring the Language of the Text Type

This unit of study offered opportunities for students to explore the language features of description, explanation, and argument. Once students

![Figure 6.7 Class inquiry task debrief discussion.](image-url)
had built up content understanding of fish and their survival needs, Ms. Flores wanted to further draw students’ attention to how they might expand on and enrich their sentences with additional details to be more precise. To do this, the students engaged in a pedagogical practice called *collaborative sentence reconstruction*, where they listen to a mentor sentence several times and take notes by drawing pictures, and then work together in pairs to reconstruct the sentence (Figure 6.8).

The purpose of this lesson is for students to gain deeper understanding of the meanings in the sentence—an important comprehension skill—and to be able to demonstrate metalinguistic awareness by discussing how the sentence is structured and how different language features are at work in the sentence. In this case, Ms. Flores wanted to raise students’ awareness of descriptive language and of how the author of the original sentence, which was excerpted from one of the science informational texts students had read multiple times, provided details about how and where fish move. The original sentence students reconstructed and then unpacked was “Los peces nadan hacia arriba para comer la comida que flota encima del agua” [“Fish swim upward to eat the food that floats on top of the water”].

---

### Collaborative Sentence Reconstruction in Kindergarten

1. Select a sentence with complex syntax from a text students have already interacted with.
2. Read the sentence aloud once: Students just listen and do not see the sentence.
3. Read the sentence a second time: Students listen and draw and label what they hear.
4. Partner sharing: In pairs, students share their labeled drawings and orally reconstruct the sentence together.
5. Group sharing: A few sets of partners share their oral sentence with the whole group, and the teacher records a group word and phrase list on chart paper so all can see. Students chorally read what is on the list.
6. Read the sentence a third time: Students add to their labeled drawings.
7. Partners reconstruct the sentence: The same pairs work together to write a sentence, as close as they can to the original sentence, using their drawings and notes from the three readings.
8. Share and compare: The teacher writes the original sentence, and invites the students to compare their sentence with the original one, prompting them to notice particular language features (e.g., specific words used, prepositional phrases, “that” chunks, long noun phrases).
9. Unpack meanings: The teacher facilitates a discussion about the meanings of the different parts of the sentences by “unpacking” them and then focusing on how each part adds detail and precision to the whole sentence.

---

*Figure 6.8* Collaborative sentence reconstruction in kindergarten.
As they discussed the sentence, Ms. Flores asked the students two main questions: “Who is this sentence about?” and “What is happening?” The question about what is happening elicits responses about the movement, or behavior, of the fish. The language feature that Ms. Flores focused on when asking these questions was “doing processes,” or in more familiar terms, “action verbs,” which are critical for describing the behaviors of animals with precision. The lesson also drew students’ attention to how authors elaborate on ideas by including additional information through prepositional phrases. The teacher elicited awareness of this language feature by asking the questions, “Where/when/how/why/in what ways does the animal move?” Prepositional phrases are one way that authors add detail about the circumstances related to processes (e.g., from side to side, under the water, through the opening). Highlighting these prepositional phrases—for instance, through questioning about where something happens—is a way to support students in adding detail to their writing.

The class drew and labeled their interpretations of sentences they heard, and reconstructed the sentences together as a whole class first (Figure 6.9). Then students reconstructed sentences with their partners (Figure 6.10).

After sharing and discussing the reconstructed sentences, the students engaged in “unpacking” or deconstructing the sentences to discuss the meanings in the different parts of the sentences (Figure 6.11). This final step of unpacking the sentence provides another opportunity to closely analyze both the language and the meanings in each portion of the sentence. The students co-construct a list of simple sentences from each portion that, when combined, express the complete meaning of the complex sentence. This activity is interactive, and questions asked of the students include “What is this part about?” and “What information is it telling us?” Sentence deconstruction simultaneously provides an opportunity to focus on meaning and form by drawing students’ attention to important information in the sentences and what the meaningful chunks are (such as specialized vocabulary used or prepositional phrases that add detail).

---

**Figure 6.9** Class text reconstruction.
Additional sentences that the class deconstructed in Stage 2 of the TLC focused on the same language features and metalanguage (i.e., doing verbs and prepositional phrases) in order to provide multiple and repeated opportunities for students to discuss the language, reinforce content understandings, and build metalinguistic awareness (Figure 6.12).
In addition to enabling students to expand and enrich their descriptions about fish, Stage 2 also introduced language for explaining causal relationships. To do this, Ms. Flores leveraged the student conversations from the water pollution inquiry task to introduce the language of causal explanation. She further engaged students in using specific language (i.e., causal language, such as “when” and “because”) to help them explain the causes or effects of water pollution with precision. She introduced open sentence frames to support effective communication, such as “Cuando [when] _____________, _____________; _____________ porque [because] _____________.” The students then drew upon their experience participating in the water pollution inquiry task, as well as their background knowledge from their interactive reading tasks about fish, to orally construct sentences that explain the causes and effects of water pollution, highlighting the subordinating conjunctions “cuando” [when] and “porque” [because].

Through these various language analysis tasks, the teacher raised students’ awareness of how particular language features in science writing...
work in order to support both their comprehension of the complex science content and scaffold their use of key language features in their writing.

