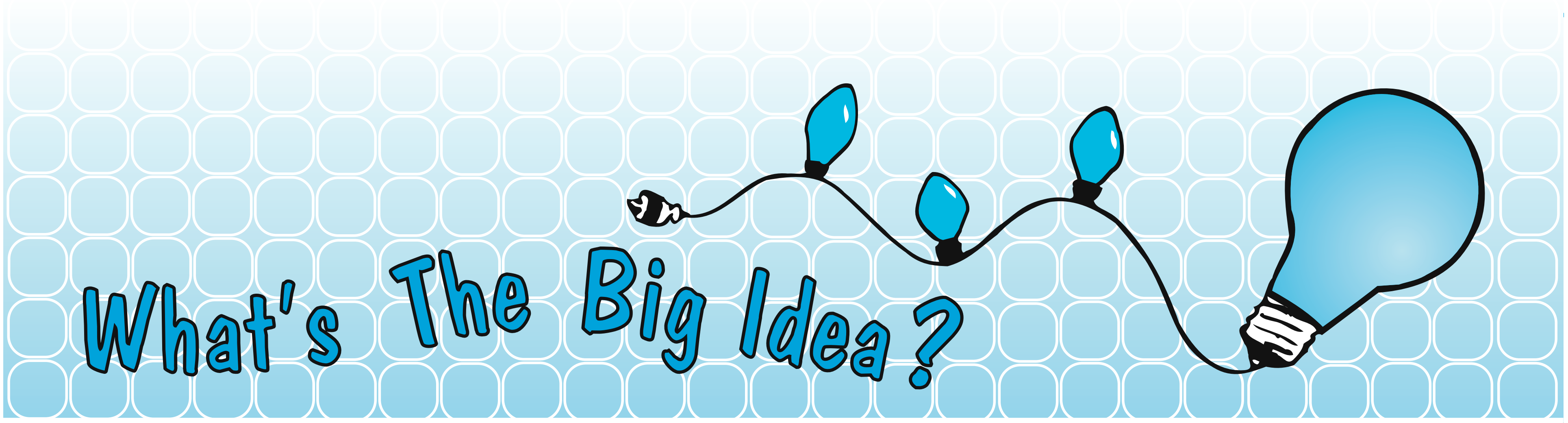

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IN THIS ISSUE...

Designing Lessons With Student Help – Expected Student Responses

(Editor's Note: This is third in a series of articles on the "TLC is a PLC." The first article provided an overview of the TLC process; the second addressed the importance of accessing prior knowledge at the beginning of a lesson and carefully selecting a sequence of learning activities that encourages students to explore ideas to maximize their understanding.

In this article, we discuss how the quality and quantity of student responses help TLC teams design for better understanding for all students.)

Recently, a TLC group of fourth grade teachers discovered that often the best way to effectively plan a lesson doesn't always involve referring to a book, using the results of a research survey or consulting academic websites – the direction can often be found with the students themselves.

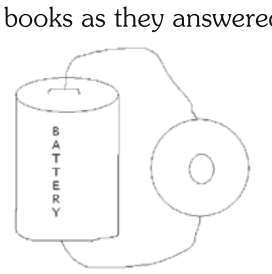
Specifically, student responses can point the way for teachers who want to plot out an effective learning experience.

Early in the morning, one TLC team, working with a facilitator, collaboratively designed a learning sequence that would address three important questions: What do we want students to learn; how will we know when they learned it; and what do we do when students experience difficulties? (*Dufour*, 2006).

Like all TLC groups, the team began their planning with the end in mind—what is it that they wanted their students to learn? Using a conceptual flow, the team identified the concept that "a complete circuit allows the flow of electricity when its components (e.g., battery, bulb and wires) are connected to form a complete path."

During the planning sessions, most teachers said they had taught a "make it light" activity with their students the year before. They were sure their students would understand the idea that electricity flows in a complete circuit and that the connections between batteries, bulbs and wires are needed to make the bulb light.

After teaching the lesson in the morning, the team met to debrief. With the facilitator, the team reviewed lesson transcriptions. They also analyzed trends in what students wrote in their science notebooks as they answered the following prompt:



Will the light bulb light in this circuit? Explain your answer.

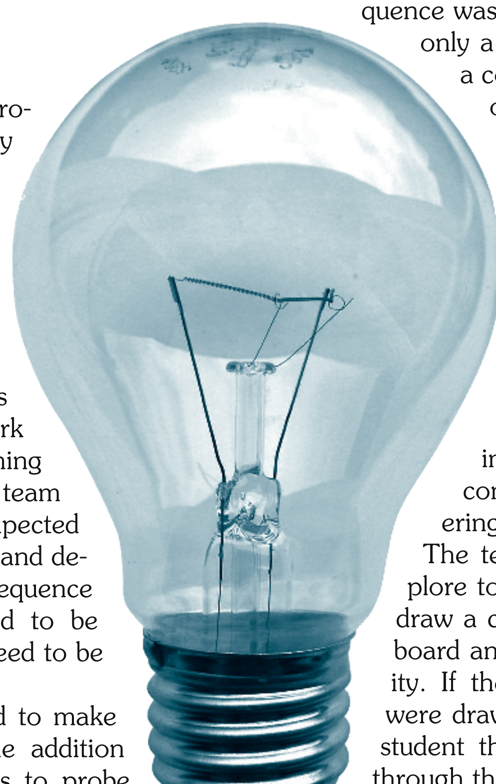
The team expected students to write statements such as: It will work because it is a complete circuit; it will work because electricity will flow in a path; it will light because the battery, bulb and wires are connected to make a complete path or circuit.

However, when the team examined the student work, they were surprised to find that only two students used the academic vocabulary of a complete circuit and only four expressed the idea of "parts" needed to be connected. Five students said electricity works because it goes in a circle. Seven students mentioned circuit "parts" rather than being specific about the battery, bulb and wires. Five students repeated the prompt as their answer (i.e., "it will work because it will work.")

These characteristics (e.g., "circle" = circuit, "parts" rather than stating the specific part; no mention of anything being connected) in the student work caused the teachers to reflect on how they had designed the student exploration.

The team realized they had given directions for the lesson, but had not designed specific questions to probe student thinking as students were exploring the circuits. Back to the drawing board!

Re-design for Student Learning



A goal of the TLC process is to provide many opportunities to move students from where they are conceptually to where the team wants students to be in their understanding of the learning sequence concept.

To this end, TLC teams use data from student work as the basis for re-designing the learning sequence. The team reviews prompts and Expected Student Responses (ESRs), and decides which parts of the sequence to keep, which parts need to be tweaked and which parts need to be deleted or added.

Our TLC team decided to make three modifications: (1) the addition of more strategic questions to probe student understanding: (2) the addition of another explore in which students, using "think-alouds" whiteboards, draw a complete circuit; and, (3) a new explain prompt for student work that included the filament as part of the complete circuit.

Tables 1.1 and 1.2 compare the questions in the Explore stage for the first teaching (Table 1.1) and for the second teaching (Table 1.2, page 4). Notice the addition of question prompts and ESRs (written in italics) in Table 1.2. The team redesigned these questions to help students clarify the parts and connection of the circuit; they also wanted to redirect student thinking about circuits having to be in circles.

The second modification to the learning sequence was added because the team realized that only a few students could correctly describe a complete circuit and the connectedness of the pathway. The teachers wanted to ensure that all students could demonstrate this understanding.

Likewise, the team decided to use a "think-aloud" strategy with students coming to the front board and drawing pictures of circuits that work and do not work, and then having the class discuss the differences.

While the TLC team was discussing their redesign, two teachers were concerned that students were not considering the filament as part of the pathway. The team decided to add an additional explore to the sequence which asked groups to draw a complete circuit on their group whiteboard and physically trace the flow of electricity. If the teachers noticed that no filaments were drawn in the bulbs, teachers could probe student thinking as to how the electricity got through the light bulb.

As a third revision to the original lesson, the TLC team added a new explain prompt (Table 1.3, page 4) so they could capture student responses that included the filament as part of the complete circuit.