**Stage 3: Joint Construction of Texts**

In Stage 3 of the TLC in Ms. Flores’s unit on human impact on earth systems, students had an opportunity to “rehearse” writing through teacher facilitation. This stage occurred after students had built up considerable knowledge about the characteristics of fish and their needs for survival, as well as how water pollution affects fish. To build on the classroom activities in Stage 2 and further prepare her students for independent writing, Ms. Flores co-constructed sentences with students about the causes and effects of water pollution on fish. She drew on students’ knowledge about the topic and the language features of description (e.g., prepositional phrases, doing verbs) and causal explanation (e.g., the subordinating conjunctions “cuando” [when] and “porque” [because]), introduced in Stage 2. As the students and teacher jointly constructed sentences, she modeled the process of writing, and co-created with them a model they could later use in their independent writing. Ms. Flores elicited ideas from the students and asked them to think about and discuss how they would put their ideas together in order to write about the topic. The class jointly constructed several sentences to explain the causes and effects of water pollution. Ms. Flores facilitated a discussion about how to write the first sentence and wrote the agreed-upon sentence on a chart, modeling for students. Then, she continued to jointly construct sentences with the students, pulling in their ideas and asking them to add details, reword, or combine ideas, as needed. The sentences they co-constructed included the following:

“*El agua está contaminada porque la gente no recoge la basura.*” [“Water gets polluted because people don’t pick up their trash.”]

“*Cuando hay mucha suciedad en el agua, los peces se enferman y mueren.*” [“When the water is very dirty, fish get sick and die.”]

“*Los peces mueren porque la gente tira basura al agua.*” [“Fish die because people throw trash into the water.”]

“*Cuando las personas tiran la basura al agua, los peces pueden morir.*” [“When people throw trash into the water, fish can die.”]

After constructing these sentences together as a class, the students wrote the sentences in their science journals (Figure 6.13).
Stage 4: Independent Writing

The children were now ready to work with their table teams to complete the final writing task, which was to create a poster to advocate for clean water. Students used success criteria that outlined the requisites for the task and worked together to create posters that explained what fish need (clean water), why fish die (polluted water), and an action step, or recommendation, that people should adopt to maintain clean water systems. Student advocacy posters (Figure 6.14) included sentences, drawings, words, and phrases relevant to the topic and task. As students wrote, Ms. Flores was available to assist as needed and continue the rich conversations around the topic to aid this final writing piece. Students utilized many of the collegial discussion skills they had worked on thus far, asking their student team members for ideas and negotiating where the drawings, sentences, words, and phrases would be located on the posters and what messages they would share.

Stage 5: Reflecting on One’s Learning and Writing

In the final stage of Ms. Flores’s TLC about clean water systems, students carefully reviewed and then presented their posters in order to teach their classmates about water systems. To carry out this activity, the class referred to the poster success criteria and were provided with sentence frames to give targeted feedback to their classmates, such as “Me gusta ___________” [I liked ___________], “¿Puedes explicar ___________?” [Can you
explain [______________________], and “Tengo una pregunta acerca de [______________________]” [I have a question about [______________________]]. The final task of the unit consisted of students writing about their reflections on their own learning (Figure 6.15).

This final writing task helped Ms. Flores to gauge what students had learned and where they were in their academic writing development, which also helped her evaluate how well she had scaffolded the teaching and learning experiences within the unit.

**DISCUSSION AND NEXT STEPS**

The TLC offers a cohesive and comprehensive approach to supporting young multilingual children’s academic writing development within the context of science learning. Through a predictable, yet flexible, five stage process, students learn to think, listen, speak, read, and write like a scientist and become increasingly aware of how language works in science. Building language skills and metalinguistic awareness in science is empowering for young learners because it helps them to be more attuned to language as they are listening to teacher read alouds or reading on their own, and to be more conscious of the language they select to communicate in speaking and writing.

Embracing the TLC comes with a committed belief that all children can learn at high levels and develop rich academic language with the right kind of support. Teachers, in their quest to find ways to amplify and enrich their
students’ learning and progress, can look to the TLC as a solid framework for continuous student development as well as their own development as educators.

**Inquiry Questions for Researchers and Teacher Educators**

- How can early-grades teachers be better supported to scaffold early academic writing in science for emergent bilingual children?
- In what ways could the TLC approach support effective planning?
- How does the TLC approach amplify the goals of new science, ELA, and ELD standards?
• What challenges and opportunities does the TLC offer our youngest learners and their teachers?

**Action Research Suggestions for Teachers**

• Work with your grade-level team to identify complex science informational texts that address some of the big ideas you’d like students to learn in science. How could you leverage the rich language in these texts to support your students’ early academic writing?
• Work with your grade level team to identify a culminating writing task in science and try out some of the activities presented in this chapter in a sequence, following the stages of the TLC. What do you notice students saying and writing? What challenges do you encounter?

**NOTES**

1. These crosscutting concepts are (a) patterns; (b) cause and effect: mechanism and explanation; (c) scale, proportion, and quantity; (d) systems and system models; (e) energy and matter: flows, cycles, and conservation; (f) structure and function; and (g) stability and change.
2. The term “clause embedding” may be unfamiliar to some teachers. A clause is a complete idea and contains a verb. When a clause is “embedded” it becomes part of another grammatical element, thereby modifying it. In the sentence, “Bees pollinate the plants that people need to survive,” the dependent clause, “that people need to survive,” is embedded in the noun group “the plants.” This type of complex grammar is common in science texts.
3. Keystone species are plants or animals that are so important to their ecosystems that if their population were significantly reduced or removed, the ecosystem would be negatively impacted or even collapse.
4. The type of metalanguage we use with teachers is often different from that which we use with children. For example, instead of the more sophisticated term “embedded clause,” which we use with adults, we use the term “that chunk” with children. Using metalanguage is not about right and wrong, but about finding a way to talk about language itself.
5. We use the metalinguistic term “processes” from systemic functional linguistics to refer to verbs since they help children to talk about language. We talk about “doing processes” (e.g., swim), “saying processes” (e.g., say, shout), “thinking/feeling processes” (e.g., wonder, want), or “being/having processes” (e.g., is, has).
REFERENCES