DESIGNING LESSONS, CONTINUED ON PAGE 2

Table 1.1 - Original Explore Stage of 5E Learning Sequence

5E	Teacher Does	Student Does	Concept
Explore	Let's explore batteries, bulbs and wires when they are not in a toy to see how they work. Your job is to find a way to make the bulb light using a battery and wires. Once you get the bulb to light, draw a picture of your complete circuit in your science notebook.	Students try many combinations to make the bulb light until they are successful. Students draw complete circuits in their science notebooks.	Electric circuits have parts that can be connected. When the parts are connected in a complete path, the bulb will light.

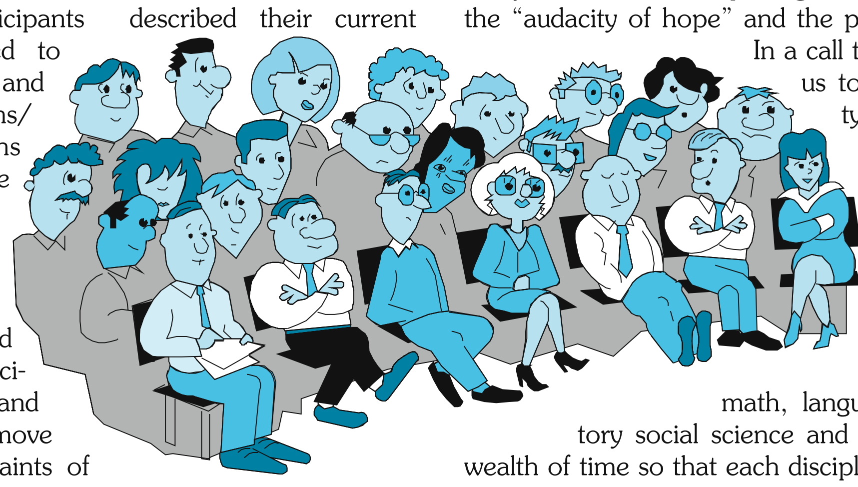
DIRECTOR'S COLUMN

Getting – and Giving – the Message

BY KATHY DIRANNA

I had the pleasure of attending three separate and unrelated educational functions within the span of two weeks. Although their audiences were different, and their reason for convening was specific to each group, there was a common theme that has importance for us. What we say and how we say it matters – especially if our message is one of hope.

The first event was the California State High School Summit where 80 invited participants heard speakers sharing research and best practices in assessment, professional development, universal access, and the nature of science in the science classroom. The participants described their current reality compared to the research, and made suggestions/ recommendations that would close the gap between the two.



Time and again, these participants shared their love of science content and their desire to move from the constraints of a test-centered environment to a learning environment. They felt their teaching had been reduced to test prep, and they were sending the message to students that science had little relevance to their lives. They also acknowledged that a "one-size" high school program does not fit the needs of all students.

Still, above and beyond these realities, there was a hope that through their recommendations for changes, students—as well as teachers!—would find a joy in learning and appreciate scientific thinking.

The second event happened while I was judging Disney's fifth grade Environmentality Challenge. As part of their project, a class had written to politicians to ask what they were doing about global warming. They wrote their letters in October of 2008 and got responses from our governor, our two state senators, presidential candidates and the president.

Most of the responses were very formal, but one response fueled the students with hope: "Creating change and making the world better is not always easy and you will probably find in your life that is it is more comfortable to ignore injustices that don't affect you directly. Don't take that comfortable road. Challenge yourself to make a difference…I leave you with three bits of advice that you make your life more fulfilling: Look out for other people, even when it does not directly benefit you; strive to make a difference everywhere you go; and get back up every time you are knocked down."

The third event occurred at a FOSS Leadership Academy statewide meeting where FOSS Co-Director Larry Malone, in his opening remarks, talked about the "audacity of hope" and the promise of change. In a call to action, he asked us to "stand up to the tyranny of reading, and storm the fortress of skill."

Larry went on stressing the need to advocate for a balance of the core subjects: science, math, language arts and history social science and to redistribute the wealth of time so that each discipline (and their integration) is a priority.

Specifically Larry made a plea for us to demand content in three areas: the arts (the celebration of our species), social sciences (interactions of our species) and the natural science (our relationship with the laws that govern our universe and the survival of our species).

All these were messages of hope, change and courage. As you close your school year, I encourage you to reflect on the messages that you given this year to your students, colleagues and parents. Remember that your words become your actions and your actions become your destiny.

As the Chilean poet and Nobel Prize winner Gabriel Mistral writes: "Many things can wait; the child cannot. Now is the time his bones are being formed and his mind is being developed. To him, we cannot say tomorrow; his name is today!" ■

DESIGNING LESSONS…, CONTINUED FROM PAGE 1

Analysis of Student Work – One More Time

After teaching the second time, the TLC team eagerly reviewed the facilitator's transcript and student work to analyze the effectiveness of their redesigned learning sequence.

This sequence resulted in dramatic changes in student thinking: it helped students move away from their initial idea that a circuit is a circle; it encouraged students to recognize and label the common parts in these circuits (battery, bulb, wires); and it reinforced students' understanding that everything is connected in a complete circuit.

The teachers agreed that by building on what students might say (based on student work from the first lesson) and planning questions to probe for student learning, the team was able to effectively help students clarify their ideas.

Looking at the groups' whiteboards, teachers noted that most groups had drawn complete circuits and labeled the components. The team was hopeful that the think-alouds would help students explain that the light bulb will not work because the filament is broken/missing and that a filament is also part of the complete circuit.

The teachers were not disappointed!

Analysis of student work indicated that all students recognized the light bulb would not work! The majority of the students were able to state that a complete circuit has all components (battery, bulb, wire and filament) connected in a path for electricity to flow. Several students described the need for a complete circuit, listing some components and only a few students did not identify a complete circuit.

Based on this analysis, the team then discussed interventions for each student who needed further clarity as well as appropriate interventions for the class in the next lesson.

By late afternoon, the TLC team and facilitator realized they had spent the day collaboratively planning, teaching and debriefing two lessons that focused on the interaction of teaching and learning.

Exhausting? No, it was exhilarating for the teachers to spend so much time reflecting on their teaching practices. Learning how to design for student learning by carefully crafting questions and activities based on ESRs, these teachers saw first-hand how the process works and that actual student work and rubrics provide constructive feedback.

Using this information, these TLC teachers are now armed with ways on how to improve the quality of their work in the classrooms, and their students can look forward to many eye-opening lessons that are challenging, interesting and full of "a-ha!" moments. ■

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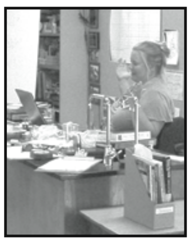
LEADERSHIP

Flipping on the Switch

BY HEATHER KOEHLER



A couple of years ago, I received an email that would change my life.

The email was looking for teachers who were interested in participating in a California Math Science Partnership Grant focusing on science in grades 4, 5 and 6. I jumped at the chance, not only because I would get paid, but also because I had just lost my grade level partner; she taught science while I taught California history. I knew I needed a refresher, but little did I know that my reward for participation would be far greater than I realized.

I was overwhelmed and excited the first time I traveled to Southern California to attend a mid-year K-12 Alliance staff development training. At first, the experience was very uncertain – I didn't know most of the people who were traveling with me and I was unsure of what to expect in the big picture.

I arrived with one foot back in the classroom and oh, the things I learned!

I was fortunate to see well-known Kendall Zoller discuss nonverbal communication and discovered how to apply this perception to my teaching and classroom experience. I also learned about Curriculum Topic Study and was totally inspired by teachers who presented practical ways to use science notebooks.

When I arrived, I knew virtually no one; but when I left, I had a network of teachers whom I could call upon in my county and state. Just as important, I also gained deeper content and pedogological knowledge, as well as ideas on how to implement them in my classroom Monday morning.

Even though I was exhausted flying home Sunday afternoon, I was also totally energized to teach. Participation in this grant gave me the confidence and skills to be a better science teacher – and it has led me to challenge myself in my profession.

Less than six months after becoming a lead teacher for the grant, I was given the opportunity to become a curriculum coach for my elementary school. Since this position was brand new to the school and the district, it came with little training and a vague job description.

I was worried this change of position would jeopardize my participation in the grant, but I was able to transition to becoming a Staff Developer in Training. Because of the training and support given to me by the K-12 Alliance and the LAKE Science Collaborative, I was able to grab the reins and drive forward.

Through participating and facilitating TLCs – and with the help and coaching of Regional Directors and the TLC Field Guide – I have received the appropriate skills for working with adult learners. I now have a well-stocked "tool bag" that gives me the confidence to lead meetings and facilitate trainings.

In fact, I recently become an AB 472 trainer and a district technology trainer. Next year, I look forward to more changes. I am going to become an official Science Staff Developer and delve back into teaching in my own classroom again. I am very excited to implement science notebooking and accountable talk with a new group of students.

Overall, the Lake Science Collaborative and the K-12 Alliance have been invaluable in my professional development and have helped me get through many a burn-out slump. I am always invigorated by the experience of working with such inspirational teachers.

My light bulb has been lit! ■

Heather Koehler is a fourth grade teacher and curriculum coach at Burns Valley Elementary School in the Konocti Unified School District.

TEACHING & LEARNING

Science as a Pathway to Language

BY JO TOPPS AND SUSAN GOMEZ-ZWIEP

Want to create a rich environment for students to develop and use their language skills? Make sure that classroom is full of inquiry-based activities and experiences that excite students so much, they can't help but talk about what they are seeing, feeling, touching and hearing.

In science-rich classrooms children have plenty to talk about – objects float and sink, volcanoes erupt, plants grow and flower, animals reproduce; all this and more before recess!

Research demonstrates that as students develop language, they need many opportunities to use that skill – science instruction provides numerous occasions for students to hone their basic English abilities as they learn specific science content language.

To encourage science instruction in the content area of English language development, a new partnership was recently formed between the Montebello Unified School District and Garvey School District with CSU Long Beach, CSU Dominguez Hills, CSU Los Angeles and the K-12 Alliance.

Funded through a California Post-secondary Education Commission (CPEC), Improving Teacher Quality (ITQ) grant, this program involves K-4 teachers who are expanding the work of the Teaching Learning Collaborative (TLC) to include an English language development lens.

Teachers familiar with the TLC know that anticipating Expected Student Responses (ESRs) is integral in designing high-quality science lessons. Now, imagine ESRs encompassing a full range of responses that represent the many language proficiency levels teachers find in their classrooms everyday.

As teachers in the CPEC program use the 5Es to plan for instruction, they also consider the forms and function of language. This planning helps them anticipate the many different responses and language forms they can expect from their students.

When a science lesson is focused on how students think and observe, language is naturally a big part of that description. Teachers need to be aware of all of the responses they will hear from their students -- from the very advanced speakers of English to the modest beginners.

For example, a student, who is just starting to grasp the English language, may point to an object or name features of an object. In an Earth science lesson, students are prompted to move from simply saying, "rock" to "I see a rock" or the "the rock has colors." The teacher provides sentence frame(s) so these students can express what they have observed.

Similarly, the teacher provides intermediate and advanced language proficient students with the forms of language (sentence frames) appropriate to their English language development.

The chart shown below (Table 2.1) shows the types of sentence frames teachers might provide for their students during an observation lesson.

It's important the science learning objective is the same for all students; in this case, all students need to

SCIENCE AS A PATHWAY, CONTINUED ON PAGE 4

Table 2.1 - Science Thinking Process and Language Form and Function Chart

Science Thinking Process	Language Function	Language Forms
Observation	Description	Beginning: This is a_______. I see a_________. The _____ has a_____. Intermediate: It feels like a ________. The _____is made of ______. Above the _____ I see a______. Advanced: Another detail about this _____ is ______. I notice that the______ is ______. Before the ______ looked like, now the _____ looks like____.

Table 2.2 - Learning Sequence Concept: Plants Have Structures Grade 3

Teacher Does	Student Does	Language Objective	Concept
Engage			
Teacher engages students with the following scenario: "Your neighbor asks you to take care of their garden and they want to be sure that you know a little bit about plants." Provides students with real plants and pictures of a plant (same plant for all groups)		Pre-Assessment of Language Abilities (Note: We will be introducing sentence frames in the Explore so grammatically correct sentences are not a focus at this point.)	Science Prior Knowledge Plants are all around us.
Teacher gives students a T-Chart (What do I know/ What questions do I have) regarding what students know about plants. Teacher asks: "What do you know about plants?"	In small groups, students create a chart that shows their prior knowledge about plants. Beginning: • Green, flowers, we eat, grow • They may point to a structure and say "flower" • Write in their native language. "We eat plants, they grown in the ground, they have leaves." Intermediate: • Uses simple sentences: "We eat they, they are green, them have leaves." • Switch codes between English and their native language (e.g. "It is verde.") Advanced: • Uses complex sentences (Plants have green leaves and flowers, plants grow in the ground and need water.)		Plants have observable characteristics. Humans use plants.

Encouraging Participation: Coachella's Science Bi-Literacy Program

BY JENNY LOPEZ NGIGI AND RAMON ORTEGA

The exhilaration of hands-on science is making afternoons at Cesar Chavez Elementary (CCE) in Coachella more exciting for the K-2 grade students enrolled in the school's dual immersion program.

Indeed, the new Science Bi-Literacy program has not only students buzzing about science, but also teachers, administrators, upper classmates who, along with the K-12 Alliance, are integral players in this collaborative effort.

Implemented at the start of the 2008-2009 school year, the Science Bi-Literacy program provides science experiences to students enrolled in the ongoing bi-literacy program; that program has been a part of CCE since 2007. Hands-down, the students are enjoying the after-school science program. According to first grader Devon Willis, "Doing different activities makes learning science fun."

Classmate Jose Alberto Murillo agrees, adding that "We need to continue with science every day to learn mas y mas (more and more)."

The after-school program came from the idea of "It Takes A Village;" namely, that effective education comes from a partnership with people who are directly – and some indirectly – involved in the students' lives. Parents, teachers, administrators and upper grade peer role models; each has a role in the program.

"The program is the perfect opportunity for our students in the dual language program to be exposed to a specialized science curriculum," says Principal Maria Sarabia Ponce. "Jenny knows the budget constraints our state and district is facing and she has made everyone realize how important their role is in this program – especially the parents. Their involvement has made all the difference."

For example, the school administration provides space for the program, as well as snacks and ongoing constructive feedback. In turn, teachers collaborate on long-term planning for instruction of the material to be covered and also train volunteer helpers. Supporting the program, the K-12 Alliance provides FOSS instructional materials and teacher training.

Parents help the teachers prepare materials and also take on the roles of teachers by leading small group science exploration. In a similar fashion, upper grade level volunteers help with necessary duties such as distributing materials, assisting parent teachers and lending a hand during notebook observations.

As a result of these combined efforts, a typical program day begins with a teacher leading a whole-group discussion on the topic of the day; this discussion activates student prior knowledge.

After students provide impute about what they know and think they know about a given topic, they break up into small groups where concepts (such as solids, liquids and gases) are explored through a hands-on activity. Afterward, students reflect on their observations and make notebook entries.

At the end of the science session and after the students are dismissed, teachers, parents and volunteers engage in an informal debriefing session to discuss highlights of the day and possible improvements for future sessions.

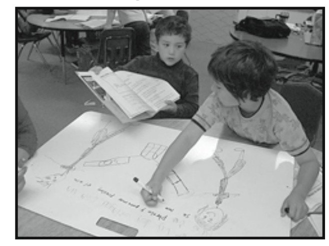
Overall, the program has been a success because of high student attendance and great enthusiasm about the science activities and reflection sessions. "The reason that I like science class is that it is challenging and we learn more and more. The more we learn the more we can explain to others. Doing experiments is what makes us learn," explains first grader Paul Casas.

In addition, the low student to teacher ratio encourages effective classroom management which otherwise might be unattainable especially during writing sessions.

Finally, upper grade student volunteers have the opportunity to take on leadership roles as peer tutors and become role models to the younger students. "I think the science program is educational because it shows young children that science is everywhere," says fourth grader William Reyes. Other helpers, like Eloisa Madrigal, say the program "helps me learn science words in Spanish."

And parents too feel a sense of ownership with the program. "I enjoy learning along with my daughter," says Guillermina Lua, parent volunteer.

"The students love the hands-on experience they get, and the feeling of accomplishment after writing their discoveries in their notebooks," adds fellow parent volunteer Raquel Delgado. "As the students and I learn new material, we discover and learn new content specific vocabulary and continuously use it within the exploration of the module. Science is a wonderful tool that isn't intimidating for the students."



The Science Bi-Literacy program has the potential to be replicated at other school sites in the district, but organizers stress the success comes only from full participation from parents, teachers and upper grade students. It's a big commitment, but one well worth it.

Until such programs are routinely found at school sites across California, parents need to rely on everyday opportunities to bridge math and language arts with other areas of student academic achievement, especially science. Working with teachers, administrators and peer role models, parents realize that academics and learning doesn't stop when the bell rings at the end of the school day. Those experiences continue as long as the student is eager and the teacher is ready. ■

Jenny Lopez Ngigi is a fourth grade teacher at Cesar Chaves Elementary (CCE) in Coachella and a K-12 Alliance staff developer. Ramon Ortega is a fourth grade teacher at CCE as well.

SCIENCE AS A PATHWAY..., CONTINUED FROM PAGE 3

make accurate observations. Likewise, the language objective is also the same for all students. Teachers want every student to use language to describe an object or event; the only difference is the language used by the student.

The 5E format (Table 2.2, page 3) is an example of how teachers plan for student responses at all language levels.

As teachers learn how to better predict expected student responses, they will also understand how to model and prompt language to move students to the next level of proficiency – all the while developing their understanding of science concepts.

To that end, the CPEC program continues to make connections between content knowledge in science and English language development. These links give teachers a deeper pedagogical understanding, but also provides students with more opportunities to achieve in science, English and beyond. ■

DESIGNING LESSONS..., CONTINUED FROM PAGE 1

Table 1.2 - Revised Explore Stage of 5E Learning Sequence with Additional Questions

5E	Teacher Does	Student Does	Concept
Explore	Let's explore batteries, bulbs and wires that are not in a toy to see how they work.		Electric circuits have parts that can be connected. When the parts are connected in a complete path, the bulb will light.
	Your job is to find a way to make the bulb light using a battery and wires.	Students try many combinations to make the bulb light until they are successful.	
	Once you get the bulb to light, draw a picture of your complete circuit in your science notebook.	Students draw complete circuits in their science notebooks.	
	Once you draw one way to light the bulb, continue experimenting and draw one way you are sure the bulb will not light.	*And draw those that don't work.*	
	Why did the bulb light?	*The light bulb lights because it is a complete circuit.*	
	Explain what you mean by complete circuit.	*It is when electricity goes in a circle.*	
	Does electricity always flow in a circle? Could it be another shape?	*Yes/No*	
	If students persist in thinking that electricity can only flow in a circle, ask the following questions:		
	What would happen if we placed the parts in a square? In a rectangle? Would it be possible for the bulb to light? (If necessary have students build a circuit with the parts in the shape of a square/rectangle)	*Yes/No*	
	What is in common about all of the shapes of the circuit?	*All shapes will light the bulb.*	
	You've told me it would work in a circle, in a square, and in a triangle. What parts do they have in common?	*All of the shapes have the same parts: battery, bulb and wire.*	
	How do the parts help make the light bulb light?	*Metal need to touch metal. The metal base of the light bulb needs to touch the top of the battery. The wire needs to touch the metal case on the bottom of the light bulb. The wire needs to connect to the bottom of the battery.*	
	How would you add this information to your idea of a complete circuit?	*All of the parts need to be connected in a complete circuit.*	

Table 1.3 - New Explain Stage of 5E Learning Sequence

Explain	Take a look at the circuit on your worksheet. Will this light bulb work? Tell me why or why not.	The light bulb will not work. The circuit has a battery, bulb and wire. It is not a complete circuit because the filament is broken/missing. The path for the flow of electricity is not connected.	A complete circuit allows the flow of electricity when its components, e.g., battery, bulb (including filament), and wires are connected to form a complete path.